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Adolescent Brides and Grooms' Education: Theory and Evidence

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Abstract

Public policy addressing the harmful practice of adolescent marriage tends to leave out men, as prospective grooms. Using micro-level data from Nigeria in combination with plausible instrumental variables, we find that a male's education significantly decreases the likelihood that he marries an adolescent girl. We show that this negative relationship is not a mere mechanical effect reflecting the endogeneity between schooling and marriage-timing decisions, and that it is stronger where patriarchal gender norms are weaker. We develop a model that explains this causal effect as resulting from the complementarity between father's and mother's education in the production of child quality.

Keywords: Adolescent Marriage; Groom Education; Quantity-Quality Trade-off.

JEL Classification: C12, C13, C14, J12, J13, O12.

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1 Introduction

The marriage of adolescent girls is a global scourge, but its prevalence is highest in the developing world. It is estimated that one in three adolescent girls living in the developing world is married before the age of 18 (UNFPA 2012). In absolute terms, these are very high numbers. For India the figure is 26.6 million adolescent brides; 3.9 million for Bangladesh, and 3.3 million in Nigeria. Public policy addressing this issue emphasizes public investment in girls' education as a promising avenue for ending this harmful practice (e.g.,Field and Ambrus (2008)). A country's success at applying this policy prescription, however, may hinge on it winning political support from men, as prospective grooms. Yet, while virtually all countries have laws mandating a minimum age at marriage for females, lack of enforcement of these laws in developing countries is seen as tantamount to males' opposition, as prospective grooms, to the elimination of adolescent marriage. Consider, for instance, an uneducated prospective groom, and suppose he derives more pecuniary benefits from quantity, than from quality, of offspring. Since more educated females tend to have a higher opportunity cost of childbearing (Becker, 1981), this fact will tend to bias the uneducated prospective groom's choice of bride type in favor of a less educated bride. Hence his incentive to oppose female education– so as to maximize his chances of achieving his desired fertility. But what evidence exists about the effect of a male's level of education on his choice of bride type? The answer to this question is what motivates this paper.

The key idea motivating this analysis is that educated males are more likely to want educated offspring. To the extent that marriage is entered into primarily for reproductive purposes, and paternal and maternal education are complementary in enhancing children's cognitive development, males with more years of schooling are also more likely to marry educated females, and thus may support school enrolment for girls. In a sense, therefore, public investment in boys' education today may, in the long run when these educated boys become prospective grooms themselves, represent a promising avenue for ending adolescent marriage. Casual macro-level evidence drawn from Figure 1 below lends support to this idea. Figure 1 reveals a negative association between average years of schooling completed among males and the proportion of adolescent brides for a sample of African countries.

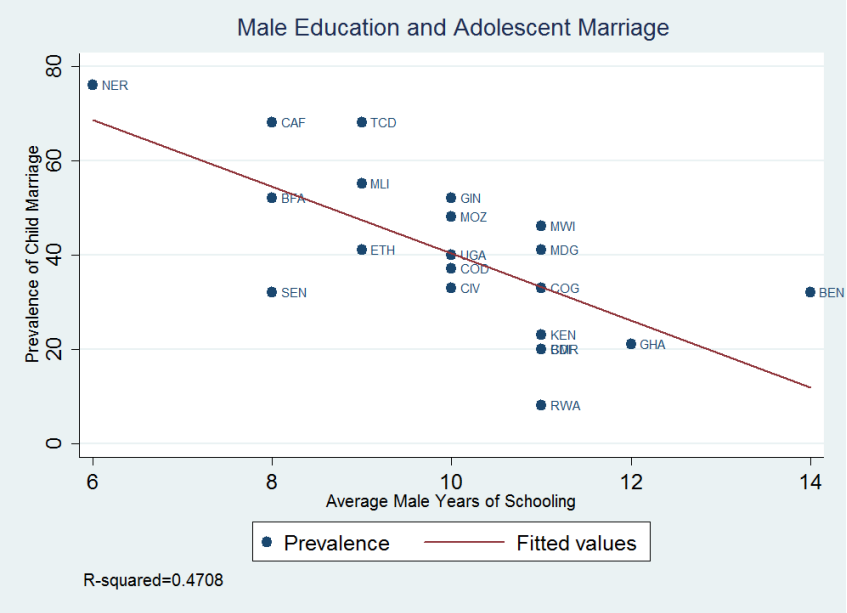

Figure 1: Male education and the prevalence of adolescent marriage

Figure 1 shows that the proportion of adolescent brides is lower in countries where the average number of years of schooling completed is higher for males. This negative correlation suggests that education promotes a shift away from conservative gender norms that cast women and girls in submissive positions relative to boys and men (Jones et al., 2014). But what micro-level evidence exists about the effect of schooling on the likelihood that a male marries an adolescent girl? Our empirical analysis answers this question using micro-level data from Nigeria. Casual micro-level evidence shown in Figure 2 below suggests that, in Nigeria, the proportion of males married to adolescent girls is higher among the less educated.

However, critics may argue that there is no a priori reason to believe that this negative association reflects the direct effect of education. Indeed, it may be seen as a mere mechanical effect reflecting the endogeneity between education and marriage-timing decisions. In particular, because a male with no schooling may marry young, he may end up picking an adolescent bride, not because he lacks education, but simply because he married early. Likewise, a more educated male may marry an older bride, not because he has more years of schooling, but because completing many years of schooling forces him to delay participation in the marriage market. To identify the direct effect of schooling on the probability that a male marries an adolescent bride thus requires that we rule out the above-mentioned

