ELSEVIER
www.elsevier.com/locate/worlddev

World Development Vol. 91, pp. 173–192, 2017
0305-750X/

http://dx.doi.org/10.1016/j.worlddev.2016.11.010

Intergenerational Education Effects of Early Marriage in Sub-Saharan Africa

MARCOS DELPRATO [a], KWAME AKYEAMPONG [b] and MÁIRÉAD DUNNE [b,*]

[a] *University of Cambridge, UK*
[b] *University of Sussex, Brighton, UK*

Summary. — This paper analyzes the evolution of the effects on educational inequality of early marriage by looking at the impact of whether women had married young on their children's schooling outcomes for 25–32 countries (Demographic and Health Surveys) in 2000 and 2010 for Sub-Saharan Africa. We also explore indirect pathways—mother's education, health, and empowerment as well as community channels—operating from early marriage to child schooling and assess the presence of negative externalities for non-early married mothers and their children on education transmission in communities with large rates of child marriage. In our econometric analysis we employ OLS, matching, instrumental variables, and pseudo-panel for a better understanding of changes over time. Our results show that early marriage is still a significant source of inequality, though its impact has decreased across time: girls born to early married mothers are between 6% and 11% more likely to never been to school and 1.6% and 1.7% to enter late, and 3.3% and 5.1% less likely to complete primary school, whereas boys are between 5.2% and 8.8% more likely to never been to school and 1% and 1.9% to enter late, and 2.3% and 5.5% less likely to complete primary school. Second, child marriage increases gender inequality within household's with girls losing an additional 0.07 years of schooling as compared to boys if born to early married mothers. Third, our estimates show that mother's education and health mediate some of the effect of early marriage and that the large prevalence of child marriage in a community also impairs educational transmission for non-early married mothers. Fourth, empowering of young wives can weaken other channels of transmission of education inequalities. Overall, our findings highlight the need to target these children with the appropriate interventions and support to achieve the greater focus on equity in the global post-2015 education agenda.

Key words — early marriage, intergenerational transmission, education, community, empowerment, Sub-Saharan Africa

1. INTRODUCTION

The Dakar Framework for Action set at the World Education Forum in 2000 established an ambitious six Education for All (EFA) goals to be achieved by 2015. In relation to the goal of achieving access to education for all, there has been an improvement in net enrollment ratios with more children enrolled in school during the last decade in Sub-Saharan Africa (SSA), however, among the poorest children the chances of completing primary education still remains low (Akyeampong, 2009; UNESCO, 2014; World Bank, 2011). Besides poverty, cultural traditions, and gender violence, the incidence of early marriage is a major reason for disadvantaged groups, particularly poor girls, not making as much progress in enrolling and completing primary education (Lee-Rife, Malhotra, Warner, & McGonagle Glinski, 2012; Loaiza & Wong, 2012; Malhotra, Warner, McGonagle, & Lee-Rife, 2011).

Although the incidence of early marriage and its impact on educational access is widespread and well documented (see, for instance: Carmichael, 2011; Delprato, Akyeampong, Sabates, & Hernandez-Fernandez, 2015; Erulkar, 2013; Field and Ambrus, 2008; Godha, Hotchkiss, & Gage, 2013; Jensen & Thornton, 2003; Raj & Boehmer, 2013), children of early married mothers is a group that has received little research and policy attention. In particular, research that has looked at the impact of marrying young on children's educational opportunities and the pathways through which this occurs, as well as the implication on gender gap, has been lacking. Understanding the factors underpinning the transmission of educational inequalities from early married mothers to their children in Sub-Saharan Africa is important for developing policies and programs that tackle the intergenerational effects of early marriage on educational access for adolescent girls. Besides, because daughters of young wives are more at risk of not accessing or completing primary education because of social norms on age of marriage and related parental aspirations (Maertens, 2013), understanding the factors that promote early marriage for this group will help to understand what policies are likely to make a difference. Moreover, this is key to achieving Sustainable Development Goals (SDG4) and in particular goal 5 which makes an explicit call for the elimination of "child, early and forced marriage" (UN, 2015).

In this paper, we use the term early marriage, also known as child marriage, to mean legal or customary marriage between two people, of whom one or both spouses are below the age of 18 (Article 1, Convention of the Rights of the Child, CRC). [1] We focus on girls, and define early married mothers or young wives (henceforth denoted as EMM) as those who enter marriage before the age of 18. We chose to focus on Sub-Saharan Africa (SSA) because of the high prevalence of the early marriage of young adolescent girls. According to UNICEF, currently, out of the 10 countries with the highest rates of early marriage 7 are in SSA (UNICEF, 2014). It is estimated that 700 million women will be married before age 18 by 2050 and that SSA will surpass South Asia on the number and global share of child marriage. Even by doubling the current rate of decline, in 2050 SSA, will account for 47% of the total child marriage in the world (UNICEF, 2014). This makes focusing on the issue of child marriage critical and important to improving access to quality education for adolescent girls, and the importance of research which helps to map out the scale of the problem, but also produce insights into the factors

* Final revision accepted: November 13, 2016

responsible for its prevalence in SSA. Findings from our study will also help to inform policies that have the potential to reduce its prevalence in SSA.

In this paper, we estimate the impact of early marriage on children's education for SSA, looking for changes in this relationship across time and taking stock on whether child marriage is a source of educational inequality. We analyze 25–32 countries (Demographic and Health Surveys) around the year 2000 (wave 1) and 2010 (wave 2) drawing on a range of child education indicators. We also investigate indirect pathways (mother's education, health and empowerment[2] as well as community channels) operating from early marriage to child schooling and, by focusing on non-EMM and their children, we explore the nature of negative externalities on the transmission of education in communities with high incidence of child marriage. The analysis is performed separately for boys and girls to establish if early marriage, not only diminishes education investments on children, but also if it contributes to widening gender inequality within households.

We employ ordinary least squares (OLS) and matching techniques as well as instrumental variables (IV) to account for the plausible endogeneity in the early marriage–children's schooling relationship. Moreover, we construct a pseudo panel which in our view offers a better understanding of change over time in comparison to analysis of each wave separately.

The remainder of this paper is organized as follows. Section 2 reviews the literature on how early marriage translates into lower schooling for children. In Section 3, we present a model linking early marriage and empowerment, because of the importance of the latter in addressing the former. Section 4 presents the data and Section 5 describes the alternative econometric approaches used. In Section 6, we present the main empirical findings and robustness analysis. Finally, in Section 7, we conclude with a discussion of the implications and present key recommendations from our analysis.

2. LITERATURE REVIEW AND CONCEPTUAL BACKGROUND

(a) *Theoretical perspective on early marriage*

Early marriage can have several effects on educational opportunities for young children. How early marriage affects children's education requires that we understand what lies behind the phenomenon. Decisions on child marriage need to be understood beyond parental preferences that are self-regarded, they should also consider other type of non-altruistic preferences and the role of social expectations.

How does one explain the incidence of child marriage? According to analysis by Bicchieri, Jiang, and Lindemans (2014), behaviors are influenced by pRefs. , options and beliefs, and early marriage is not an exception. As collective practice, it is often based on a cluster of individual behaviors which regulates behavior as individuals conform to it by their beliefs. Thus, for early marriage to be a social norm, it needs to be influenced by what other people do (empirical expectations) and think should be done (normative expectations). They argue that one can categorize different types of practice of early marriage based on the different kinds of preferences and beliefs that sustain them. Diagram 1 offers a typology of these different categories of early marriage.

The diagram shows whether child marriage is a rational response, a custom, a moral rule, a descriptive norm or a social norm. Knowing this is important as the incentives to modify it ultimately relies on what constitutes and drives child marriage. For example, there can be incentives to marry girls young as wealth transfers from the bride's family to the groom at the time of marriage (dowry) are lower if brides are young and uneducated (Maertens & Chari, 2012). This makes the collective practice of child marriage a rationale response (category 1) as it is rooted in self-interest. Also, when parental personal normative beliefs (such as to preserve virginity before marriage and protection of girls' sexuality) are important, forcing daughters to marry young is a route to accomplished this (Khanna, Verma, & Weiss, 2013). In this case child marriage is classified as a moral rule. Moreover, when child marriage decisions are more strongly shaped by social expectations (where failure to conform can result in disapproval or shame for the family within the community for example), child marriage falls into categories 3 and 4. Rational responses behind child marriage can be weakened by changing economic incentives behind it, while if child marriage is a social norm changes can only occur collectively, in a coordinated way (Bicchieri & Mercier, 2014).

(b) *Factors influencing education outcomes and early marriage*

The educational choice of households made for their children often depends on the expected returns and costs of education and household's income especially if family is credit constrained (Black & Devereux, 2011), but it also depends on the aspiration of parents (Genicot and Ray, 2014). Restricted investments in schooling may be due to, low parental aspirations because of their low education (Chevalier, Denny, & McMahon, 2009), which can also be influenced further by family composition (number of children and also gender composition) that puts a strain on the distribution of resources and opportunity costs of schooling (Nishimura & Yamano, 2013). Gender-cultural factors, in particular, can be a further obstacle to educate girls (Glick, 2008). Overall, these factors operate at different levels: individual, household, community, cultural.

Individual factors are particularly key. Children's ability and gender can influence the levels of educational investments made by parents. There is a genetic component in the transmission of ability—the nature component—(Becker & Tomes, 1986; Behrman, Pollak, & Taubman, 1995) which directly influences the expected returns that children would obtain from further schooling. What is more, cognitive abilities can be setback for lack of care around birth. Young married girls start child-bearing soon after marriage with increased health risks from complications in pregnancy and death during delivery, low-birth weight, and high risk of infant mortality coupled with short birth spacing (Godha *et al.*, 2013; Raj & Boehmer, 2013). More importantly, young wives' nutrition can decline during pregnancy, and coupled with a lack of maternal health care services and vaccinations' usage (Singh, Kumar, & Pranjali, 2014; Singh, Rai, & Singh, 2012), this can have long-term effects on children's cognitive abilities and their associated educational returns. In other words, by having children at a young age, young mothers risk transmitting genetic disadvantage that can affect the child's cognitive abilities and limit the returns from investing in their education. For example, health as a channel can result in fewer education investments through its impact on the cognitive abilities of the children of EMM. Educational investments also depend on a child's gender which traverses all levels. Families and communities may see girls as having little importance outside of their roles as wives, with any benefits perceived to accrue to the future husbands' families, while boys are given preference in the belief that they will look after their parents (Huisman & Smits, 2009).

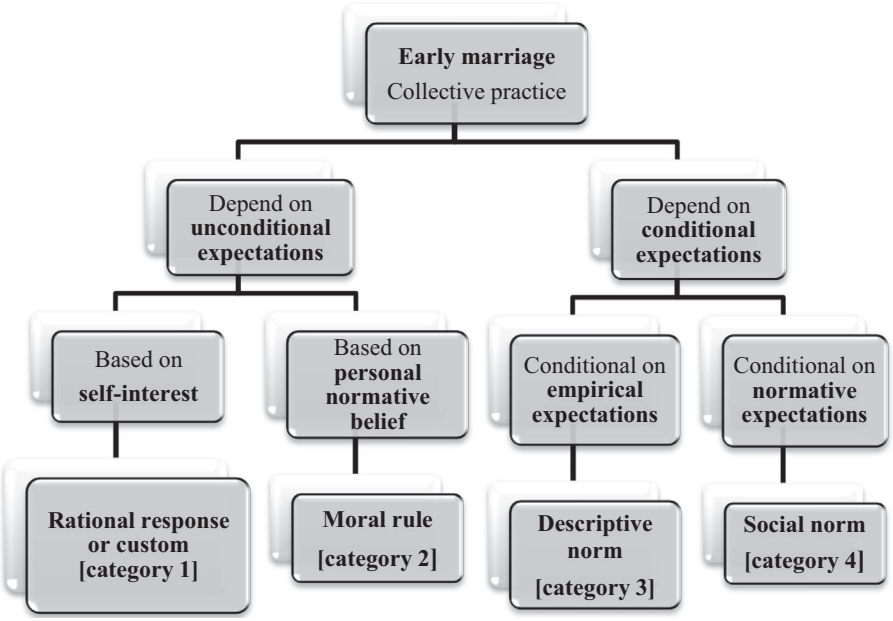

Diagram 1. *Categorization of early marriage based on preferences and beliefs. Source: Bicchieri et al. (2014).*

Household factors, equally play an important role. Within the family level, there is a mixture of determinants of children's education, ranging from wealth, demographic factors, parental education, and more specific factors linked to child marriage such as dowry, mother's employment, and autonomy. In developing countries, household's wealth is vital when deciding on educational investments. Parents, especially if they are poor, tend to consider the benefits of schooling (increased earnings) against direct costs (e.g., fees, uniforms, textbooks, travel costs) and indirect costs (e.g., helping with household chores, work on family enterprises or paid labor, looking after siblings) (Nishimura & Yamano, 2013). For poor households, if they perceive the benefits of investing in education to be low, they may be less willing to invest their meager resources in educating their child. This could lead to pressure on the child to contribute to household income through work. Besides, opportunity costs can be large for poor families, especially when demographic factors (such as short birth spacing) put an additional strain on family resources (Longwe & Smits, 2012; Webbink, Smits, & De Jong, 2012). In a study about the demand for schooling in two African countries, Lincove (2015) finds that the most common reasons cited by parents of out-of-school children in Nigeria, is work (29%) and then school costs (21%), whereas in Uganda it is school costs (reported by parents for 32% of out-of-school children).

As a mechanism of intergenerational transfer of human capital, parental education is paramount (Chevalier *et al.*, 2009). Parental education has an impact on current income which in turn affects children's educational attainment. The literature on child development, highlights that mother's education in particular has a major influence on child's educational attainment (Haveman & Wolfe, 1994; LeVine, LeVine, Schnell-Anzola, Rowe, & Dexter, 2011). Because early marriage has negative effects on mother's education (Delprato *et al.*, 2015; Field and Ambrus, 2008; Lloyd & Mensch, 2008), we anticipate that the correlation between the education of EMM and their children to be stronger. [3] Moreover, EMM's lower education levels constrain their employment opportunities and diminish their agency or empowerment (decision-making power) within households, and as a result they are less likely to have strong influence on children's educational decisions. For instance, Solanke (2015) finds that, in Nigeria, the probability of women to be in the high empowerment category is increased twofold for those married between age 15 and 19 than those married at age 14 or less. Likewise, Durrant and Sathar (2000) show that empowered women in Pakistan are more able to positively invest in their children increasing their chances of ever attending school.

Additionally, other household's factors related to early marriage (e.g., dowry) operate at different levels. Dowry is a cultural factor which can also be driven by economic reasons. It sets back aspirations on girls' education by creating incentives to marry girls young and, equally, the bride's price—i.e., the amount paid by the groom to the parents of a bride for marrying consent—often increases, the younger the bride. This creates an economic incentive to marry girls young to save and obtain wealth, especially for households in economic hardship (Field and Ambrus, 2008). In other contexts, such as when the bride leaves her natal family to live in her husband's household, dowry can be a mechanism to heighten a bride's autonomy (Chan, 2014).

Community-level factors also play an important role. Local communities can transmit beliefs on early marriage are endorsed (Bicchieri *et al.*, 2014), with most early marriage arrangements in SSA more prevalent in rural communities. Loaiza and Wong (2012) report that on average, for 48 countries in the last 10 years, nearly 70% of total child marriage happened in rural areas. In rural areas the lack of good educational facilities and infrastructure, long distances to school, means communities are often isolated and have safety concerns. Households may therefore postpone the decision to send children to school until they are older (Glick & Sahn, 2006). Overage enrollment for girls increases the risk of early marriage before they complete basic education (Akyeampong, Lussier, Pryor, & Westbrook, 2012). In effect, the location of schools and security concerns can constrain education participation for children living in rural communities, which particularly affects rural girls. Also, because labor market opportunities are confined in rural communities and agricultural jobs requires little education, returns on girls' edu-

cation can be limited in rural areas and further amplify the gender gap (Colclough, Rose, & Tembon, 2000). This is compounded by the fact that young wives tend to marry men working in low-skilled manual and farm occupations (Khanna *et al.*, 2013), and who are also likely to have lower and gender-bias aspirations in rural locations because of poverty traps.[4]

Early marriage in rural communities is mostly a community-driven phenomenon because it depends on social expectations formed in close networks who believe they ought to conform (Bicchieri *et al.*, 2014). This leads to social pressure in communities with high prevalence of early marriage where failure to conform can result in disapproval for the family (Bayisenge, 2010, chap. 4; Srinivas, 2000). In those circumstances, child marriage is seen as a route to strengthen family ties, clan and tribal connections, or political alliances and, sometimes, acts as a mechanism to settle obligations (UNIFPA, 2006).

There is also the element of cultural factors which in combination with economic inequalities might feed into each other, leading to gender inequality traps (Morrisson & Jütting, 2005; World Bank, 2011). At the individual level, cultural factors are closely tied to parent's aspirations and beliefs which shape social norms re-enforcing social structures on gender roles (Hiller, 2014). Cultural norms are prone to be stable, thereby gender inequality is reproduced over time due to slow-moving social norms (Cooray & Potrafke, 2011; Morrisson & Jütting, 2005). Early marriage is one of this persistent-harmful social norms endorsed by patriarchal norms which see girls as the property of fathers and husbands (Walker, 2012), with girls' education seen in some settings as incompatible with the responsibilities and expectations of marriage. Beliefs about the ideal age of marriage for girls can constrain the education that parents aspire for their daughters. Maertens (2013), for example, finds that in rural India only 39% of the girls would be allowed by their parents to pursue higher education compared to 71% of the boys. In SSA, socio-cultural risk factors are underpinned by traditional social—male dominated—stra tification structures that compound religion with customary practices to justify child marriage (Walker, 2012). This happens across religions in the region, either in the Christian traditional regions of Ethiopia or in the Muslim countries of Western Africa. Furthermore, discriminatory social norms are reflected in formal structures. Child marriage's laws are often not effective due to cultural factors because there are widespread exceptions from customary or religious laws (Loaiza & Wong, 2012).

(c) *Empowerment of early married mothers*

In this section we turn our attention to how women's empowerment within the family affects children's educational opportunities, above all if women are married young. We argue that empowering women through education or other social and cultural initiatives or interventions can strengthen their ability to resist detrimental practice, such as early marriage, or strengthen their powers of negotiation to prevent early marriage and the consequences which follow, as we have outlined above. As Arestoff and Elodie Djemai (2016) have argued "young women being more empowered means that women from recent generations are more empowered than their counterparts from older generations... with one explanation being changes in educational attainment" (p. 70). Many key development outcomes depend on women's ability to negotiate favorable intra-household allocations of resources (Doss, 13; Duflo, 2012), and which can also influence choices they make regarding their girl child's education. A woman is not considered to be empowered if, for example, "she does not take part in household decisions" (Arestoff & Djemai, 2016, p. 71). If women are involved in decisions about life-choices, for example when they choose to marry and their children's schooling, this can lead to greater agency for later generation of women (Arestoff & Djemai, 2016).

The role of women's empowerment on demographic outcomes has been documented in a number of contexts affecting contraceptive use and reproductive choices (Larsson & Stanfors, 2014; Upadhyay & Karasek, 2012), violence (Dalal, 2011; Uthman, Lawoko, & Moradi, 2010), and children's nutrition and education outcomes (Guilbert, 2013; Imai *et al.*, 2014). Thus, we place a high value on women's empowerment when it comes to addressing the phenomenon of EMM.

Our review of the literature revealed that EMM affects education outcomes through three channels: (1) maternal education, (2) health, (3) community. We hypothesize that young wives' early marriage status impacts negatively on their children's education once community and family factors are controlled for. Also, young wives' low education limits their bargaining power within the household affecting the educational prospects of their daughters more than their sons. This could be due to lower aspiration for girls' education in the communities of EMM which can be conflated by dowry effects. Our main argument is that, more empowered women have a better chance of limiting the effects of these factors and reducing the transmission of educational inequalities from EMM to their children. We have surmised from the literature review that early married mother's children are likely to get less education as a result of their low education, risk to poor health, and community values on education. Empowering EMM has the potential to limit health, education, and community effects on transmission of inequalities.

3. THEORETICAL BARGAINING MODEL

In this paper, the theoretical model guiding our econometric specification builds on the household collective models where household's members have different preferences, with the implication that modifications of individual-specific control over resources translates into changes in resource allocation patterns (Chiappori, 1997). If women's voice and powers of negotiation are strengthened this can have a positive impact on their bargaining power and control over resources. In particular, we use the idea that the bargaining process over the sharing rule of resources—i.e., the amount agreed that each member of the household is allowed to spend of the remaining income after expenditures in public goods (Chiappori, 1997, p. 43)—depends on a set of environmental factors or opportunities of spouses outside marriage (Chiappori, Fortin, & Lacroix, 2002). Some studies exploit this to examine how empowerment and marriage affect children's investments (see Fafchamps, Kebede, & Quisumbing, 2009; Park, 2007), but not with a separate analysis for early marriage. We go a step further, and in our model, the key direct environmental factor is early marriage.

We now formally define the model.[5] The discounted utility for groom i derived from marrying potential bride j is $W_i^m = W^m(A_j^m, A_i^f; \theta_{ij})$ where θ_{ij} is the sharing rule, and for the bride j is $W_j^f = W^f(A_j^m, A_i^f; \theta_{ij})$, where A represents premarital endowment for men (m) and women (f). Welfare maximization by the household can be defined as a solution to the problem:

$$\max_{\theta}\alpha(F_{ij})U^{m}(\theta Y)+(1-\alpha(F_{ij}))U^{f}((1-\theta)Y) \quad \text{subject to} \quad Y = Y(A_j^m, A_i^f) \tag{1}$$

where α is the welfare weight which depends on the environmental factor F_{ij} and Y represents the budget constraint. Maximizing (1) yields a division of welfare between spouses which depends on the sharing rule; with θ being increasing in α and hence in the environmental factor F_{ij} (Fafchamps *et al.*, 2009). Our assumption is that, bargaining power and bargaining abilities of spouses depend on expected share of assets on divorce and crucially on S_i—the relative bargaining effectiveness—which in our context is strongly affected by early marriage EM_i (a component of the contextual factors F_{ij}). That is, how much women can derive from the household utility and those of their children by the sharing rule is influenced by the effectiveness of their bargain which is an inverse function of marrying young: $S_i = f^{-1}(EM_i)$, where $EM_i \in F_{ij}$. Household optimization (Park, 2007) leads to the following demand function for child's quality—education level or health status,

$$s^* = s^*(A^m, A^f, Y, p', h', EM) \tag{2}$$

where s^* is the optional demand of children's schooling, Y is total income, p' is a price vector, h' is a children's quality endowment vector and EM is an indicator of early marriage. The main reason why early marriage affects schooling decisions of children is due to its overreaching importance as measure of empowerment itself as young wives' lack of full maturity at the time of marriage makes them especially vulnerable and subject to domestic violence and sexual abuse, and unable to make critical decisions about their children's education. This is reflected in lower autonomy on their education decisions (Carmichael, 2011; Jensen & Thornton, 2003; Murphy-Graham, 2010) and those of their children. We do not estimate the bargaining model but exploit its empirical implications.

4. DATA

Our analysis is based on DHS data from SSA (Measure DHS, 2013a). The DHS provides a wide range of information for all household members on health, nutrition as well as education. The DHS has the double advantage of providing nationally representative samples that are also comparable across countries (Measure DHS, 2013b) and, vitally, that can link parental information to their children. For the first wave we employ and pool surveys around the year 2000 (25 in total) and for the second wave the latest 32 available surveys (with 2010 as the average year).

Table 1 displays the countries included and size of the working sample: women 30- to 39-year-old who first married or entered into union. Two reasons are behind the choice of the working sample. First, the lower bound of 30 years of age is chosen to overlap with children's educational outcomes which are approximately defined for children's age group between 8 (for never been to school) and age 17 (for primary completion). Second, the upper bound of 39 years is chosen as to not overlap with one of the instruments employed in the IV approach, past incidence of early marriage (based on the 40–49 cohort).

To provide a more comprehensive picture on transmission of educational inequality through early marriage, we make use of four indicators measuring different zones of educational exclusion which locate different populations whose access is denied or not likely to lead to a full completion of basic education (Lewin, 2009). These are: those who will never go to school (zone 1); primary drop-outs (zone 2); primary enrolled but at a risk of drop out (zone 3). [6] Never been to school, the first indicator, is defined as children who never attended school for the age group two years after a country official primary entry age plus three. The second indicator, overage in primary school (a group at risk of dropping out), comprises children attending primary two or more years older than the specific grade age. The third indicator, primary completion, is defined for those children aged between one year after primary official leaving age plus three. [7] Finally, years of schooling is calculated for the age group 10–14.

As found in other studies (Lee-Rife *et al.*, 2012; Loaiza & Wong, 2012), our working sample confirms there has been little improvement in lowering child marriage rates during the last decade in SSA (from 52% in wave 1 to 46% in wave 2, with a reduction of 3% from 18% for girls married before age 15). Thus, a child born to EMM still poses a disadvantage to their education prospects. In both waves children of EMM are 10% less likely to complete primary compared to children of non-EMM, and are 10% more likely to be overage and between 20% and 12% more likely to have never accessed education (see Table 2). As expected, there are also important differences on background characteristics for the two groups. For instance, households of EMM have nearly an additional child than those from the non-EMM group. They are 40% more likely to be in the bottom quintile of the wealth distribution, and are 5% less likely to have attended secondary education compared to non-EMM. This gap is also observed at the community level—e.g. EMM communities have larger number of young children and stunting rates and lower rates of fathers in qualified occupations.

Moreover, for each country, there is a direct linkage between child marriage and educational performance—countries with higher incidence of child marriage tend to show poorer educational performance. Figures 1 and 2 depict the distribution of prevalence of early marriage and educational performance (for wave 2). Figure 1 shows that darker shaded countries (mostly Western Africa countries such as Niger, Burkina Faso, Mali, and Guinea) where child marriage is severe, also have higher rates of out-of-school children and low primary completion rates above the regional average (Figure 2).