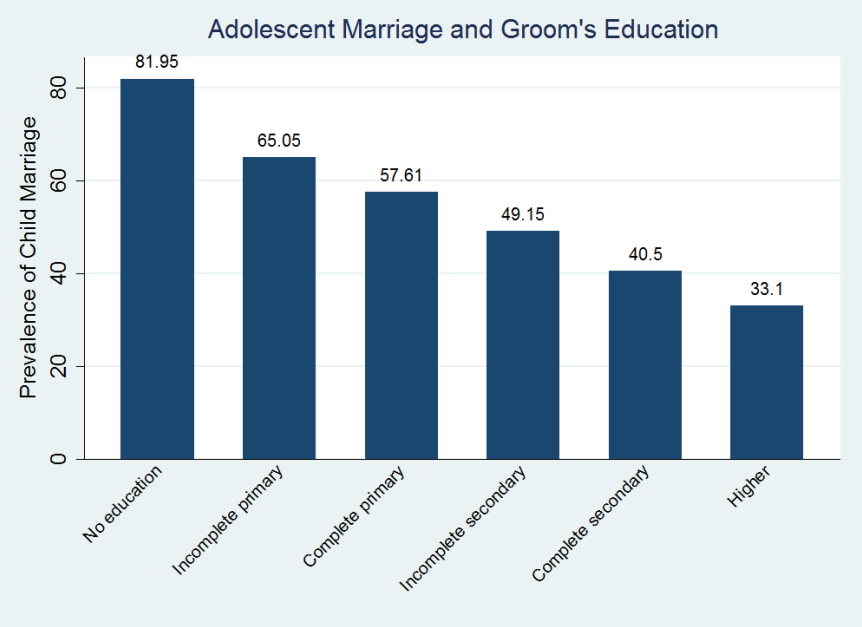

Figure 2: Proportion of men married to adolescent girls by education in Nigeria

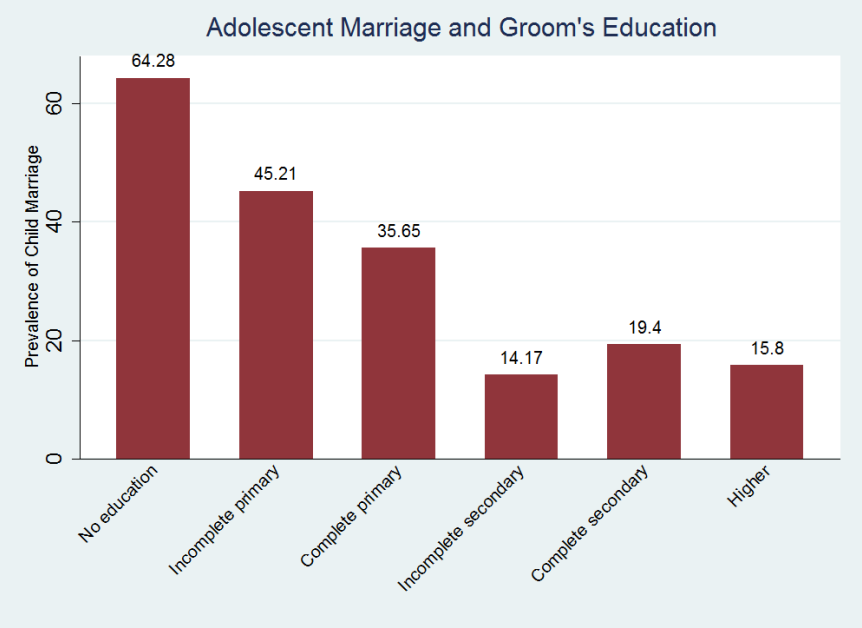

Figure 3: Proportion of men married to adolescent girls by education among men whose age at marriage was 30 or higher in Nigeria

mechanical effect. Figure 3 above, built from Figure 2 by excluding from our sample all males married before the age of 30, provides a glimpse of the impact of controlling for this mechanical effect. This figure reports the proportion of married males whose wives were adolescent at the time of marriage, by levels of educational attainment, and for a subset of

males aged 30 or higher at marriage. Excluding from this sample all males married before the age of 30 allows us to restrict attention only to those whose levels of education are more likely to be exogenous to their marriage-timing. Interestingly, the resulting sub-sample of married males still exhibits a significant degree of heterogeneity with respect to completed years of schooling, even though they all got married after they turned 30. As shown in Figure 3, the strong negative association persists whereby the proportion of males whose wives were adolescent at the time of marriage is lower among the more educated. This descriptive finding motivates our formal investigation and identification of the causal effect of schooling on the probability that a male marries an adolescent girl.

Estimates from ordinary least squares (OLS) regressions show that an additional year of education decreases the probability that a man marries an adolescent girl by more than 3 percentage points. This effect is robust to controlling for a male's age, his religious affiliation, region of residence, area of residence (urban vs. rural), and professional activity. We also control for other potential confounders including the husband's age at marriage, and the proportion of his older co-ethnics living in his neighbourhood who married adolescent girls. As argued above, controlling for the groom's age at marriage eliminates the possibility that the estimated effect of his level of education is driven by the above-mentioned mechanical effect. Furthermore, controlling for the proportion of older co-ethnics who married adolescent girls is important because they are more likely to have a vested interest in the preservation of patriarchal gender norms that support the institution of adolescent bridehood, and thus may influence the bride choices of younger male cohorts. Despite these controls, we still find that less educated males tend to marry adolescent girls.

However, our OLS regressions suffer from three potential endogeneity issues. First, in a context where marrying early is becoming more stigmatized, female respondents in a survey might overreport their age at first marriage, for fear of a backlash. Even though, in our regressions, a female's age at marriage is not an independent variable of interest, it remains that females most likely to misreport their age at first marriage may be those married to less educated males, in which case we have an attenuation bias. Second, a male's ability is likely to determine simultaneously his level of education and the age of his bride at mar-

riage. Since ability is unobserved in our dataset, this likely creates an omitted variable bias problem. Indeed, if ability positively affects education and negatively affects the probability of marrying an adolescent girl, then not controlling for this variable may lead to another downward bias. Finally, a male's level of education and the age of his bride at marriage are potentially jointly determined, as a result of the fact that his bride's age at marriage and his own level of education and marriage-timing may all be jointly determined.

For identification therefore, we propose two instruments for male education. The first instrument is the average level of education of older male co-ethnics (5 years older or higher) living in the same neighborhood. The validity of the first stage regression relies on the theory of human capital externalities according to which the level of education of older cohorts has a positive effect on the education of younger cohorts (e.g., Borjas (1992), Wantchekon et al. (2015), and Dev et al. (2016)). Moreover, even though, as for younger males, the education of older males might be determined by unobserved ability, this does not compromise the validity of the first stage regression, which only requires that the instrument and the regressor of interest be correlated. However, for the exclusion restriction condition, the use of this instrument raises a potential issue. Indeed, if older co-ethnics themselves married adolescent girls, they may use ethnic tradition and/or customs to directly affects the probability that younger male co-ethnics marry adolescent girls –the dependent variable of interest. One reason for them to act in this way is that they may have a vested interest in the persistence of patriarchal gender norms that cast females in submissive roles relative to males. In order to ensure that this instrument satisfies the exclusion restriction condition, we directly control for the proportion of male co-ethnics whose brides were adolescent at the time of marriage.

The second instrument is the average number of years of schooling completed among older males (5 years older or higher) from other ethnic groups living in the same neighborhood. As in the case of the first instrument, the validity of the first stage regression is supported by the theory of human capital externality. Indeed, Dev et al. (2016) show that human capital externalities flowing from older cohorts to younger ones, though stronger within a given ethnic network, also extend to younger cohorts outside this network. Our interest in this second instrument stems from the fact that, unlike the first, it is unlikely to have a direct

effect on the dependent variable in our setting. The reason is that, in Nigeria, a country where individuals are mostly accountable to their own ethnic group for the life choices they make, there is no clear normative mechanism through which older males from one ethnic group can influence the type of bride (adolescent or legal-age) a younger male from another ethnic group can have.

Consistent with the above discussion, we follow a two-step strategy for applying our IV approach. First, we use each IV separately in our estimations, then use them simultaneously in the same regressions. For each IV, compared to OLS estimates, we find a stronger negative relationship between schooling and the likelihood that a male marries an adolescent girl. Interestingly, this effect is stronger when estimated using the second IV. Even when we combine both IV in the same regressions, we still find a strong negative effect of schooling.

We also perform a number of robustness checks to account for sources of heterogeneity in the effect of male education, and to rule out the operation of a possible mechanical effect. To account for potential sources of heterogeneity, we estimate the effect of schooling on the probability that a male marries an adolescent girl, by distinguishing between the northern and southern regions of Nigeria, and between urban and rural areas. What motivates this sensitivity analysis is the possibility of regional heterogeneity in the relative strength of patriarchal gender norms underpinning females' marriage-timing. Since norms and customs tend to be more binding in close-knit communities, such as ethnic groups, castes (Akerlof, 1976), and rural communities, it is important to investigate the potential implications of this source of heterogeneity for the effect of male education. Moreover, different social groups, communities, or regions may have different marriage customs, e.g., castes in India (Akerlof, 1976). These differences in turn may result in ethnic-based, regional, or community-based disparities in the degrees of entrenchment of patriarchal gender norms. Therefore, testing for regional differences as a source of heterogeneity offers the opportunity to detect the effects of socio-cultural beliefs and practices of which patriarchal gender norms are an important component. Estimation results show a stronger effect of male education in the South than in the North, and in urban than in rural areas.