5. METHODOLOGY

We employ various econometric techniques to account for the different issues which may bias the relationship of early marriage with children's education. On the one hand, to derive robust relationships for cross-section estimations—controlling for selection on both observables and unobservable—we rely on OLS and matching techniques as well as IV to control for endogeneity. On the other hand, to look at changes in this relationship across time we use pseudo panel data models by combining the two waves of DHS data.

(a) *OLS and double robust estimators*

We do not estimate the bargaining model as we do not have information on pre-marital variables. Instead, we estimate a reduced form of children schooling as a function of the bargaining indicator (captured by environme $S_{ihk} = f(X_{ihk}, EM_{hk}, H_{hk}, Co_k)$ ntal factor early marriage EM)

Table 1. *Sub-Saharan Africa's DHS surveys used*

Country	Wave 1		Wave 2	
	Year	*N*	Year	*N*
Benin	2001	7,633	2011	24,043
Burkina Faso	1998	7,567	2010	21,873
Burundi			2010	11,451
Cameroon	1998	5,498	2011	14,901
Chad	1996	7,488	2004	6,672
Comoros			2011	6,012
Congo	2005	7,225	2012	12,574
Côte d'Ivoire	1998	2,927	2012	11,221
D. R. Congo			2013	22,759
Ethiopia	2000	16,754	2011	18,436
Gabon	2000	6,160	2012	8,612
Ghana	1998	5,284	2008	5,712
Guinea	1999	8,653	2012	10,498
Kenya	1998	8,823	2008	8,993
Lesotho	2004	6,252	2009	6,814
Liberia			2013	10,969
Madagascar	2003	9,584	2008	21,203
Malawi	2000	13,542	2010	28,117
Mali	2001	14,463	2012	15,470
Mozambique	2003	13,638	2011	16,152
Namibia	2000	6,565	2006	8,874
Niger	1998	9,752	2012	18,331
Nigeria	1999	7,918	2013	45,191
Rwanda	2000	10,261	2010	14,421
Sao Tome and Principe			2008	3,013
Senegal	2005	15,199	2010	18,156
Sierra Leone			2013	19,343
Swaziland			2006	4,133
U. R. Tanzania	1999	4,253	2010	12,183
Uganda	2000	8,164	2011	10,050
Zambia	2001	8,238	2007	8,108
Zimbabwe	1999	5,430	2010	8,774

Notes: Sample sizes refer to the working sample: mother's aged 30–39.

and a set of children, household and community characteristics. There are three units of analysis in the regressions: the child (i), the household (h), and the community (k). The analysis is performed separately for boys and girls. For each wave we pool all countries and estimate by OLS the child schooling regression,

$$S_{ihk} = f(X_{ihk}, EM_{hk}, H_{hk}, Co_k) \quad (3)$$

where S_{ihk} denotes child's schooling indicators (never been to school, late entry, primary completion, and years of education) for child i living in household h and community k. Our key independent variable is EM_{hk}—whether the mother of the child had married young or before 18-year-old. Other covariate included is X_{ihk} which is a vector of child characteristics including age and birth order. The vector of household variables H_{hk} includes: number of boys and girls at home, household head male, mother's working, mother's religion Muslim, mother's body mass index (BMI). The vector of community variables Co_k includes community health variables (average number of children under 4, average stunting rate, proportion of underweight mothers), dummy for rural community, and community socio-economic variables (development index based on household assets and proportion of fathers in with upper non-farm occupation). [8] We also include country dummies and GDP. We also investigate indirect pathways operating from early marriage to child schooling by OLS regression (3) by sub-samples: parental education channel, health and empower channels, and the ecological community channels (given by community location, fertility, education quality, and socio-economic characteristics).

Because it is unreasonable to assume that marrying young is a random event, a comparison of children born to a young married mother to those whose mothers married later may be biased. In order to attenuate the selection bias generated by confounding factors and identify an appropriate counterfactual for the treated group of children (i.e., children born to young wives, $EM_i = 1$), we adopt matching techniques (Rosenbaum & Rubin, 1983). The aim of matching is to find a group of non-treated children (born to mothers married after age 17, $EM_i = 0$) who are similar to the treated children in all observed characteristics except for the variable early marriage. Matching allows us to account for the potential bias arising from a correlation between the treatment group and observed covariates. [9] In particular, we are interested in estimating average treatment effect on the treated (ATT). The matching estimator used is a double robust estimator (Bang & Robins, 2005) which uses the same specification for estimating the propensity score and the outcome model. This estimator has the theoretical advantage that it yields unbiased estimates if either or both the propensity and outcomes are correctly specified—the double robust property which offers more protection against misspecification.

Table 2. *Summary statistics of children's schooling outcomes and covariates by marriage status*

Variables	Wave 1		Wave 2	
	Early married mothers	Non-early married mothers	Early married mothers	Non-early married mothers
Children's schooling outcomes				
Never been to school (%)	0.36	0.18	0.25	0.13
Overage (%)	0.51	0.40	0.46	0.35
Primary completion (%)	0.19	0.30	0.25	0.34
Years of education	2.21	3.08	2.92	3.51
Demographic factors				
Age	19.91	20.03	19.33	19.91
Birth order—second or third	0.17	0.20	0.18	0.22
Birth order—fourth	0.29	0.20	0.30	0.18
Number of sisters	1.77	1.52	1.86	1.56
Number of brothers	2.03	1.65	2.14	1.68
Household head—male	0.85	0.80	0.84	0.80
Mother work	0.68	0.70	0.67	0.70
Mother—Muslim	0.36	0.23	0.32	0.21
Mother's BMI	22.79	23.59	24.33	25.08
Child sex—male	0.49	0.48	0.50	0.49
Socio-economic factors				
Household wealth—Q1	0.24	0.18	0.25	0.17
Household wealth—Q2	0.23	0.18	0.22	0.18
Household wealth—Q3	0.22	0.19	0.21	0.19
Household wealth—Q4	0.18	0.20	0.19	0.21
Household wealth—Q5	0.12	0.23	0.13	0.26
Father occupation—lower non farm	0.25	0.35	0.32	0.37
Father occupation—upper non farm	0.16	0.23	0.16	0.23
Mother education—at least some primary	0.23	0.28	0.29	0.29
Mother education—at least some secondary	0.04	0.10	0.08	0.12
Father education—at least some primary	0.19	0.22	0.24	0.24
Father education—at least some secondary	0.04	0.07	0.06	0.10
Community factors				
Number of children under 4	0.40	0.35	0.43	0.37
Average stunting rate	0.36	0.32	0.32	0.28
Underweight mothers (%)	0.11	0.08	0.08	0.07
Rural community	0.79	0.67	0.77	0.63
Development index	−0.24	0.05	−0.18	0.18
Parents with secondary education (%)	0.10	0.17	0.15	0.23
Upper non-farm occupation—father (%)	0.63	0.67	0.48	0.68

Notes: Authors' calculations based on DHS surveys. Working sample: mother's aged 30–39.

(b) *Instrumental variable (IV) approach*

There can be unobservables which can affect both the decision of early marriage and educational outcomes which will bias its association, with educational differences of treated and untreated children explained by pre-existing characteristics of women who marry young versus those who marry later. To account for endogeneity, we employ two models with two instruments measured at the community level. In model 1, we use the proportion of non-premarital sex (Z_1) and the past prevalence of early marriage (Z_2) and in model 2 we replace the later instrument with the female/gender ratio (Z_3). We expect the instruments to be linked with decision of women to marry young. The proportion of non-premarital sex is an indication of the value the community attaches to girls' virginity and reflect safety concerns behind early marriage decisions. If families feel they cannot protect their daughters from latent risks, parents may consider early marriage as a safeguard against premarital sex and sexual harassment (Malhotra *et al.*, 2011). Past prevalence of child marriage in a community is an indication of its cultural dimension with early marriage passed on through generations by social pressure (Bayisenge, 2010, chap. 4) while the female/male community ratio captures competition for future husbands.

We do not anticipate that the instruments to be strongly correlated with the error term. The value attached to virginity represents, as well as protection mechanism, a cultural dimension of communities which is not linked to socio-economic factors and so it is more likely to be valid. Past incidence of early marriage is based on community-level aggregate and it is unlikely to have a direct impact on schooling at the individual level. Although instruments are validated by specification tests (see Section 6(a)), we do not claim that IV estimates are unbiased. Our IV approach has the common drawbacks of cross-section analysis—results show at best conditional statistical correlations rather than causality.

(c) *Pseudo panel*

Here we combine the two rounds of DHS data using a pseudo panel which permits us to identify the determinants of children's schooling over the years. We construct the

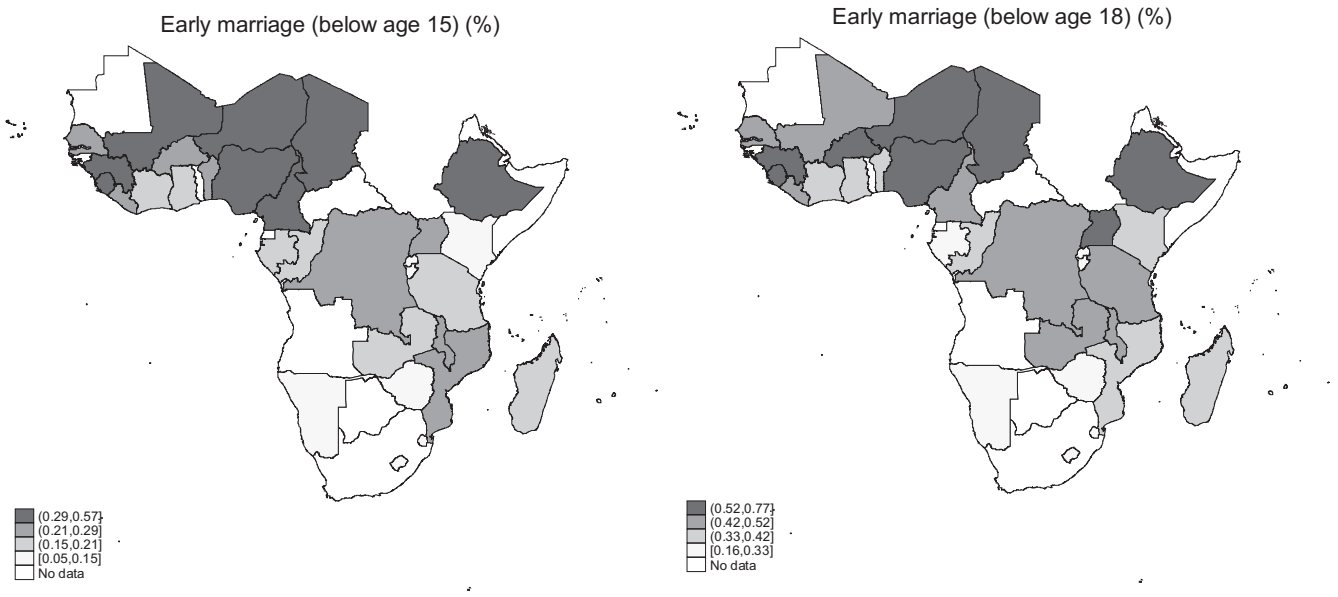

Figure 1. *Incidence of early marriage in SSA. Darker shaded countries indicate larger early marriage prevalence. Authors' calculation based on the DHS surveys, wave 2.*

pseudo panel by aggregating datasets for each country by cohorts observed in both waves leaving 25 countries. To increase samples size before collapsing the data by cohorts, we employ a larger group of women—i.e., aged 30–49. Cohorts are defined based on year-of-birth brackets and the country of residence. Because age's distribution varies considerable between and within countries, we generate cohorts for each country based on quantiles for the mothers' age distribution rather than using fixed age groups. Specifically, for each country, we split the age distribution into 20 bins, guarantying a 5% of the total sample for each cohort c ($c = 1,\ldots, C = 20$). Cohort c is defined as,

$$\overline{S_{ihkct}} = f(\overline{X_{ihkct}}, \overline{EM_{hkct}}, \overline{H_{hkct}}, \overline{Co_{kct}}) \tag{4}$$

where the average is taken for each cohort c in time t (=1 for wave 1, and =2 for wave 2). The cohort's choice provides enough time variation and it maximizes efficiency by using numerous cohorts, all of size above the minimum bound of 100 individuals per cell (Verbeek & Nijman, 1992), to eliminate the bias of time-varying average cohort fixed effects (Deaton, 1985). The median cohort is of a reasonable size, varying across indicators from 93 for primary completion, 249 for years of education, 292 for never been to school to 356 in the case of late entry. [10] By transforming the pooled cross-section to a model of cohort means using (4) we generate a pseudo panel and estimate standard fixed and random effect models using panel data techniques,

$$\overline{S}_{ict} = \alpha + \sum_{l=1}^{L} \bar{X}^{l}_{i_{ct}} \beta^{l} + D_t + \bar{\eta}_{ct} + \bar{e}_{ct} \tag{5}$$

where $\overline{S}_{ict}$ is the outcome variable and $\bar{X}^{l}_{i_{ct}}$ the 1 covariate (which also includes the additional socio-economic variables of the full model), D_t a time dummy (=1 for wave 1), $\bar{\eta}_{ct}$ is the average of the fixed effects for those individuals in cohort c in the year of survey t and $\bar{e}_{ct}$ is the random term. Note that $\bar{\eta}_{ct}$ deals with unobserved individual heterogeneity while controlling for cohort effects and it can also average out individual measurement errors (Warunsiri & McNown, 2010). The critical assumption for consistency is that the average fixed effects approximates the true fixed effect ($\bar{\eta}_{ct} \approx \bar{\eta}_{c}$).