We then develop a simple model of a groom's decision on the age of his bride at marriage

to uncover the theoretical mechanism underlying this negative causal effect. In this model, marriage is entered into primarily for the purpose of reproduction. This assumption is supported by empirical evidence in the context of sub-Saharan Africa (e.g., Thomas et al. (1991); Leigh and Gong (2010)). Reproduction generates a surplus, which is a composite of quantity and quality of offspring. As in Becker et al. (1990), parental investment in offspring exhibits a quantity-quality trade-off, owing to the fact that both quantity and quality are costly, and parents have limited resources. Moreover, maternal and paternal education are strategic complements in the production of child quality. This strategic complementarity causes production of child quality to be more cost-effective when both spouses are sufficiently educated. Consistent with the existing literature on the effect of adolescent marriage on girls' education (e.g., Field and Ambrus (2008)), we take a female's age at first marriage as a proxy for her level of education. In this context, a typical prospective groom's problem thus is to maximize his marital surplus by his choice of bride's age, quantity, and quality, of offspring. We show that if this strategic complementarity is sufficiently strong, then the bride's age at marriage becomes increasing in her groom's level of education.

We provide empirical evidence supporting this mechanism. More precisely, we test for the interactions between the strategic complementarity of father's and mother's education and the quantity-quality trade-off underlying parental investment in children. As argued above, together these factors comprise the mechanism underpinning the negative effect of a prospective groom's level of education on the age of his bride at marriage. We effectively find that the interacting effect of the father's and mother's education is negative for the number of children they have, and positive for the level of education of these children. These results are corroborated by an additional analysis showing that the interacting effect of a groom's level of education with whether his bride was an adolescent at the time of marriage is negative for the number of children they have and positive for the quality of these children. Overall, these findings suggest that a marriage involving an adolescent bride leads to more quantity, and less quality, of offspring. Because more educated males are likely to want better educated offspring, this biases their choice of bride in favor of legal-age brides.

This study contributes to the broader literature linking the social outcomes of adolescent

girls and women to their interactions with men as fathers and husbands. Field and Ambrus (2008) provides empirical evidence in the context of Bangladesh that adolescent marriage reduces female education, and argue for the enforcement of laws implementing a legal age of marriage consent. Jacoby and Mansuri (2010) find evidence that, while not a first-best solution, the *Watta Satta* traditional marriage institution in rural Pakistan which consists of bartering a bride for a bride between two families, was an effective protection for married women against domestic violence. Ashraf et al. (2014) provide evidence from Zambia that females' adoption of contraceptives is constrained by males' attitude and behaviors. Duflo et al. (2015) conduct a randomized evaluation involving 328 schools in Western Kenya to contrast the performances of alternative public policies aimed at enhancing girls' education, and highlight adolescent marriage as an important constraint to female education. We build around this literature by exploring factors that may alter prospective grooms' attitudes toward adolescent girls' marriage.

The remainder of the paper is organized as follows. Section 2 describes the data and outlines our empirical strategy. Section 3 presents estimation results. Section 4 presents a theoretical model that explains the mechanism underpinning the negative association between a male's level of schooling and the age of his bride at marriage. Section 5 provides empirical evidence supporting this mechanism. Section 6 concludes the paper.

2 Data and Empirical Strategy

This section describes the data we use to analyze the causal effect of schooling on the likelihood that a male marries an adolescent girl. It also outlines our empirical strategy.

2.1 Data Description

To examine the causal relationship between a male's level of education and the likelihood that he marries an adolescent girl, we use DHS data from Nigeria. We use a sample of 8,658 couples (married or living together man and woman). The choice of Nigeria as the setting of

our empirical analysis is appropriate because, with a proportion of 43%, this country ranks 13th in the World among countries with the highest proportion of women aged $20-24$ who married before age 18 –the legal age for marriage consent. In absolute terms, this represents $3,306,000$ women, ranking Nigeria 3rd in the World, behind India with $26,610,000$ women affected, and Bangladesh with $3,931,000$[1].

We use the Couple's Recode (CR) dataset. The Couple Recode dataset contains information on pairs of individuals (male and female) who are either married or are cohabiting in a union Information is collected on their demographic and socioeconomic characteristics. We also have information on the age at first marriage. We use this information to define a dummy variable equal to 1 if a female married before the age of 18. Therefore, a couple is considered to have experienced adolescent marriage if the female partner was younger than 18 years of age at the time the couple was formed. The outcome variable we analyze is the couple's adolescent marriage status. Our main independent variable is the husband's level of education.

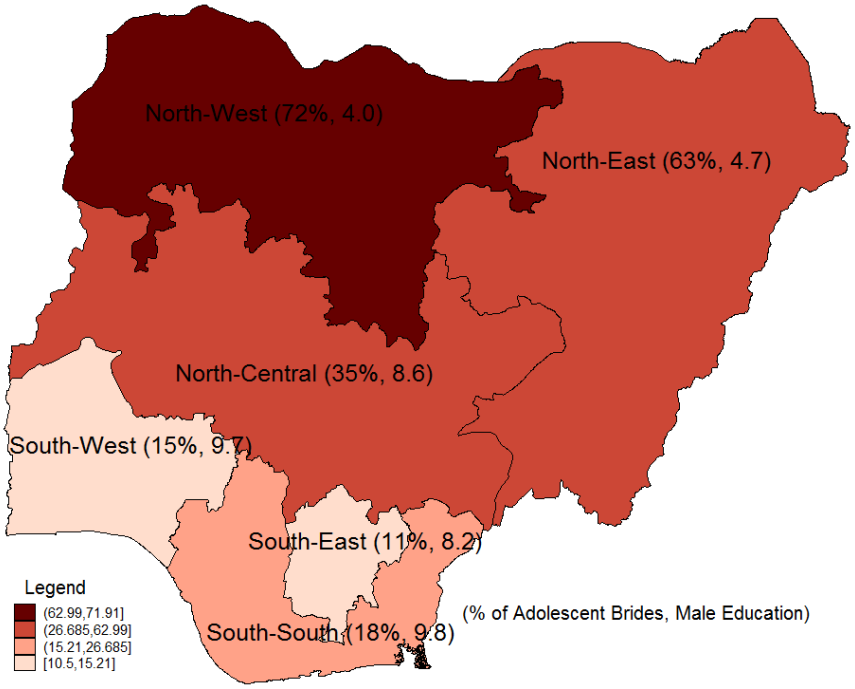

Figure 4: Geographic distribution of average males' schooling and prevalence rates of adolescent brides in Nigeria

[1]UNICEF, State of the World's Children, 2016

Nigeria displays large significant cross-regional disparities both in the average number of years of schooling completed by males and in the prevalence of adolescent marriage (Figure 4). The North-West region is the most affected by adolescent marriage, and is also the region where the average number of years of schooling completed is lowest among males. The South-East and the South-South regions are the least affected (11% and 18% respectively) and are also characterized by higher levels of schooling in average among males (8.2 and 9.8 respectively)

Table 1 below presents additional summary statistics. It shows that 59.4% of females were married before age 18. Nearly 82% of males with no education married adolescent girls. Among males with primary education, the percentage of those who married adolescent girls decreases slightly to 61%. This figure decreases further to 44% among males with secondary education.

2.2 Identification Strategies

The analysis uses two identification strategies. First, we rely on a baseline strategy that uses least squares regression. Then we resort to the instrumental variables approach as a second identification strategy. We complement this two-stage empirical analysis with a series of sensitivity analyses and robustness checks to account for regional heterogeneity as well as to control for a potential mechanical effect which may govern the association between a male's level education and the probability that he marries an underage girl.

2.2.1 OLS Estimation

We start by estimating the following linear probability model (LPM) over the sample of Nigerian males married to females aged 15 - 49.

$$y_i = \beta_0 + \beta_1 E_i + \beta_2 X_i + \epsilon_i \tag{1}$$

where y_i is individual i's bride type (equal 1 if individual i's wife was under 18 at marriage,

and 0 otherwise), E_i is the number of years of education attained by individual i, and X_i is a vector which includes the following controls: man i's age at first marriage, religion, individual i's professional occupation, a dummy variable indicating whether individual i resides in a rural area, a dummy variable indicating whether individual i resides in northern region, sex ratio to capture the effect of supply of brides relative to grooms. We use heteroskedasticity robust standard errors when estimating the linear probability model to deal with the issues of the violation of the homoskedasticity and normality of errors assumptions.

2.2.2 IV Estimation

As acknowledged in the Introduction, our baseline regressions have potential endogeneity issues. The main challenges confronting our identification of the causal effect of schooling on the likelihood that a male marries an adolescent girl are the potential issues of measurement errors, omitted variables bias, and joint determination. First, With adolescent marriage becoming increasingly decried worldwide, female respondents in surveys may overreport their age at marriage, for fear of a backlash. Since underage girls tend to marry less educated males, as shown in our sample, measurement errors in brides, age at marriage may lead to an attenuation bias. Second, a male's ability is likely to determine simultaneously his level of education and his choice of a bride type. Since ability is unobserved in our dataset, we have an omitted variable bias. If ability has a positive effect on the acquisition of human capital and a negative effect on the probability of marrying an underage girl, then not controlling for this variable may result in another source of downward bias. Third, a male's marriage-timing and the age of his bride at marriage may be jointly determined. In fact, in developing countries, marriage exhibits a significant age-gap between the groom and his bride, with the former being a number of years older than the latter. For example, from our dataset, we find evidence showing that in Nigeria, the groom is on average 7 years older than his bride. In this context, because less educated males–those who quit school early–are likely to marry young, to comply with the 7-year age-gap, they are more likely to marry adolescent girls. This suggests that a male's level of education and the age of his bride at marriage may be jointly determined through the potential correlation of education with marriage-timing.

To resolve these potential endogeneity issues, we use two instrumental variables for male education. The instrumental variables method involves estimating a two-stage model in which the second stage consists of estimating equation (1) , while the first stage consists of estimating the following equation:

$$E_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 X_i + \nu_i \tag{2}$$

In equation (2), Z_i is the vector of instruments, Xi is the vector of control variables as in equation (1).

The first instrument is the average level of education of older male co-ethnics (5 years older or more) living in the same neighborhood. The second instrument is the average level of education of older male cohorts (5 years older or more) from other ethnic groups living in the same neighborhood. As discussed in the Introduction, these instruments are justified because of human capital externalities flowing from older to younger cohorts (e.g., Borjas (1992), Wantchekon et al. (2015), and Dev et al. (2016)). But a potential issue with this first instrument for exclusion restrictions is that the education of the older cohorts (if married themselves) might be correlated with their own choice of bride's age at marriage, which in turn, may influence younger male cohorts' choices of bride's age at marriage. In other words, if older male co-ethnics are uneducated themselves, and married adolescent girls, they may have a vested interest in the persistence of conservative norms that cast women in submissive roles relative to men, and thus may exert pressure on the younger male cohorts to preserve these patriarchal gender norms by marrying adolescent girls. We argue that controlling for the proportion of older male co-ethnics who married adolescent girls assuages this issue.

Our second instrument for male education is the average level of education of older male cohorts (5 years older or higher) from other ethnic groups living in the same neighborhood. Our interest in this instrument stems from the fact that, unlike in the case of the first instrument, there is no clear normative mechanism through which older male cohorts from one ethnic group can influence whether or not a younger male from another ethnic group marries an adolescent girl. In fact, in many ethnically diverse countries such as those from

sub-Saharan Africa, ethnic identities are strong predictors of attitudes and behaviors, making it less likely for individuals from different ethnic groups to have the same attitudes or behaviors in relation to marriage.

We estimate the causal effect of schooling on the likelihood that a male marries an adolescent girl using each instrument separately, then using them simultaneously. This effect is estimated using two-stage least squares (2SLS). To provide additional evidence for the validity of our instrumental variable strategy, we undertake three statistical tests: (i) the *Hausman* exogeneity test to test the null hypothesis of exogeneity of the men's level of education in the demand for child brides equation; (ii) the *Sargan* test for overidentification of the two instruments when we use them simultaneously; and (iii) the *Stock-Yogo* test, which tests weak identification.

3 Estimation Results

In this section, we report our estimates contrasting baseline estimates with those obtained using the instrumental variables approach.

3.1 OLS Estimates

We begin the analysis by first reporting the OLS estimates of Equation (1). These estimates are reported in Table 3. Column (I) of Table 3 reports estimates with controls. It shows that each additional year of schooling for a male reduces the probability that he marries an adolescent girl by 3 percentage points. Column (II) controls for a male's religious affiliation, region of residence (North vs. South) and area of residence (rural vs. urban). This causes the figure reported in Column (I) to fall by roughly half, but the effect remains significant. In addition, we find that being affiliated with the Muslim faith increases the probability of marrying an adolescent girl by 18 percentage points in comparison to other religious affiliations. We also find that living in the northern region of Nigeria increases this probability by 20 percentage points, while living in the rural area increases it by 12 percentage points.

Column (III), in addition to controlling for variables in column (II), controls for the influence of the proportion of older co-ethnics who married adolescent girls on the younger cohorts bride choice. We find that an additional point increase in the proportion of older co-ethnics who married adolescent girls is associated with an increase in the probability that a male marries an adolescent girl by 38 percentage points. This effect reflects the tendency for younger male cohorts to conform to existing gender norms regulating marriage. However, we do not find that controlling for that variable significantly affects the coefficient on male education. This suggests that the above-mentioned mechanical effect we were concerned about is not present in our setting, which is reassuring.

In addition to controlling for variables in column (III), Column (IV) also controls for the current age of males in our sample, as well as their age at first marriage. Results indicate that each additional year of delay in marrying is associated with a decrease in the probability that a male marries an adolescent girl by 2 percentage points. We also uncover a slow decline in the practice of adolescent marriage from one generation of males to the next. Indeed, we find that increasing a male's age by one additional year is associated with an increase in the probability that he marries an adolescent girl by 0.3 percentage points.

Finally, column (V) controls for a proxy of the supply of adolescent brides in the community, and for males' professional activities. We use the male/female sex ratio as a proxy of the supply of adolescent brides. We find that an additional percentage point increase in the male/female sex ratio is associated with an increase in the probability that a male marries an adolescent girl by 1.6 percentage points. This result implies that, in a community where the supply of adolescent brides is high, more males tend to marry adolescent girls.