6. EMPIRICAL FINDINGS

(a) *Estimations by gender and pseudo panel results*

In this section we present the paper's main findings. Table 3 summarizes the results by gender for each wave for all econometric specifications using the controls of Eqn. (3). The basic finding from Table 3 is that early marriage in SSA is a powerful mechanism of transmission of education inequality for both girls and boys in both waves. In all econometric specifications, mother's early marriage status impairs their ability to transfer education to the next generation (for OLS, matching, and IV). We also observe that early marriage has a negative and significant effect on primary completion and years of schooling, and a positive and significant impact on the likelihood to never have been to school and to enter primary education late (see columns (1–2), (4–5), (6–7), (9–10) of Table 3). This confirms the baseline hypothesis: low returns to schooling, increasing education costs and family income constraints resulting in lower education investments for young wives' children. Because of the controls employed, the effect of early marriage is net of family structure and health factors, school supply (captured by geographical location), community average infrastructure and its value to education (measured by parents in higher occupations who presumably are more motivated to send their children to school), and other community ecological health factors. Though all results (from Tables 3–8) and conclusions should be interpreted with the standard caveat, they represent associations and do not necessarily imply causality.

Early marriage is a stronger barrier for access than to retention measures—i.e., its association with never been to school is larger than for completion and there are smaller effects for late entry. Early marriage has a major impact on zone 1 of education exclusion (those children who will never go to school) than on zone 2 indicators (primary drop-outs) and finally on zone 3 indicators (children enrolled but a risk of dropping out or late entrants). For instance, OLS estimates (columns (1) and (6)) show that for girls there is a lower completion rate effect between 5% and 3% while for never been to school this is twice as large (11–6%). The larger impact on access could sug-

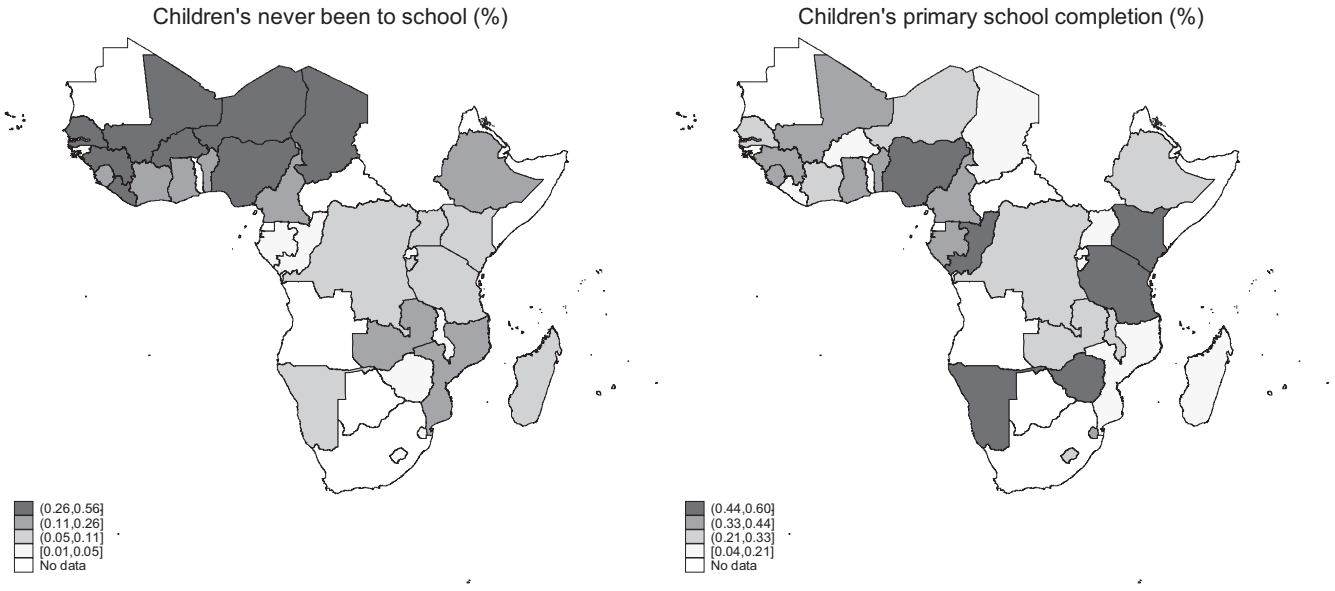

Figure 2. *Children never been to school and primary school rate in SSA. Darker shaded countries indicate larger rates. Authors' calculation based on the DHS surveys, wave 2.*

gest that social norms and parental values on education may pose an influence of the same level as family credit constraints when taking decision on whether to send children to school. But opportunity costs are also important. In fact, the likelihood to enter school late (mostly linked with higher opportunity costs of schooling in terms of forgone paid-work) is around 1.7% higher for children from EMM. This holds back the efficiency of education systems as most late entrants end up dropping out (Wils, 2004) and can also create difficult multiage learning situations for teachers and other students (Akyeampong, 2005; Wang, 2011).

By comparing gender estimates we can pin down any gender bias in educational investments through the impact of early marriage. Our estimates show that EMM's daughters—possibly because of lower aspirations or increasing dowry prices—are relatively more affected in their schooling opportunities than EMM's sons. For years of schooling there is a gap favoring boys (or a lower effect) of 0.07 (wave 2, column (6)) which in turn implies over a 1% higher negative effect for both completion rates and out-of-school rates for girls.

Because OLS estimates are averaged effects for treated and untreated children and may hide the extent of the early marriage driven inequality, we include in columns (2–3) and (8–9) of Table 3 matching estimators. [11] Double robust matching estimates lead to similar conclusions than OLS estimates. Importantly, by displaying the average treatment effect on the treated (ATT) as a percentage of the untreated potential outcome mean (columns (3) and (7)—ATT (%)) we put an emphasis on the scope of human capital investment inequalities driven by child marriage. For instance, in wave 2, girls whose mothers were married young (treated) are 32% more likely to be out of the school as compared to those whose mother married later on (untreated) and 11% fewer chances to finish primary. For boys, too, this disadvantage is of 31% and 6% for never been to school and completion as their counterparts, respectively.

Results for IV estimations for the two sets of instruments are shown in columns (4–5) and columns (9–10) of Table 3 (top part). Of the two first stage specifications (columns (1–2) and columns (6–7) of the second part of Table 3), model 1 (m1) is preferred as the two instruments are statistically significant; female/male ratio turns out to be a non-significant instrument (model 2, m2). This holds across samples. In the first stage, the community rate of child marriage for older cohorts is associated with 0.35 effect on child marriage and the effect of community prevalence of non-premarital sex is of 0.25 (wave 1). The impact of the instruments is slightly lower for the second wave. Instruments are not weak and correlated with the endogenous regressor (all Kleibergen-Paap rk LM statistic p-values are zero). Model 1's instruments are further supported by the test of overidentifying restrictions: using the Hansen-J statistics we accept the joint null hypothesis (p-values > 0.10) that the instruments are valid instruments (uncorrelated with the error term) and that the excluded instruments are correctly excluded from the estimated equation. We also reject the null of exogeneity in most cases supporting the central hypothesis of early marriage and education investments endogeneity.

There is a substantial downward bias of OLS estimates—especially for never been to school and years of education indicators (e.g., never been to school OLS coefficient is 0.11 and 0.57 for IV; for years of education the OLS coefficient is -0.43 and -1.81 for IV, sample: wave 1 for girls). This is contrary to some expectations on the nature of unobservables (such as ability, value parents attach to education) which points toward an upper bias of OLS because of a positive correlation of unobservables with both early marriage and dependent variables. Yet unobservables might have a differential bearing across dependent variables. For example, low parental value attached to education is more openly linked to access to school but when a child is already in the school system other factors such as opportunity costs are brought into play. Similar explanations for the OLS downward bias in return to schooling are found in other developing countries (Warunsiri & McNown, 2010).

Did early marriage-children's schooling inequality decrease during 2000–10? A direct comparison of estimated coefficients of waves 1 and 2 of Table 3 shows that inequality had improved, with most coefficients halving in size. Yet a more qualified answer can be obtained from the pseudo panel anal-

Table 3. *Summary of the impacts of early marriage on children's schooling outcomes. OLS, double robust treatment effects, and IV results by gender*

	Female					Male				
	(1) OLS	(2) ATT	(3) ATT (%)	(4) IV (m1)	(5) IV (m2)	(6) OLS	(7) ATT	(8) ATT (%)	(9) IV (m1)	(10) IV (m2)
Wave 1										
Never been to school	0.107***	0.096***	0.324***	0.567***	0.587***	0.088***	0.079***	0.335***	0.414***	0.508***
N	13,463	13,463	13,463	13,463	13,463	15,171	15,171	15,171	15,171	15,171
Overage	0.017***	0.013**	0.031**	**0.046**	−0.043	0.008	0.002	0.004	**−0.046**	−0.02
N	16,856	16,856	16,856	16,856	16,856	22,539	22,539	22,539	22,539	22,539
Primary completion	−0.051***	−0.042***	−0.195***	**−0.218*** **	−0.175**	−0.055***	−0.043***	−0.163***	−0.095	−0.127**
N	5477	5477	5477	5477	5477	11,038	11,038	11,038	11,038	11,038
Years of education (age 10–14)	−0.428***	−0.394***	−0.154***	**−1.808*** **	−2.021***	−0.389***	−0.334***	−0.120***	**−1.377*** **	**−1.645*** **
N	13,148	13,148	13,148	13,148	13,148	16,502	16,502	16,502	16,502	16,502
Wave 2										
Never been to school	0.061***	0.065***	0.319***	0.451***	**0.544*** **	0.052***	0.054***	0.306***	0.243***	**0.439*** **
N	29,618	29,618	29,618	29,618	29,618	33,330	33,330	33,330	33,330	33,330
Overage	0.016***	0.012***	0.029***	−0.135***	−0.181***	0.019***	0.010***	0.020***	−0.009	−0.151***
N	44,560	44,560	44,560	44,560	44,560	54,654	54,654	54,654	54,654	54,654
Primary completion	−0.033***	−0.026***	−0.112***	−0.171*	**0.166***	−0.023***	−0.018***	−0.063***	**−0.239*** **	0.037
N	14,131	14,131	14,131	14,131	14,131	22,533	22,533	22,533	22,533	22,533
Years of education (age 10–14)	−0.261***	−0.259***	−0.083***	**−1.710*** **	−0.563	−0.191***	−0.174***	−0.055***	−1.476***	−0.733**
N	30,365	30,365	30,365	30,365	30,365	35,491	35,491	35,491	35,491	35,491

		Female					Male				
IV tests and first stage results		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	IV model	First stage (m1)	First stage (m2)	**Under identification test**	Over identfication test	Endogeneity test	First stage (m1)	First stage (m2)	**Under identification test**	Over identfication test	Endogeneity test
Wave 1											
Never been to school											
Past prevalence of early marriage	IV (m1)	0.349***		363.6 (0.00)	**0.65 (0.42)**	**46.95 (0.00)**	0.388***		492.5 (0.00)	**2.50 (0.11)**	**33.20 (0.00)**
Non-premarital sex		0.231***	0.304***				0.232***	0.318***			
Female/male gender ratio	IV (m2)		0.05	261.6 (0.00)	5.42 (0.02)	30.53 (0.00)		−0.146	339.8 (0.00)	**1.53 (0.22)**	**29.65 (0.00)**
Overage											
Past prevalence of early marriage	IV (m1)	0.290***		269.1 (0.00)	**2.56 (0.11)**	**0.38 (0.54)**	0.305***		405.5 (0.00)	**2.14 (0.14)**	**1.04 (0.31)**
Non-premarital sex		0.260***	0.306***				0.227***	0.307***			
Female/male gender ratio	IV (m2)		−0.022	253.9 (0.00)	0.07 (0.79)	1.02 (0.31)		−0.133	374.8 (0.00)	6.33 (0.01)	0.46 (0.50)
Primary completion											
Past prevalence of early marriage	IV (m1)	0.327***		106.8 (0.00)	**1.40 (0.24)**	**4.09 (0.04)**	0.360***		335.1 (0.00)	0.27 (0.60)	0.61 (0.44)
Non-premarital sex		0.185***	0.265***				0.256***	0.339***			