In order to explore the effect of a male's pre-marital income on the probability of marrying an adolescent girl, we use a proxy for the groom's pre-marital income, because pre-marital income is not observed in the data. The strategy we employ is to use professional occupation as a proxy of groom's pre-marital income. We justify this strategy by the fact that a male's professional occupation is unlikely to change after his marriage.

Table 2 shows that more than 70% of individuals working in agriculture are among the 40% less well-off compared to 51% of unskilled workers. Table 2 also indicates that 26% of skilled

workers are among the 40% less well-off, while only 10% of professional workers are among the 40% less well-off. We thus consider a male's professional occupation to be a good proxy of his level of income. Results in column (V) show that having the highest professional status (skilled workers and professional workers) has a negative effect on the probability that a male marries an adolescent girl. But, this result is not statistically significant. Since a male's pre-marital income may be correlated with his level of education, the above finding suggests that any effect a male's pre-marital income may have on the probability that he marries an adolescent girl is totally mediated by his level of education.

Figure 5 plots the estimates of the predictive margins of male education on the probability of marrying an adolescent girl, with 95% confidence intervals for the entire sample. Figure 5 shows that the probability of marrying an adolescent girl is decreasing in a male's number of years of schooling.

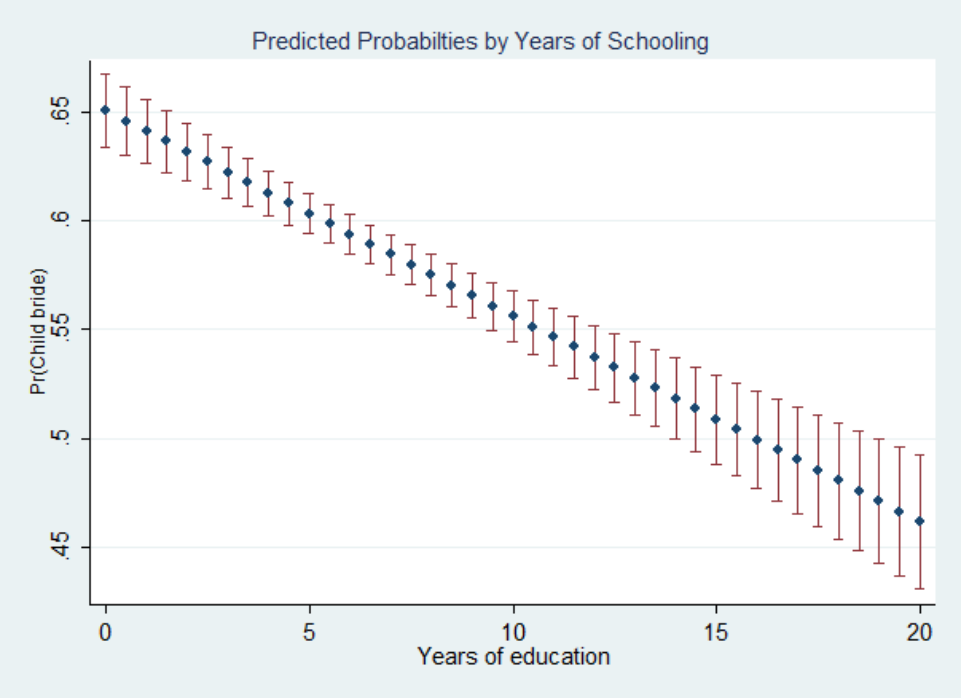

Figure 5: Effect of male's level of education on the probability of marrying an adolescent girl

3.2 IV Estimates

The results of the second-stage regressions are presented in Table 4. In column (I) where we use our first instrument, the average level of education of older male cohorts (5 years older or more) from other ethnic groups living in the same neighbourhood, we find that each additional year of schooling for men is associated with a decrease by 0.038 of their predicted probability of marrying an underage bride and this falls to 0.026 when we use our second instrument (Column II). In column (III), we use both instruments simultaneously. We find that each additional year of schooling for a male causes the predicted probability that he marries an adolescent girl to decrease by 3.5 percentage point.

To examine the validity of the instrumental variables strategy, we undertake three statistical tests. First, we test the null hypothesis that male education is exogenous. The Hausman test indicates that we can consider male education as an endogeneous variable and therefore we should deal with this identification issue. Second, we perform the Sargan-Hansen test for overidenfication when we use both instruments. The test indicates that the instruments are valid. Third, we perform the Stock-Yogo test, which tests weak identification of instruments. The weak instrument problem arises when the correlation between the endogenous regressor and the set of instrumental variables is weak. We can reject the null hypothesis of weak identification in all three specifications of the test. All these tests reassure that the estimated effect of a male's education on the likelihood that he marries an adolescent girl is causal.

3.3 Sensitivity Analysis and Robustness Checks

In this section, we conduct several sensitivity analyses and robustness checks for the effect of male education on adolescent marriage. We estimate this effect separately for urban and rural areas, and for Southern and Northern Nigeria. We also estimate this effect for males who got married at the age of 30 or higher.

3.3.1 Urban versus Rural and North versus South

As discussed in the Introduction, a male's attitude towards adolescent marriage may be related to characteristics other than his own educational attainment. For example, as gender norms may be more binding in close-knit communities such as rural communities, residing in the city as opposed to a rural area may impact a male's attitude toward adolescent marriage. Figure 6 below confirms these regional differences. It shows that, at all levels of male education, the likelihood of marrying an adolescent girl is larger in the North than in the South (Panel (a)), and in rural areas than in urban areas (Panel (b)). It also shows that the effect of male education on adolescent marriage is stronger in urban areas as well as in the South.

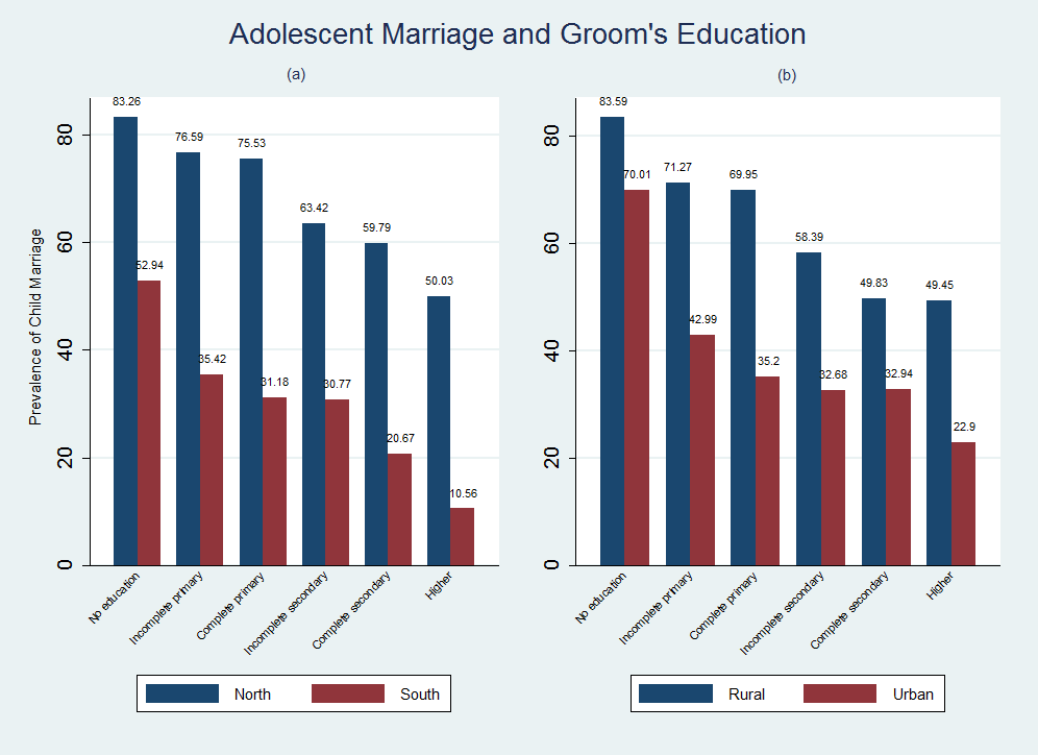

Figure 6: Proportion of men married to underage girls by region and rural/urban in Nigeria