Female/male gender ratio	IV (m2)		−0.335**	78.8 (0.00)	1.93 (0.16)	2.10 (0.15)		−0.166	288.6 (0.00)	1.62 (0.20)	1.73 (0.19)
Years of education (10–14)											
Past prevalence of early marriage	IV (m1)	0.347***		324.3 (0.00)	**0.10 (0.75)**	**22.83 (0.00)**	0.371***		538.4 (0.00)	**1.42 (0.23)**	**15.00 (0.00)**
Non-premarital sex		0.217***	0.303***				0.253***	0.333***			
Female/male gender ratio	IV (m2)		−0.051	250.6 (0.00)	7.62 (0.01)	20.03 (0.00)		−0.121	409.5 (0.00)	**2.16 (0.14)**	**17.48 (0.00)**
Wave 2											
Never been to school											
Past prevalence of early marriage	IV (m1)	0.239***		298.6 (0.00)	14.18 (0.00)	24.30 (0.00)	0.266***		347.9 (0.00)	10.86 (0.00)	7.77 (0.01)
Non-premarital sex		0.150***	0.210***				0.108***	0.192***			
Female/male gender ratio	IV (m2)		0.024	268.7 (0.00)	**0.01 (0.95)**	**36.54 (0.00)**		0.062	249.2 (0.00)	**0.27 (0.60)**	**24.49 (0.00)**
Overage											
Past prevalence of early marriage	IV (m1)	0.223***		386.9 (0.00)	10.51 (0.00)	7.81 (0.01)	0.246***		475.8 (0.00)	10.39 (0.00)	0.43 (0.51)
Non-premarital sex		0.167***	0.231***				0.107***	0.209***			
Female/male gender ratio	IV (m2)		−0.084	432.7 (0.00)	7.17 (0.01)	17.01 (0.00)		−0.01	435.2 (0.00)	9.96 (0.00)	12.74 (0.00)
Primary completion											
Past prevalence of early marriage	IV (m1)	0.204***		90.7 (0.00)	1.04 (0.31)	1.78 (0.18)	0.238***		192.8 (0.00)	**1.80 (0.18)**	**7.52 (0.01)**
Non-premarital sex		0.115***	0.194***				0.105***	0.192***			
Female/male gender ratio	IV (m2)		−0.064	98.1 (0.00)	**2.56 (0.11)**	**4.79 (0.03)**		0.042	163.3 (0.00)	0.13 (0.72)	0.49 (0.48)
Years of education (10–14)											
Past prevalence of early marriage	IV (m1)	0.230***		266.4 (0.00)	**2.47 (0.12)**	**15.52 (0.00)**	0.247***		331.6 (0.00)	7.97 (0.00)	12.81 (0.00)
Non-premarital sex		0.139***	0.211***				0.120***	0.206***			
Female/male gender ratio	IV (m2)		−0.049	270.8 (0.00)	5.96 (0.01)	0.61 (0.44)		0.02	302.1 (0.00)	2.58 (0.11)	2.30 (0.13)

Notes. (1) Models' controls. Demographic household characteristics (children age and birth order, number of daughters and boys at home, household head male, mother's working, mother's religion Muslim, mother's BMI); community health variables (average number of children under 4, average stunting rate, proportion of underweight mothers), dummy for rural community, community socio-economic variables (development index based on household assets and proportion of fathers in with upper non-farm occupation); and countries' dummies and GDP. (2) The average treatment on the treated (ATT) is estimated using Inverse-probability-weighted regression adjustment (IPRWA). The ATT (%) indicates the ATT as a percentage of the untreated potential outcome mean. (3) Instruments are community proportion measured as follows: non-premarital sex is the proportion of women who have not had sex before marriage in the 20–40 age group; past prevalence of early marriage is the proportion of women aged 40–49 who had married before age 18; and the gender ratio is the proportion of female/male in the 20–40 age group. Models' specifications are as follows: IV (m1) and IV (m2) include the instrument proportion of non-premarital sex, IV (m1) second instrument is past prevalence of early marriage and IV (m2) second instrument is female/male gender ratio. (4) Under identification tests are based on Kleibergen–Paap rk LM statistic; over identification tests on Hansen *J* statistic; and the endogeneity tests on *C*-statistic. All IV models pass the under identification tests. We display in bold IV estimates supported by tests (i.e., where the over identification null is rejected and the endogeneity null is accepted).
Standard errors clustered at the community level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4. *Pseudo panel estimates*

	Never been to school		Overage		Primary completion		Years of education	
	Fixed effects	Random effects	Fixed effects	Random effects	Fixed effects	Random effects	Fixed effects	Random effects
Early marriage	0.160***	0.233***	0.061**	0.317***	−0.124***	−0.059	−0.800***	−0.618***
Wave 2 dummy	0.028	−0.001	0.022	0.042	−0.051***	−0.016	−0.182*	0.075
Early marriage × wave 2 dummy	−0.142***	−0.096**	−0.036	−0.166***	0.064**	0.05	0.544***	0.323
Socio−economic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.932***	0.534***	−0.232**	−1.419***	−1.603***	−1.560***	−8.555***	−4.981***
N	653	653	652	652	688	688	679	679
R^2	0.763	0.861	0.309	0.713	0.493	0.728	0.561	0.834
Hausman test $\chi^2(32)$ stat (*p*-val)	263.93 (0.00)		581.14 (0.00)		181.14 (0.00)		514.17 (0.00)	

Notes: (1) Pseudo panel estimates are based on the sample of 25 countries observed in the two waves. The sample consists of mothers married between age 30 and 49. (2) Models without socio-economic controls include the same explanatory variables as in Table 3. (3) Additional socio-economic controls are household-level variables (wealth, father's occupation, and parental education) and community education (proportion of parents with secondary education).
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

ysis of Table 4. The Hausman test is used to choose between the fixed effects and random effects models. For the four dependent variables we reject the null that differences in coefficients are not systematic and so the fixed effect methods—addressing the issue of omitted variable bias arising from unobserved heterogeneity and at the same time controlling for cohort effects—are appropriate and the basis of our analysis.

Table 4 shows that, although the net effect of child marriage is still significant after accounting for cohort effects and additional socio-economic controls, an improvement in terms of lower transmission of education inequality has been achieved since Dakar. The interaction terms between early marriage and wave 2, time dummy are statistically significant (for all dependent variables except from overage) and of the right sign, nearly half of the size of the direct effect of the covariate early marriage. For the cohort of young wives' children born around the mid 90s, the pseudo panel estimates for access reveals a remarkable progress (total effect of just 2%). Though progression and achievement are still a concern with total negative effects of 6% for primary completion and 0.30 years of schooling, this could partly be explained by the scaling up of policies fostering UPE in the region (such as fee abolition) but the neglect of incentives to keep children in schools coupled with rising indirect costs.

(b) *Indirect channels of education inequality transmission*

Our analysis shows significant evidence of a negative association between early marriage and children's schooling. Yet policies may be informed by differences on how low educational investments of young wives are broken down by sub-populations. These sub-populations define indirect channels and reveal the existence of heterogeneity on the mechanisms behind intergenerational transmission of education inequality or the impact of early marriage on children's education. Table 5 displays OLS estimates by four plausible hypothesis of transmission: education, health, empowerment, and community characteristics.

Estimates for the education channel are contained in Panel A of Table 5. In theory, the negative relationship that we estimate between early marriage and children's education could reflect the fact that EMM are less educated and hence the bias in the individual data estimates. Indeed, this seems to be the case. If either parent has low education, the children effect from the event of mothers marrying young is to have higher chances of never been to school (of 6%) and not completing primary school (of 2%). Mother's literacy, too, is a powerful driver. This highlights that part of the main results of Table 3 are driven by low parental education, confirming the ability/-motivation and family education environment components of transmission (see Section 2).

The early marriage effect is found to also operate via poor family planning and a lack of antenatal and child care. Short birth spacing and lack of vaccinations might lead to lower parental investments and negative consequences on children's cognitive abilities. Hence, estimates for the health channel (Panel B of Table 4) found some supports for the hypothesis that lower life spans, as well as lack of care around birth and nutrition deficits during pregnancy yield lower educational returns of EMM children, which in turn act as a disincentive for investments on education. Certainly, the effect of early marriage on primary completion is significant for a child in the group of household with short birth spacing but not statistically significant otherwise; the additional years of education lost for EMM children is twice as large if they have not received basic vaccinations (−0.25 versus −0.13).

Moreover, we find that our estimates are not totally driven by lower empowerment of young wives (Panel C of Table 5); at least not as much as found for the education and health channels. Among young wives, an increase in empowerment in terms of decision making over patterns of household spending, mother's freedom of movement and power to negotiate sex, does not automatically lead to lower effects on children's education. [12] There is, however, a positive gap for access: children of empowered young wives have, on average, a 2% lower chance to be out of school.

Although EMM lack of empowerment does not fully explain children's schooling decisions beyond access, indirectly EMM weight on intra-household decisions matters because of its' influence as mediators on the relationships of education, health, and community factors with children's schooling. If EMM have some degree of empowerment, this can limit health, education, and community effects on transmission of educational inequalities. Table 6 supports this. It shows the effects (predictions) of the interactions between indicators of empowerment with the education, health, and community pathways (of Table 5) for the sub-sample of young wives. Children of disadvantaged EMM (i.e., those young wives with low education, poor antenatal care, high fertility, and living in

Table 5. *OLS estimates by sub-samples (wave 2)*

Panel A: education	Father education		Mother education		Mather literate	
	Low	High	Low	High	No	Yes
Never been to school	0.066***	0.019**	0.062***	0.008	0.056***	0.006*
N	45,155	6,129	52,689	7,060	41,340	21,217
Primary completion	−0.022***	−0.014	−0.019***	−0.009	−0.016***	−0.013
N	25,102	4062	29,317	4806	24,036	12,430
Years of education	−0.215***	−0.085	−0.194***	−0.131**	−0.166***	−0.069**
N	46,470	6497	54,378	7665	43,309	22,157

Panel B: health	Short birth spacing		Child vaccinations		Antenatal visits (hosp)		Mother height	
	No	Yes	No	Yes	No	Yes	Low	High
Never been to school	0.052***	0.071***	0.060***	0.043***	0.044***	0.066***	0.059***	0.054***
N	31,427	11,563	40,033	10,467	31,263	7344	21,450	21,973
Primary completion	−0.013	−0.033***	−0.034***	−0.021*	−0.023***	−0.016	−0.021**	−0.020**
N	11,673	5196	24,231	5969	17,331	3882	11,976	12,513
Years of education	−0.182***	−0.287***	−0.255***	−0.130***	−0.194***	−0.172***	−0.201***	−0.242***
N	26,040	10,869	42,491	10,921	31,831	7705	22,210	22,884

Panel C: mother's empowerment measures	Spend large purchases (empowered)		Spend husband income (empowered)		Visit family (empowered)		Refuse sex (empowered)	
	Yes	No	Yes	No	Yes	No	Yes	No
Never been to school	0.044***	0.062***	0.044***	0.059***	0.051***	0.056***	0.051***	0.063***
N	29,730	28,106	23,594	31,790	35,557	22,226	34,385	18,762
Primary completion	−0.030***	−0.020***	−0.032***	−0.026***	−0.029***	−0.021**	−0.022***	−0.030***
N	17,110	16,018	13,677	18,262	20,684	12,426	19,738	10,388
Years of education	−0.213***	−0.207***	−0.176***	−0.249***	−0.204***	−0.224***	−0.186***	−0.226***
N	30,733	29,359	24,424	33,016	37,067	22,971	35,669	19,790

Panel D: community characteristics	Community location		Community poor		Community lack of education quality		Community fertility		
	Urban	Rural	No	Yes	No	Yes	Low	Medium	High
Never been to school	0.027***	0.067***	0.041***	0.073***	0.044***	0.053***	0.027***	0.051***	0.078***
N	17,194	45,754	35,066	27,882	20,482	42,466	12,990	30,473	15,853
Primary completion	−0.047***	−0.019***	−0.037***	−0.012*	−0.032***	−0.025***	−0.061***	−0.016**	−0.01
N	10,459	26,205	20,885	15,779	12,343	24,321	8066	17,973	8517
Years of education	−0.289***	−0.204***	−0.226***	−0.212***	−0.271***	−0.182***	−0.292***	−0.165***	−0.218***
N	18,003	47,853	37,085	28,771	22,047	43,809	13,963	32,181	15,852

Notes: (1) Same controls as in Table 3. (2) Low-education category is defined as no education or incomplete primary; high education as some secondary and above. (3) Mother's literacy is based on her ability to read all or part of a sentence. Respondents who had attended at least some secondary school were assumed to be literate. (4) Short birth spacing is defined as when the preceding and succeeding birth intervals are less than 2 years. (5) Low height is defined as if mother height is below the country median and high otherwise. (6) Child vaccination includes the basic child vaccinations for BCG, DPT, measles, and polio. (7) Antenatal visit hospital denotes if mother has attended pre-birth controls at a health facility. (8) A women is defined as empowered (categorical variable equals to 1) if she has a say on large household purchases, on her husband's earnings, on visits to family, and whether she can refuse to have sex without condom, 0 if not empowered. (9) A community is defined as poor if the proportion of households in the bottom two quintiles wealth distribution is larger than a half. (10) A community lack of education quality is measured by the proportion of women who are non-literate after completing 5 or 6 years of school. (11) A community fertility is low if the fertility rate is in the distribution's bottom quartile; medium if it is between q25 and q75 and high if it is in top quartile. Community fertility rates are calculated using the Stata module tfr2 (Schoumaker, 2012).
Standard errors clustered at the community level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

poor communities) have between 4% and 8% higher chances to access education if their mothers are more empowered than their counterparts (columns (1)–(4) of Table 6). Also, children of empowered EMM (with education, health, and community setbacks) have higher completion rates by 1–3% than the children of non-empowered EMM ((columns (5)–(8)). Empowering of EMM can therefore wane other channels of transmission of education inequalities.