In order to confirm this heterogeneous effect, we estimate it for each region using both OLS and IV regressions. The results are presented in Table 6. The top panel shows the OLS results for both the North and the South, and the bottom panel shows the IV results. The estimates in the first column (I) from the top panel, which do not include any control, show that each

additional year of schooling causes the probability that a male marries an adolescent girl to decrease by 2.5 and 2 percentage points in the North and the South, respectively. When we control for all potential confounders in column (III), we find that this causal effect is slightly stronger in the North.

When we use both instruments simultaneously (last column of the bottom panel), we find that an additional year of schooling for a male decreases the probability that he marries an adolescent girl by 2.6 percentage points in the North. For the South, the corresponding figure is much higher at 5.1 percentage points. These results suggest that the effect of a male's education on his probability of marrying an underage girl is much larger in the South than in the North.

Table 7 presents estimates of the effects of education on the probability that a male living in a rural area of Nigeria marries an adolescent girl. The top panel shows the OLS results for both the urban and the rural areas, and the bottom panel shows the IV results. The estimates in the first column (I) from the top panel, which do not include any control, show that each additional year of schooling decreases the probability that a male marries an adolescent girl by 2.6 and 2.6 percentage points in urban and rural areas, respectively. When we control for all potential confounders in column (III), we find that these effects decrease to 0.8 and 1 percentage points, respectively, but remains statistically significant. In the bottom panel, we observe that, in all three IV specifications, the estimates of the effect of a male's education on his probability of marrying an underage girl is negative and statistically significant in both areas, but is larger is urban areas.

3.3.2 Males Married at 30 or Higher

To control for a potential mechanical effect which may govern the association between a male's level education and the probability that he marries an underage girl. We restrict our sample to a subset of males aged 30 or higher at the time of the marriage. By focusing on males who married at 30 or higher, we virtually eliminate the mechanical effect whereby a less educated male marries younger than his more educated counterpart, and for this reason,

he more likely than his more educated counterpart to marry an underage girl. As shown in Table 10, a male's level of education still has a significant effect on his probability of marrying an underage bride even though he got married at age 30 or higher both OLS and IV estimations. This also confirms that the estimated effect of education on the probability that a male marries an adolescent girl is not a mere mechanical effect.

4 A Model of Bride Choice

The evidence in the previous section suggests that a male's level of education negatively affects the probability that he marries an adolescent girl. In this section, we develop a simple model of a prospective groom's decision on the age of his bride at marriage to explains this causal relationship. In this environment, marriage is entered into for the sole purpose of reproduction, and prospective brides are differentiated by their age θ. One can therefore think of the lower bound of θ as corresponding to the age at first menarche, and the upper bound, to the normal age at menopause. To keep the focus on the link between a groom's level of education and the age of his bribe at marriage, assume for simplicity that for each age θ there is an infinite number of brides, so that no prospective groom faces celibacy irrespective of his preferred bride's age at marriage. There is a measure one of prospective groom. Each prospective groom is characterized by his exogenously given characteristics, (e, ω), describing his level of education, e, and pre-marital income, ω. A groom's level of education and income may, or may not, be positively correlated.

4.1 The Reproductive Surplus

A prospective groom forms a household when his marriage post is picked up by a prospective bride of his desired age, θ. Once the couple is formed, childbearing begins yielding a reproductive surplus, ϕ, to the couple. There are several ways to think about this reproductive surplus. One way is as the joy and pride of maintaining a family lineage. Supporting this view is the evidence that in many African cultures, marriage and procreation are intertwined and

inseparable, because children are considered a source of power and pride, and an assurance of family continuity (Dyer et al. (2004)). An alternative way of interpreting this reproductive surplus is as old-age support from grown up children to their parents (Hoddinott (1992); Oliveira (2016); Lambert and Rossi (2016)).

For simplicity, assume that all children born to a married couple survive childhood to generate a reproductive surplus to their parents. There are no out-of-wedlock childbearing, so that the only way a prospective groom can earn a reproductive surplus is by getting married.

For each married couple, the reproductive surplus is a Cobb-Douglas function of the quantity, n, and quality, q, of their children:

$$\phi = (q)^{\gamma} (n)^{1-\gamma}, \tag{3}$$

where $\gamma \in (0, 1)$ captures the contribution of child quality to the reproductive surplus. As in Becker et al. (1990), $\gamma < 1/2$ means prospective grooms prefer quantity to quality, and $\gamma > 1/2$ means the reverse.

A child's quality is influenced by participation in formal schooling—an activity whose productivity level depends on parents' ability to create a home environment that stimulates their children's cognitive development. More formally, a child's quality is given by:

$$q := 1 + \varphi(\theta, e)\, s, \tag{4}$$

where s denotes the child's level of schooling, and $\varphi(\theta_a, e)$, a factor capturing the effect of a child's home environment on the productivity of schooling, and which itself depends on maternal education as proxied by maternal age at marriage, θ, and paternal education, e. Our assumption that a bride's age at marriage is a proxy for her level of education draws from empirical evidence showing lower levels of education among child brides than among their legal age counterparts (Field and Ambrus (2008); UNICEF et al. (2014)). Further, our own computations using 2013 DHS data for Nigeria—the setting of our empirical analysis—show that among married women aged 15 - 49, those married before their 18th birthday have in average 2.7 years of schooling compared to 8.31 years of schooling in average for those

married at 18 or higher. By choosing the age of his bride therefore, a prospective groom indirectly also chooses her level of education as well.

Expression (18) implies that schooling and a stimulating home environment are complementary in the production of child quality, so that a child with no schooling has a level of quality normalized to unity. We also make the following assumption:

Assumption 1. The function φ has the following property:

$$\begin{aligned} (i) \qquad \varphi_j &> 0, \qquad j = \theta, e \\ (ii) \qquad \varphi_{jj} &\leq 0, \qquad j = \theta, e \\ (iii) \qquad \varphi_{jl} &> 0, \qquad j, l = \theta, e. \end{aligned}$$

Assumption 1 reflects empirical findings showing that the quality of parenting affects a child's success in school (Herbers et al. (2011)); and that parents' education is the channel through which parenting influences a child's school success (Serafino and Tonkin (2014)). In particular, property (i) of Assumption 1 states that maternal education and parental education are essential inputs in the production of child quality; property (ii) states that the level of productivity of each parent's input is non-increasing in the level of the input; finally property (iii) states that paternal and maternal education are complementary in the production of child quality. In other words, the effect of increasing the level of paternal education on the productivity of child schooling is higher, the higher the level of maternal education. We argue that the strategic complementary between paternal and maternal education in the production of child quality along with the well-known quantity-quality trade-off in parental choice of quantity and quality of offspring form the mechanism that governs the effect of a groom's education on the probability that he marries an adolescent girl.