Different sources of bias coming from communities are likely to be small as the results in Table 3 include community controls. We find that the effect of early marriage in rural communities is considerably larger for the indicator never been school and smaller for primary completion in comparison to urban communities (Table 5, Panel D), which may imply that the effect of early marriage is channeled by supply constraints. Likewise, primary and years of education impacts are larger for poor urban areas. In other words, community location and poverty matter more when it comes to children's access to education. This is further supported by estimates by community fertility levels—that is, early marriage is not statistically associated with children's primary completion in community with high fertility rates but on the contrary it has a large effect in low-fertility communities.

(c) *Effects of delaying early marriage among young wives*

Because of weak law enforcement on child marriage, [13] an intermediate step could be to raise the age of marriage among

Table 6. *Impact (linear predictions) of empowerment on education, health, and community channels (wave 2—early married sample). OLS estimates*

	Never been to school				Primary completion			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pathway—education	Mother education low		Mother non-literate		Mother education low		Mother non-literate	
	Empowered	Not empowered	Empowered	Not empowered	Empowered	Not empowered	Empowered	Not empowered
Spend large purchases	0.219	0.284	0.243	0.309	0.218	0.211	0.224	0.219
P-Value of Wald test on coefficients	0.00		0.00		0.28		0.51	
N	26,773		27,724		17,066		17,914	
Visit family	0.228	0.290	0.254	0.313	0.214	0.215	0.221	0.221
P-Value of Wald test on coefficients	0.00		0.00		0.84		0.95	
N	26,746		27,702		17,050		17,901	
Refuse sex	0.229	0.299	0.255	0.319	0.229	0.202	0.238	0.204
Test F-stat (p-val)	0.00		0.00		0.00		0.00	
N	25,137		25,592		15,952		16,361	
Pathway—health	Short birth spacing		Antenatal visit (hosp)		Short birth spacing		Antenatal visit (hosp)	
	Empowered	Not empowered	Empowered	Not empowered	Empowered	Not empowered	Empowered	Not empowered
Spend large purchases	0.238	0.297	0.275	0.328	0.212	0.209	0.158	0.216
P-Value of Wald test on coefficients	0.00		0.01		0.79		0.00	
N	22,477		17,355		10,237		10,830	
Visit family	0.257	0.289	0.293	0.327	0.206	0.216	0.172	0.220
P-Value of Wald test on coefficients	0.01		0.07		0.48		0.00	
N	22,455		17,337		10,231		10,821	
Refuse sex	0.245	0.321	0.290	0.328	0.215	0.208	0.200	0.182
P-Value of Wald test on coefficients	0.00		0.04		0.66		0.33	
N	20,691		16,727		9,291		10,491	
Pathway—community	Poverty		Lack of education quality		Poverty		Lack of education quality	
	Empowered	Not empowered	Empowered	Not empowered	Empowered	Not empowered	Empowered	Not empowered
Spend large purchases	0.249	0.330	0.229	0.296	0.214	0.223	0.253	0.247
P-Value of Wald test on coefficients	0.00		0.00		0.34		0.44	
N	27,897		27,897		18,009		18,009	
Visit family	0.261	0.333	0.240	0.298	0.219	0.221	0.252	0.247
P-value of Wald test on coefficients	0.00		0.00		0.80		0.55	
N	27,875		27,875		17,998		17,998	
Refuse sex	0.266	0.340	0.240	0.307	0.227	0.203	0.266	0.232
P-Value of Wald test on coefficients	0.00		0.00		0.01		0.00	
N	25,742		25,742		16,437		16,437	

Notes: Same controls as in Table 3.
Standard errors clustered at the community level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 7. *Multivalued average treatments effects comparisons (wave 2)*

	Never		Primary completion		Years of education	
	Contrast	Std error	Contrast	Std error	Contrast	Std error
t = 2 vs t = 1						
Married between age 15 and 17 vs married between age 10 and 14	-0.055^{***}	0.005	−0.009	0.006	0.182^{***}	0.024
t = 3 vs t = 1						
Married at age 18 or older vs married between age 10 and 14	-0.086^{***}	0.004	0.023^{***}	0.006	0.339^{***}	0.022
t = 3 vs t = 2						
Married age 18 or older vs married between age 15 and 17	-0.031^{***}	0.004	0.031^{***}	0.006	0.158^{***}	0.020
N	62,948		36,664		65,856	

Notes: (1) Same controls as in Table 3. (2) Delta-method standard errors. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 8. *Effect of early community prevalence on educational intergenerational effects—OLS estimates for children of non-young married mothers*

	Wave 1				Wave 2			
	Primary completion	Years of education	Primary completion	Years of education	Primary completion	Years of education	Primary completion	Years of education
Mother's years of schooling	0.034***	0.157***	0.022***	0.131***	0.027***	0.137***	0.010***	0.101***
Community early marriage x mother's years of schooling	−0.021***	0.005	−0.019***	0.001	−0.008**	−0.005	−0.007*	−0.015
Socio-economic controls	No	No	Yes	Yes	No	No	Yes	Yes
R^2	0.218	0.341	0.264	0.395	0.219	0.328	0.266	0.373
N	5,859	11,634	5859	11,634	15,132	29,637	15,132	29,637

Notes: (1) Models without socio-economic controls include the same explanatory variables as in Table 3. (2) Additional socio-economic controls are household-level variables (wealth, father's occupation, and parental education) and community education (proportion of parents with secondary education).
Standard errors clustered at the community level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

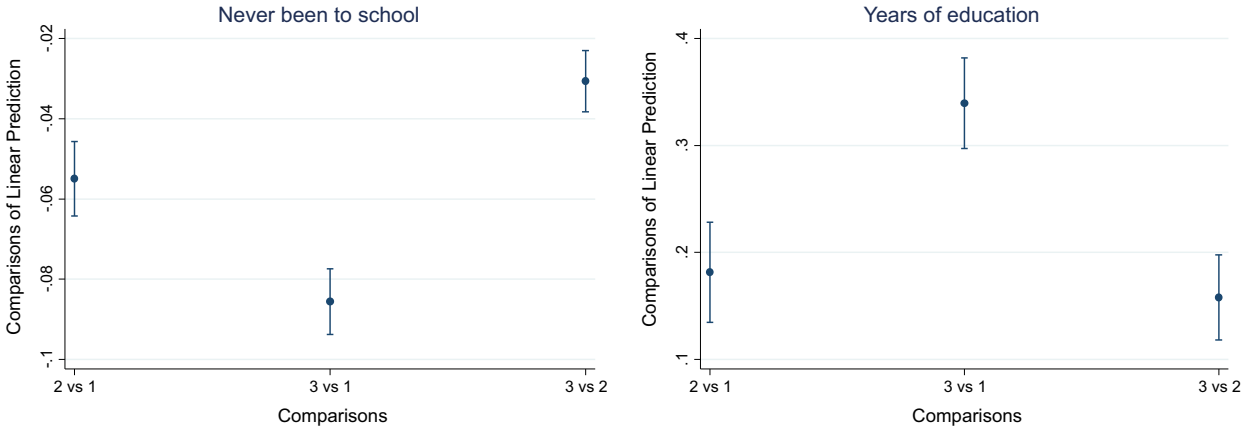

Figure 3. *Multivalued treatment effects estimates comparison (wave 2).*

Table 9. *Whole-sample impacts of early marriage on children's schooling outcomes. OLS and Matching (waves 1 and 2)*

	(1) OLS	(2) ATT	(3) ATT (%)	(4) IV	(5) OLS	(6) OLS	(7) ATT	(8) ATT (%)	(9) IV	(10) OLS
Wave 1										
Never been to school (N = 28,634)	0.097***	0.088***	0.331***	**0.481****	0.018***	0.055***	0.050***	0.165***	**0.320****	0.010*
ICC (rho)					0.708					0.638
Primary completion (N = 16,515)	−0.054***	−0.043***	−0.173***	−0.126**	−0.036***	−0.018***	−0.012**	−0.053**	0.033	−0.023***
ICC (rho)					0.589					0.606
Years of education (N = 29,650)	−0.406***	−0.362***	−0.134***	**−1.548****	−0.169***	−0.160***	−0.140***	−0.057***	**−0.544****	−0.108***
ICC (rho)					0.526					0.48
Socio−economic controls	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Community fixed effects	No	No	No	No	Yes	No	No	No	No	Yes
Wave 2										
Never been to school (N = 62,984)	0.057***	0.060***	0.316***	0.340***	0.020***	0.040***	0.041***	0.200***	0.176***	0.016***
ICC (rho)					0.44					0.41
Primary completion (N = 36,664)	−0.027***	−0.021***	−0.079***	**−0.223****	−0.021***	−0.007	−0.003	−0.013	−0.034	−0.011**
ICC (rho)					0.45					0.435
Years of education (N = 65,856)	−0.223***	−0.212***	−0.067***	−1.586***	−0.135***	−0.115***	−0.099***	−0.033***	−0.515**	−0.085***
ICC (rho)					0.433					0.409
Socio-economic controls	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Community fixed effects	No	No	No	No	Yes	No	No	No	No	Yes

Notes: (1) Models without socio-economic controls include the same explanatory variables as in Table 3. (2) Additional socio-economic controls are household-level variables (wealth, father's occupation, and parental education) and community education (proportion of parents with secondary education). (3) IV is model m1 with the community instruments past prevalence of early marriage and non-premarital sex. IV estimates are shown in bold is they pass over identification and endogeneity tests. (4) The intra-class correlation coefficient (ICC) is the proportion of the total variation of schooling outcomes attributed to communities.
Standard errors clustered at the community level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

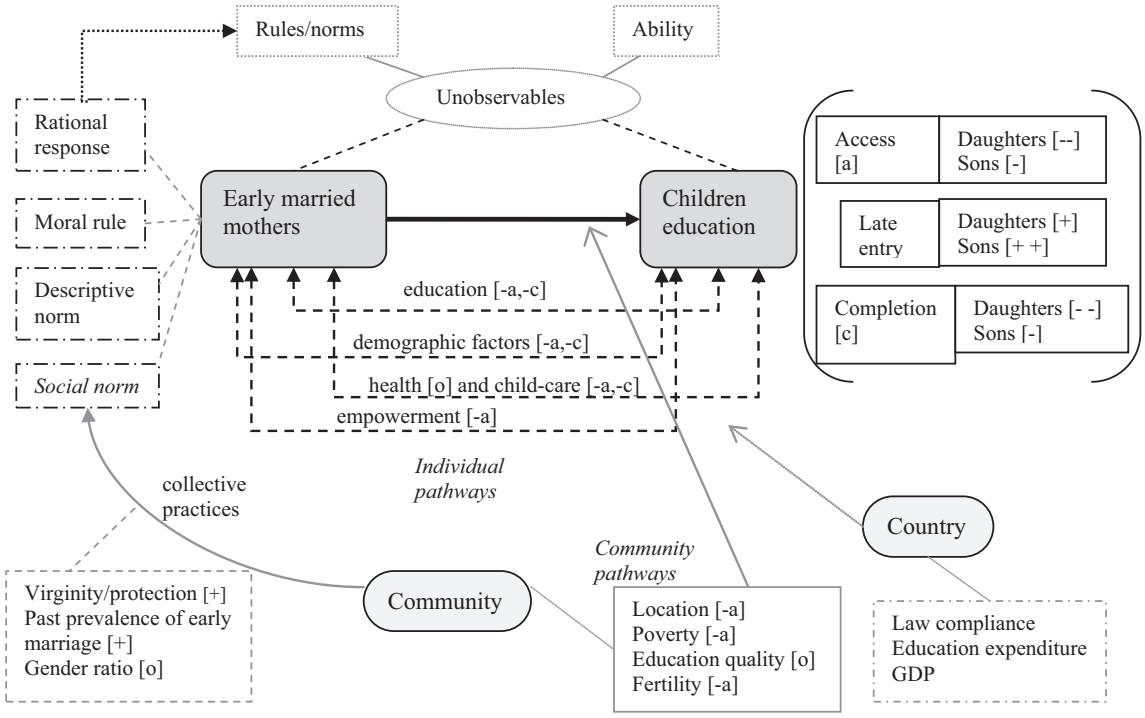

Diagram 2. *Summary of main findings.*

young wives by providing for girls at risk incentives to stay in school. In turn, this can benefit their children's schooling prospect since, as earlier shown, mothers' education can minimize the transmission of inequalities. For example, an evaluation of an education subsidy program for upper primary school students in Kenya, Duflo, Dupas, and Kremer (2014) find that it leads to reduction in adolescent girls' dropout (from 19% to 16%), pregnancy (from 16% to 13%), and early marriage.

We were interested in whether there are any potential benefits of delaying marriage for children's schooling, particularly among children of wives who had married very young. To answer this question, we follow a matching multi-treatment approach (Cattaneo, 2010; Wooldridge, 2010) to minimize the impact of observables in the selection of marriage at different ages. We define three treatments effects: married between age 10 and 14 (treatment 1, $t = 1$); married between age 15 and 17 (treatment 2, $t = 2$); and married after age 18 (treatment 3, $t = 3$). That is, we have divided the early married treatment group into two additional treatment groups—women married at very young age and women married at an intermediate age. We estimate contrasting effects are the population-averaged treatment effects of getting treatment 2 instead of 1, treatment 3 instead of 1, and treatment 3 instead of 2.

Estimates for the contrasting effects for wave 2 are shown in Table 7.[14] We find that the effect of postponing age of marriage is substantial for children's likelihood to who have never been to school. Children would have had a reduced probability of 5.5% of never been to school if their mothers had married between age 15 and 17 instead of marrying between age 10 and 14. This represents a 20% reduction of the total never been to school rate of 25% for EMM's children in wave 2 (see Table 2). Less effects are obtained in terms of years of attainment—an additional 0.18 years of education (treatment contrast $t = 2$ and $t = 1$). As expected, estimates larger when contrasting treatments 3 and 1. Interestingly, as shown by Figure 3, the gains for children in terms of access to education are proportionally larger for moving from treatment 1 to treatment 2, than moving from treatment 2 to treatment 3. Children's improvement in primary completion rates is also a function of mother's age of marriage, but marginal and significant achievement is only obtained from delaying age of marriage after 18 (i.e., CI of the contrast estimates of $t = 2$ and $t = 1$ with $t = 3$ and $t = 2$ overlap). Overall, these findings strongly support policies holding back the age of marriage among the group women married at very young age as an attempt to cut back the transmission of inequality in terms of access to education.

(d) *Community early marriage effect on non-young wives' children's educational outcomes*

Child marriage may deter children's education investment more broadly regardless whether or not the child's mother had married young. In this section to isolate the impact of the community prevalence on child's human capital investment we restrict our analysis to children of non-early married mothers. Estimates from Table 8 offer some evidence on the presence of negative externalities on parental human capital investments derived from living in community with a large prevalence of child marriage, leading to lower investments of children's schooling. Even in the model with further socio-economic controls, the interaction term for mother's years of education and community prevalence has a negative and statistically significant effect on primary completion rates among children of non-early married mothers. The pathway from mother's education, one of the major mechanisms influencing a child's educational attainment, is somewhat weakened for living in communities with high child marriage prevalence. This could imply that beyond school supply constraints in communities with high rates of early marriage, socio-cultural factors may also be operating to further impede non-EMM from investing in their children's schooling.

(e) *Robustness checks*

Estimates of Table 3 exclude socio-economic controls since those are observed ex-post to the decision of marriage and controlling for them can be an additional source of bias. We found earlier that individual and community socio-economic channels (measured by parental education and community poverty) are mediating factors on the transmission of intergenerational inequality. Hence, for robustness, Table 9 contains OLS, matching estimates, and IV estimates for the whole sample with and without socio-economic controls (household's wealth, father's occupation, parental education, and community proportion of parents with secondary education) as well as models with community fixed effects. [15]

On the one hand, still accounting for average socio-economic differences in households and communities, all estimates (i.e., of columns (6)–(9)) are statistically significant, although a comparison of the matching estimates of columns (3) and (8) shows that economic drivers greatly reduce the impact on the transmission of inequality. This agrees with the idea that socio-economic factors are more prominent under more difficult circumstances. For example, while children have 33% higher chance to be out of school as compared to untreated individuals (%ATT), for the same comparison for children with the same average household and community economic characteristics, this gap is reduced to 16% (wave 1).

On the other hand, we test the robustness of our main results for community-level unobserved heterogeneity by controlling for community fixed effects. Estimates for fixed effects models are significant (column (5) and (10) of Table 9). Therefore, even after controlling for underlying differences in educational outcomes across communities, the analysis still shows that early marriage holds back the transfer of education over generations. [16]

7. CONCLUSIONS

In this paper we investigated whether early marriage is associated with reduced educational opportunities for children, and how this relationship has changed over time since 2000 using two waves of DHS surveys for 25–32 countries from SSA.

Our results can be summarized in four findings. First, regardless of the method we employed, early marriage in SSA is widely negatively associated with access and retention of children in education. Although there has been some improvement in terms of lowering its effects in the last decade, early marriage is still a strong driver of transmission of intergenerational inequality, particularly for access to school. This was also true when accounting for socio-economic constraints faced by the early married type of household. Second, the negative effect of early married affects girls more than boys, contributing to a widening of gender inequalities over generations. This could be due to cultural perceptions on women's role in society which translates into education gender bias. Third, we find that increasing the age of marriage among the youngest EMM can have substantial effects in terms of children's likelihood to be in school. Four, inequality on investments on child education is channeled through various pathways—i.e., mother's education, family planning, antenatal and postnatal care, empowerment for children's access to school, and community in terms of education supply. Last, there is still a role of empowerment as an indirect mechanism that permeates through all channels of transmissions lessening education inequality. That is to say that children of EMM with low education and access to health services or poor family planning, for instance, are less likely to suffer in terms of their educational opportunities if their mothers have some degree of empowerment.

We restate the paper's findings in Diagram 2, where we denote by the negative (−) and positive (+) signs the direction of the associations and the lack of association is shown by the symbol (o). Also, the letters *a* and *c* represent access and retention/completion measures, respectively. For example, the diagram illustrates that community location and poverty are negative mediating factors between early married mothers and children's education for access indicators [−a]; for the indicator late entry, early married has larger (positive) effect for sons [++] than for daughters [+].

The diagram also shows that community-level variables are important mediating factors between early marriage and children's educational outcomes. The significance of the community was demonstrated in our paper by the finding that, living in a community with a high prevalence of early marriage, also has an impact on the educational outcomes of children of mothers who do not enter marriage early.

(a) *Policy recommendations and implications for the post-2015 agenda*

Our results underscore the importance of child marriage as one of the critical indicators related to intergenerational education effects in SSA. Target 4.5 under SDG4 (Education quality) makes a call to "eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable", while for SDG5 (Gender equality) target 5.3 states: "eliminate all harmful practices, such as child, early and forced marriage…" (UN, 2015). According to our analysis, the equity target for education will not be achieved unless policies which aim to reduce significantly the incidence of child marriage are introduced and monitored.

As our analysis show, an intermediate step will be to raise the age of marriage among young wives by providing for girls at risk incentives to stay in school (see Baird, McIntosh, & Özler, 2011 for the case of the Zomba Cash Transfer Programme in Malawi). This program deterred girls at higher risk of early marriage through education; girls who were not enrolled in school at baseline were 40 percent less likely to marry after receiving cash transfers conditional upon school enrollment (Lee-Rife *et al.*, 2012). School level and community programmes which focus on the wider intergenerational benefits of completing education and marrying at a later age should also be promoted. In addition, our estimates also show that an important step is to strengthen early married women empowerment to lessen the negative impact of education, health, and community factors as drivers of education inequality transmission.

Indeed, sensitivity to social expectations around early marriage is often due to a lack of empowerment (Bicchieri *et al.*, 2014) and having access to further schooling delaying marriage only works by promoting empowerment (Solanke, 2015). That is why many child marriage programs include empowerment initiative as a primary objective (Malhotra *et al.*, 2011) so that girls can reject it and possibly take the lead in the collective process of change. In a review of 23 programs seeking to address child marriage implemented during 1973–2009, Lee-Rife *et al.* (2012), found that that the strongest programs are those that worked directly with girls to address the multiple drivers of child marriage aiming for sustainable changes. An example of this type of programs is the Berhane

Hewan program in Ethiopia which addressed social norms, girls' lack of status and social capital, barriers to schooling, and economic factors, and which succeeded in reducing very early child marriage among girls aged 10–14 and increase girls' empowerment (Lee-Rife *et al.*, 2012).

All in all, our results advocate for negative cultural practices and norms directed at girls have to be addressed through a combination of campaigns and incentives to ensure vulnerable girls enroll in school and stay on to complete at least a secondary level of education. Governments should work through community leaders and parents/households to raise awareness of the harm that early marriage does to girls in terms of their future prospects and impact on their children's education, as well as through changes to the school curriculum, school processes, and by promoting practices which empower girls and ensure they reach higher levels of education.

NOTES

1. The Convention of the Rights of the Child can be found at: http://www.unicef.org/crc/index_30160.html.

2. Women 's empowerment is a multidimensional concept that it has been alternatively referred as: the power to make choices or the ability to access the components of life (such as education, employment and health care) or the relative position of power within the gender system (see Imai, Kobina Annim, Kulkarni, & Gaiha, 2014, for details).

3. Indeed, our working sample EMM have 1.04 and 0.87 fewer years of education than their counterparts in waves 1 and 2, respectively (see Section 4).

4. Pasquier-Doumer and Risso Brandon (2015), for instance, find that living in rural areas is negatively associated with educational aspirations for indigenous children at age 8 in Peru, and as children become older, there is a pro-boy aspiration in rural areas.

5. The notation closely follows Section 2 of Fafchamps *et al.* (2009).

6. This classification follows CREATE (http://www.create-rpc.org/about/exclusion/) Zones of Exclusion. It consists of six zones: those who will never go to school (Zone 1), those who start but do not finish (Zone 2), and those who do participate but attend infrequently, are overage, and are low achieving (Zone 3); those who fail to transit to secondary school (Zone 4), and those who drop out from secondary (Zone 5), or those who participate and learn little (Zone 6).

7. Using a higher lower bound of the age group for the indicators never been to school and primary completion indicators provides a more stable group as it accounts for children who either may enter or finish later than expected.

8. In a full specification we add more socio-economic controls at the household (wealth, father's occupation, and parental education) and community level (proportion of parents with secondary education). Note that these covariates are potentially endogenous. For instance, household wealth is the current level of household wealth for women aged 30–39 and thus are likely an outcome of the previous marriage decision. That is why these covariates are not used in our main specification, although we include them as further controls in a sensitivity analysis (see Section 5).

9. A key assumption in the matching method is the conditional independence assumption (CIA), which implies that selection into treatment is solely based on observable characteristics. Another key condition is the common support or overlap condition which ensures that for each treated unit there are control units with the same observables: $0 < \Pr(EM_i = 1|X_i) < 1$.

10. A similar criterion for the construction of pseudo panels for pooled DHS data is used by Ziegelhöfer (2014).

11. Estimated densities of the propensity score distributions for different education indicators for treated and untreated girls and boys (available from the authors upon request), reveal major overlap for treated and untreated groups (indicating the possibility of existence of a match) with regions of common support between 0.2 and 0.8. Thus, our models show a satisfactory match by visual observation.

12. It should be noted that some studies find that empowerment indicators based on the DHS do not always lead to better development outcomes (e.g., Upadhyay & Karasek, 2012) and so results for the empowerment channel should be interpreted with this caveat in mind.

13. In 2010, 158 countries had laws establishing the legal age of marriage for women without parental consent as 18, yet in 146 countries laws permit girls to marry younger than 18 with the parental consent or other authorities (Loaiza and Wong, 2012). Thus laws that prohibit child marriage without exceptions are missing in many countries. Also it is estimated that in 74 countries which have reported to the Compulsory Registration Act have not yet set the minimum age for marriage (Right to Education Project, 2013). Another issue is that often the law is avoided as birth certificates are forged by bribed corrupt officials to facilitate child marriages.

14. It is important to note that our analysis does not encounter any common support problem with larger values at either zero or one for conditional densities.

15. We also carry out estimates by SSA regions, not reported due to space constrains. We find that the extent of transmission of inequality is more problematic in Western Africa (WA) as compared to Middle Africa (MA) and Eastern Africa (EA), while in Southern Africa (SA) the effect is null. For example, the negative impact of child marriage is of 0.33 years of schooling in WA while in MA (0.2) and EA (0.14) (wave 2). Full OLS and matching results are available from the authors upon request.

16. For space limitation, we do not report specific covariates' effects. OLS estimations for the whole sample are available from the authors upon request.

REFERENCES

Akyeampong, K. (2009). Revisiting free compulsory universal basic education (FCUBE) in Ghana. *Comparative Education, 45*(2), 175–195.

Akyeampong, A., Lussier, K., Pryor, J., & Westbrook, J. (2012). Improving teaching and learning of basic maths and reading in Africa: does teacher preparation count?. *International Journal of Educational Development, 33*(3), 272–282, ISSN 0738-0593.

Akyeampong, A. K. (2005). Extending basic education to out-of-school children in northern Ghana: What can multi-grade schooling teach us?.