4.2 Preferences and Budget Constraint

Each prospective groom has preferences over his own consumption of a numeraire, c, and over the household's reproductive surplus, ϕ, conditional upon being married. We assume that these preferences are represented by a log-linear utility function:

$$V_a = \log c + \beta \log \phi \tag{5}$$

where β is the relative utility weight placed upon the reproductive surplus.

Each prospective groom makes the decisions on the age of his bride at marriage, θ, his own consumption, c, the number of offspring, n, and child's level of schooling, s. It costs κs units of the numeraire to provide a child with a level of schooling s, where $\kappa > 0$ denotes the exogenously given per unit cost of education. Like child schooling, child bearing is a costly activity. The per child cost of childbearing is $\psi(\theta)$, and depends on the age of the bride at marriage.

Assumption 2. The function ψ has the following property: $\psi' > 0$.

Assumption 2 states that the per child cost of childbearing is increasing with the mother's age at marriage. This property reflects the fact that the opportunity cost of childbearing rises with the bride's age at first marriage. Indeed, older brides may command higher labor market wages, particularly if age at marriage reflects the bride's level of education. This in turn raises the opportunity cost of an activity that is taxing on a female labor time, and thus may induce a higher compensation from her husband. Indeed, one can interpret $\psi(\theta)$ as the per child compensating payment from the groom to her bride.

The budget constraint faced by a groom with level of income ω is

$$c + [\psi(\theta) + \kappa s] n \leq \omega. \tag{6}$$

The above formulation of the budget constraint implies that all costs related to children are born by the father, and the mother's and children's consumption levels are normalized to 0.

A prospective groom's problem thus can be construed as a two-stage sequential choice problem written as follows, making use of the utility function in (5), the reproductive surplus in (3), (18), and the budget constraint in (6):

$$\max_{\theta} \left\{ \max_{\langle s,n \rangle} V(\theta, n, s) \right\} \tag{7}$$

where

$$V(\theta, n, s) := \log(\omega + [\psi(\theta) + \kappa s] n) + \beta\gamma \log[1 + \varphi(\theta, e) s] + \beta(1 - \gamma) \log n. \tag{8}$$

denotes the value of a prospective groom with socioeconomic characteristics, (e, ω), and who makes the sequential decision, $\langle \theta, n, s \rangle$. The timing of the resolution of this sequential problem is as follows. The prospective groom first chooses the age at marriage of his bride, θ. Then, marriage takes place, and immediately the groom decides on (n, s), so as to maximize the value of getting married. Each prospective groom is forward-looking, and thus chooses his bride's age at marriage, by anticipating the effect this choice will have on his desired quantity and quality of offspring, as determined by (n, s). Hence we apply a backward induction process to the solution to this sequential decision problem.

4.2.1 Optimal Child Quantity and Quality

We relate a prospective groom desired fertility, n, and child quality, q, to his socioeconomic characteristics, (e, ω), and the age of his bride at marriage, θ. But before we proceed with the characterization of the solution to this second stage decision problem, we make the following additional assumptions.

Assumption 3. $\gamma < 1/2$.

Assumption 3 is a standard assumption in the literature on parental fertility and child quality choices (e.g., Becker et al. (1990); Dessy (2000); De La Croix and Doepke (2003)). It states that all prospective grooms prefer quantity to quality of offspring, otherwise they will choose not to have children, as both quantity and quality are costly.

Assumption 4. $\forall\,(e,\theta)$,

$$\varphi\,(\theta,e) > \frac{\kappa}{\psi\,(\theta)}.$$

The term κ and $\psi\,(\theta)$ denote the cost of quality and quantity, respectively. The term $\kappa/\psi\,(\theta)$ therefore denotes the cost of quality relative to quantity of offspring, while, just to recall, $\varphi\,(\theta,e)$ denotes the marginal productivity of schooling for a child whose mother was married at age θ, and whose father has a level of education, e. Assumption 4 allows us to focus exclusively on interior solutions; it states that the marginal productivity of schooling always exceeds the relative cost of child quality, even for a child whose mother was a child bride and whose father is uneducated.

We draw on Assumptions 1- 4 to characterize the solution to the second-stage problem. Indeed, using (3), it can be shown that given the age of the bride he selected, θ, a prospective groom with socioeconomic characteristics, (e,ω), has optimal quantity and quality of offspring given by:

$$n = \frac{\beta\,(1-2\gamma)\,\varphi\,(\theta,e)\,\omega}{[1+\beta\,(1-\gamma)]\,[\varphi\,(\theta,e)\,\psi\,(\theta)-\kappa]} \equiv N\,(\theta,e,\omega) \tag{9}$$

$$q = \frac{\gamma}{(1-2\gamma)\,\kappa}\,[\varphi\,(\theta_a,e)\,\psi\,(\theta)-\kappa] \equiv Q\,(\theta,e,\omega) \tag{10}$$

It follows from (9) that unless all prospective grooms prefer quantity to quality of offspring (i.e., $1-2\gamma>0$, as implied by Assumption 3), none of them will desire children, and thus none of them will gain from marriage. Likewise, one can also see from inspection of (10) that unless the marginal productivity of schooling exceeds the relative cost of child quality (as implied by Assumption 4), no groom will invest in child quality. By Assumptions 1-4, we thus obtain the following results from partial differentiation of (9) and (10) respectively:

Claim 4.1 *Under Assumptions 1-4, the following statements are all true:*
(i) The number of children born to a married couple is decreasing in the bride's age at marriage ($\partial N/\partial\theta<0$);
(ii) it is also decreasing in the groom's level of education ($\partial N/\partial e<0$);

(iii) But it tends to rise with the groom's income ($\partial N/\partial \omega > 0$).

This claim basically implies that a marital match between a less educated male and an underage girl is characterized by a higher number of children than one involving a highly educated male and/or an older bride. It implies that a high desired fertility may be what attract less educated males towards underage girls as brides. This results reflects the interplay between the usual quantity-quality trade-off (Becker et al. (1990); Oliveira (2016)) and the fact that compared to an older bride, a younger bride induces a lower marginal productivity of schooling for offspring (Marteleto and Dondero (2013)), and a lower cost of childbearing which tips the balance in favor of quantity, at the expense of quality.

Claim 4.2 *Under Assumption 1-4, the following statements are all true:*
(i) The level of educational attainment of children born to a married couple is increasing in the bride's age at marriage ($\partial Q/\partial \theta > 0$);
(ii) it is also increasing in the groom's level of education ($\partial Q/\partial e > 0$);
(iii) but it is independent of the groom's income ($\partial Q/\partial \omega = 0$).

Just like Claim 4.1 above, Claim 4.2, reflects the interplay between the quantity-quality trade-off and the fact that compared to an older bride, a younger bride induces a lower marginal productivity of schooling for offspring, and a lower cost of child bearing, thus reducing the return to investment in child quality relative to quantity. It suggests that a couple in which the groom is less educated and the bride younger faces a higher opportunity cost of investment in child quality than one in which the groom is more educated and/or the bride is older.