In A. W. Little (Ed.), *Education for all and multigrade teaching - challenges and opportunities* (pp. 215–238). Netherlands: Springer.
Arestoff, F., & Elodie Djemai, E. (2016). Women's empowerment across the life cycle and generations: Evidence from Sub-Saharan Africa. *World Development, 87*, 70–87.
Baird, S., McIntosh, C., & Özler, B. (2011). Cash or condition? Evidence from a randomized cash transfer program. *Quarterly Journal of Economics, 126*(4), 1709–1753.
Bang, H., & Robins, J. (2005). Doubly robust estimation in missing data and causal inference models. *Biometrics, 61*, 962–973.
Bayisenge, J. (2010). Early marriage as a barrier to girl's education: A developmental challenge in Africa. In C. Ikekeonwu (Ed.), *Girl-child education in Africa* (pp. 43–66). Nigeria: Catholic Institute for Development, Justice & Peace (CIDJAP) Press.
Becker, G., & Tomes, N. (1986). Human capital and the rise and fall of families. *Journal of Labor Economics, 4*(3), S1–S39.
Behrman, J., Pollak, A., & Taubman, P. (1995). The Wealth Model: Efficiency in Education and Distribution in the Family. In J. R. Behrman, R. A. Pollak, & P. Taubman (Eds.), *From parent to child: Intrahousehold allocations and intergenerational relations in the United States*. Chicago: University of Chicago Press.
Black, S., & Devereux, P. (2011). Recent developments in intergenerational mobility. In A. Orley, & D. Card (Eds.). *Handbook of labor economics* (Vol. 4B, pp. 1487–1541). Amsterdam: Elsevier.
Bicchieri, C., Jiang, T., & Lindemans, J. (2014). A Social Norms Perspective on Child Marriage: The General Framework. Behavioral Ethics Lab, University of Pennsylvania, unpublished draft.
Bicchieri, C., & Mercier, H. (2014). Norms and beliefs: How change occurs. *Iyyun: The Jerusalem Philosophical Quarterly, 63*, Reprinted in:B. Edmonds (Ed.). *The complexity of social norms*. Springer.
Carmichael, S. (2011). Marriage and power: Age at first marriage and spousal age gap in lesser developed countries. *The History of the Family, 16*(4), 416–436.
Cattaneo, M. (2010). Efficient semiparametric estimation of multi-valued treatment effects under ignorability. *Journal of Econometrics, 155*, 138–154.
Chan, W. (2014). Marital transfers and the welfare of women. *Oxford Economic Papers, 66*, 1019–1041.
Chevalier, A., Denny, K., & McMahon, D. (2009). A multi-country study of inter-generational educational mobility. In P. Dolton, R. Asplundh, & E. Barth (Eds.), *Education and inequality across Europe*. London: Edward Elgar.
Chiappori, P.-A. (1997). Collective models of household behavior: The sharing rule approach. In L. Haddad, J. Hoddinott, & H. Alderman (Eds.), *Intrahousehold resource allocation in developing countries: Methods, models and policy* (pp. 39–52). Washington, DC: IFPRI.
Chiappori, P.-A., Fortin, B., & Lacroix, G. (2002). Marriage market, divorce legislation, and household labor supply. *Journal of Political Economy, 110*, 37–72.
Colclough, Ch., Rose, P., & Tembon, M. (2000). Gender inequalities in primary schooling: The roles of poverty and adverse cultural practice. *International Journal of Educational Development, 20*, 5–27.
Cooray, A., & Potrafke, N. (2011). Gender inequality in education: Political institutions or culture and religion?. *European Journal of Political Economy, 27*, 268–280.
Dalal, K. (2011). Does economic empowerment protect women from intimate partner violence?. *Journal of Injury and Violence Research, 3*(1), 35–44.
Deaton, A. (1985). Panel data from time series of cross-sections. *Journal of Econometrics, 30*(1–2), 109–126.
Delprato, M., Akyeampong, K., Sabates, R., & Hernandez-Fernandez, J. (2015). On the impact of early marriage on schooling outcomes in Sub-Saharan Africa and South West Asia. *International Journal of Educational Development, 44*, 42–55.
Duflo, E. (2012). Women empowerment and economic development. *Journal of Economic Literature, 50*(4), 1051–1079.
Duflo, E., Dupas, P., & Kremer, M. (2014). Education, HIV, and early fertility: Experimental evidence from Kenya, *NBER Working Paper No. 20784*.
Durrant, V., & Sathar, Z. (2000). *Greater investments in children through women's empowerment: A key to demographic change in Pakistan?*, Policy Research Division Working Papers No. 137. New York: Population Council.
Erulkar, A. (2013). Very early marriage, marital relations and intimate partner violence in Ethiopia. *International Perspectives on Sexual and Reproductive Health, 39*(1), 6–13.
Genicot, G., & Ray, D. (2014). Aspirations and inequality. *NBER working papers 19976*.
Glick, P. (2008). What policies will reduce gender schooling gaps in developing countries: Evidence and interpretation. *World Development, 36*(9), 1623–1646.
Glick, P., & Sahn, D. (2006). The demand for primary schooling in Madagascar: Price, quality, and the choice between public and private providers. *Journal of Development Economics, 79*, 118–145.
Godha, D., Hotchkiss, D., & Gage, A. (2013). Association between child marriage and reproductive health outcomes and service utilization: A multi-country study from South Asia. *Journal of Adolescent Health, 52*(5), 552–558.
Guilbert, N. (2013). Early wedding, women empowerment and child mortality: Married too young to be a "Good mother"? DIAL *working paper 2013-05*.
Fafchamps, M., Kebede, B., & Quisumbing, A. (2009). Intra-household welfare in rural Ethiopia. *Oxford Bulletin of Economics and Statistics, 71*(4), 567–599.
Field, E., & Ambrus, A. (2008). Early marriage, age of menarche, and female schooling attainment in Bangladesh. *Journal of Political Economy, 116*(5), 881–930.
Haveman, R., & Wolfe, B. (1994). *Succeeding generations: On the effects of investments in children*. New York: Russell Sage Foundation.
Hiller, V. (2014). Gender inequality, endogenous cultural norms and economic development. *Scandinavian Journal of Economics, 116*, 455-48.
Huisman, K., & Smits, J. (2009). Effects of household- and district-level factors on primary school enrollment in 30 developing countries. *World Development, 37*(1), 179–193.
Imai, K., Kobina Annim, S., Kulkarni, V., & Gaiha, R. (2014). Women's empowerment and prevalence of stunted and underweight children in rural India. *World Development, 62*, 88–105.
Jensen, R., & Thornton, R. (2003). Early female marriage in the developing world. *Gender and Development, 11*(2), 9–19.
Khanna, T., Verma, R., & Weiss, E. (2013). *Child marriage in South Asia: Realities, responses and the way forward*. ICRW Publications.
Larsson, C., & Stanfors, M. (2014). Women's education, empowerment, and contraceptive use in Sub-Saharan Africa: Findings from recent demographic and health surveys. *African Population Studies, 28*(2), 1022–1034.
Lee-Rife, S., Malhotra, A., Warner, A., & McGonagle Glinski, A. (2012). What works to prevent child marriage: A review of the evidence. *Studies in Family Planning, 43*(4), 287–303.
LeVine, R., LeVine, S., Schnell-Anzola, B., Rowe, M., & Dexter, E. (2011). *Literacy and mothering: How women's schooling changes the lives of the world's children*. London: Oxford University Press.
Lewin, K. (2009). Access to education in Sub-Saharan Africa: patterns, problems and possibilities. *Comparative Education, 45*(2), 151–174.
Lincove, J. (2015). Improving identification of demand-side obstacles to schooling: findings from revealed and stated preference models in two SSA countries. *World Development, 66*, 69–83.
Loaiza, E., & Wong, S. (2012). *Marrying too young: End child marriage*. United Nations Population Fund [UNFPA].
Longwe, A., & Smits, J. (2012). Family planning outcomes and primary school attendance in Sub-Saharan Africa. *Studies in Family Planning, 43*(2), 127–134.
Lloyd, C., & Mensch, B. (2008). Marriage and childbirth as factors in dropping out from school: An analysis of DHS data from Sub-Saharan Africa. *Population Studies, 62*(1), 1–13.
Malhotra, A., Warner, A., McGonagle, A., & Lee-Rife, S. (2011). *Solutions to end child marriage. What the evidence shows*. Washington, DC: ICRW.
Maertens, A. & Chari, A. (2012). Learning your child's price: Evidence from subjective dowry data in rural India. *Working paper*.
Maertens, A. (2013). Social norms and aspirations: Age of marriage and education in Rural India. *World Development, 47*, 1–15.
Measure DHS (2013a). *DHS overview*. Calverton, MD, USA: ICF Macro, http://www.measuredhs.com/What-We-Do/Survey-Types/DHS.cfm (Accessed 14 November 2014).
Measure, D. H. S. (2013b). *Data collection*. Calverton, MD, USA: ICF Macro, http://www.measuredhs.com/data/data-collection.cfm (Accessed 14 November 2014).

Morrisson, C., & Jütting, J. (2005). Women's discrimination in developing countries: A new data set for better policies. *World Development, 33*, 1065–1081.
Murphy-Graham, E. (2010). And when she comes home? Education and women's empowerment in intimate relationships. *International Journal of Educational Development, 30*(3), 320–331.
Nishimura, M., & Yamano, T. (2013). Emerging private education in Africa: Determinants of school choice in rural Kenya. *World Development, 43*(1), 266–275.
Park, C. (2007). Marriage market, parents' bargaining powers and child nutritional and education. *Oxford Bulletin of Economics and Statistics, 69*(6), 773–793.
Pasquier-Doumer, L., & Risso Brandon, F. (2015). Aspiration failure: A poverty trap for indigenous children in Peru?. *World Development, 72*, 208–223.
Raj, A., & Boehmer, U. (2013). Girl child marriage and its association with national rates of HIV, maternal health, and infant mortality across 97 countries. *Violence Against Women, 19*(4), 536–551.
Right to Education Project (2013). The Minimum Age for Marriage Available at (http://www.right-to-education.org/node/58).
Rosenbaum, P., & Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika, 70*, 41–55.
Schoumaker, B. (2012). A Stata module for computing fertility rates and TFRs from birth histories: tfr2. *Demographic Research, 28*, Article 38.
Singh, L., Rai, R., & Singh, P. (2012). Assessing the utilization of maternal and child health care among married adolescent women: Evidence from India. *Journal of Biosocial Science, 44*(1), 1–26.
Singh, A., Kumar, A., & Pranjali, P. (2014). Utilization of maternal healthcare among adolescent mothers in urban India: evidence from DLHS-3. *PeerJ, 2*, e592.
Solanke, B. (2015). Marriage age, fertility behavior, and women's empowerment in Nigeria. *SAGE Open, October-December, 2015*, 1–9.
Srinivas, M. N. (2000). *Social change in modern India*. New Delhi: Orient Longman India.
UN (2015). Open Working Group proposal for Sustainable Development Goals. https://sustainabledevelopment.un.org/.
UNESCO (2014). *EFA global monitoring report 2013/4: Teaching and learning: Achieving quality for all gender summary*. Paris: UNESCO.
UNIFPA (2006). In ending child marriage, a guide for global policy action. International Planned Parenthood Federation and the Forum on Marriage and the Rights of Women and Girls, UK.
UNICEF (2014). Ending child marriage. Progress and prospects.
Upadhyay, U., & Karasek, D. (2012). Women's empowerment and ideal family size: An examination of DHS empowerment measures in Sub-Saharan Africa. *International Perspectives on Sexual and Reproductive Health, 38*(2), 78–89.
Uthman, O., Lawoko, S., & Moradi, T. (2010). The role of individual, community and societal gender inequality in forming women's attitudes toward intimate-partner violence against women: a multilevel analysis. *World Health Population, 12*(2), 5–17.
Verbeek, M., & Nijman, T. (1992). Can cohort data be treated as genuine panel data?. *Empirical Economics, 17*, 9–23.
Walker, J. (2012). Early marriage in Africa—Trends, Harmful effects and interventions. *African Journal of Reproductive Health, 16*(2), 231–240.
Wang, L. (2011). *Shrinking classroom age variance raises student achievement: Evidence from developing countries*, Policy Research Working Paper, 5527. Washington, DC: World Bank.
Warunsiri, S., & McNown, R. (2010). The returns to education in Thailand: A pseudo-panel approach. *World Development, 38*(11), 1616–1625.
Webbink, E., Smits, J., & De Jong, E. (2012). Hidden child labor: determinants of housework and family business work of children in 16 developing countries'. *World Development, 40*(3), 631–642.
Wils, A. (2004). Late entrants leave school earlier: Evidence from Mozambique. *International Review of Education, 50*(1), 17–37.
Wooldridge, J. (2010). *Econometric analysis of cross section and panel data* (2nd ed) Cambridge, MA: MIT Press.
World Bank (2011). *World development report 2012 — Gender equality and development*. Washington, DC.
Ziegelhöfer (2014). *Food prices and household welfare: A pseudo panel approach*. Working paper.