4.3 Male Education and Bride's Age

In our discussion of the determinants of a household's reproductive surplus, we highlighted the link between the groom's socioeconomic characteristics, (e, ω), and the quantity and quality of offspring he desires. Our next step is to characterize the direct effect of a groom's education on his bride's age at marriage. Keep in mind, however, that we are not claiming

that a groom's education is the only or most important cause of adolescent marriage. In fact, supply factors, as empirical evidence shows, also have an important role to play. The questions we have in mind and aim to address empirically are the following: if a male had a choice between an underage and legal-age, bride, which one would he choose? And does his level of education matter for this choice? The purpose of our theoretical framework thus is to derive the exogenous total effect of a male's level of education on the age of his bride at marriage, highlighting the mechanism underlying this effect.

To get us started in this discussion, we must first characterize the value of a groom as a function of his bride's age at marriage, θ. From (8), it holds that this value is given by

$$\begin{aligned} V(\theta, e, \omega) := & \log\left[\omega + \left[\psi(\theta) + \kappa S(\theta, e, \omega)\right] N(\theta, e, \omega)\right] \\ & + \beta\gamma \log Q(\theta, e, \omega) + \beta(1-\gamma) \log N(\theta, e, \omega) \end{aligned} \tag{11}$$

where

$$S(\theta, e, \omega) := \frac{\gamma\left[\varphi(\theta, e)\,\psi(\theta) - (1-\gamma)\,\kappa\right]}{(1-2\gamma)\,\kappa\varphi(\theta, e)} \tag{12}$$

denotes the optimal level of investment in child quality for a couple with characteristics (θ, e, ω). A prospective groom's first-stage problem thus is to solve:

$$\max_{\theta} V(\theta, e, \omega)$$

By the application of the *envelope theorem*, it holds that the first order condition for a maximum reduces to:

$$F(\theta, e, \hat{s}) := -\frac{\varphi(\theta, e)\,\psi'(\theta)}{\kappa} + \frac{\partial\varphi}{\partial\theta}\hat{s} = 0 \tag{13}$$

where $\hat{s} := S(\theta, e, \omega)$. The second order condition therefore is

$$\frac{\partial F}{\partial \theta} = -\frac{1}{\kappa}\left[\varphi(\theta, e)\,\psi''(\theta) + \frac{\partial \varphi}{\partial \theta}\psi'(\theta)\right] + \frac{\partial^2 \varphi}{\partial \theta \partial \theta}\hat{s} + \frac{\partial \varphi}{\partial \theta}\frac{\partial \hat{s}}{\partial \theta}$$

which must be strictly negative for a maximum to exist. Furthermore

$$\frac{\partial F}{\partial e} = \frac{\partial^2 \varphi}{\partial \theta \partial e}\hat{s} - \frac{\psi'(\theta)}{\kappa}\frac{\partial \varphi}{\partial e} + \frac{\partial \varphi}{\partial \theta}\frac{\partial \hat{s}}{\partial e} \tag{14}$$

If we denote as $\theta^* := \Theta(e)$, the solution to the first order condition in (13), then it holds that:

$$F[\Theta(e), e] \equiv 0.$$

By the *Implicit Function Theorem,* we then obtain the exogenous total effect of a groom's level of education on the age of his bride at marriage as follows:

$$d\theta^* = -\frac{F_e}{F_\theta}de,$$

where $F_j := \partial F/\partial j$, $j = e, \theta$. From (14), it follows that this total effect can be decomposed into two different parts representing the direct and the indirect effect respectively:

$$d\theta^* = -\frac{1}{F_\theta}\left[\frac{\partial^2 \varphi}{\partial \theta \partial e}\hat{s} - \frac{\psi'(\theta)}{\kappa}\frac{\partial \varphi}{\partial e}\right]de - \frac{\partial \varphi}{\partial \theta}\frac{\partial \hat{s}}{\partial e}\frac{de}{F_\theta}. \tag{15}$$

The indirect effect,

$$-\frac{\partial \varphi}{\partial \theta}\frac{\partial \hat{s}}{\partial e}\frac{de}{F_\theta}$$

works through the effect of paternal education on the couple's level of investment in child schooling, $\hat{s} := S(\theta, e, \omega)$. Since $-1/F_\theta$ is strictly positive, as are both $\partial\varphi/\partial\theta$ and $\partial\hat{s}/\partial e$, this indirect effect is unambiguously positive.

The direct effect,

$$-\frac{1}{F_\theta}\left[\frac{\partial^2 \varphi}{\partial \theta \partial e}\hat{s} - \frac{\psi'(\theta)}{\kappa}\frac{\partial \varphi}{\partial e}\right]de,$$

has an ambiguous sign, which depends on the degree of complementarity between maternal

and paternal education in the production of child quality, as measured by the cross-partial derivative $\partial^2\varphi/\partial\theta\partial e$. Observe for example that if

$$\frac{\partial^2\varphi}{\partial\theta\partial e} \leq 0,$$

then this direct effect is negative. A necessary, but not sufficient, condition for this direct effect to be positive is that

$$\frac{\partial^2\varphi}{\partial\theta\partial e} > 0,$$

as imposed in Assumption 2 above. In other words, using (12) above, it holds that:

Proposition 4.1 *Under Assumptions 1 - 4 hold, if for all θ,*

$$\frac{\partial^2\varphi}{\partial\theta\partial e} > \frac{(1-2\gamma)\,\varphi(\theta,e)\,\psi'(\theta)}{\gamma\left[\varphi(\theta,e)\,\psi(\theta)-(1-\gamma)\,\kappa\right]}\frac{\partial\varphi}{\partial e}, \tag{16}$$

then the direct effect of a male's education on the age of his bride at marriage is strictly positive.

Proposition 4.1 states that the mechanism underlying the direct effect of a male's education on the age of his bride at marriage works through the complementarity between maternal and paternal education in the production of child quality. Indeed, condition (16) states that the complementarity between parental and maternal education in the production of child quality is sufficiently strong. When this condition holds, males with low levels of education will most likely choose younger (less educated) brides. From a public policy perspective, this proposition suggests that public policy targeting boys in their formative years, for example, through improved access to education, may represent a promising long-term avenue for reducing the incidence of child marriage.

5 Testing the Mechanism

This section provides empirical evidence in support of the mechanism underlying the effect of education on a prospective groom's net payoff from marriage with an underage girl as outlined

in the theoretical model. Just to recall, in the theoretical model, marriage is entered into for the sole purpose of reproduction– an activity that generates a surplus to both spouses. In keeping up with the existing literature, this surplus is modelled as a Cobb-Douglas function of the quantity and quality of offspring, both of which are costly to produce. Furthermore, again, in line with the existing literature, we model maternal and paternal education as inputs in the production of child quality. In that context, we show that the mechanism that matches prospective grooms with low levels of education to underage girls as potential spouses works through the relatively high (respectively, low) cost of quality (respectively, quantity) such a match entails. Indeed, given that there exists a quantity-quality trade-off, and to the extent that paternal and maternal education are complementary in the production of child quality, a marital match between a less educated male and an underage girl yields higher quantity, but low-quality, offspring. We test this mechanism in two parts. First, we test whether a household in which the husband and the wife have low levels of education has more children than one in which the husband and the wife have higher levels of education (Claim 1). Second, we test whether a household in which the husband and the wife have low levels of education has low quality children than one in which the husband and the wife have higher levels of education (Claim 2).

To test the first part of the mechanism, we use an OLS regression to estimate the interaction effects of a husband and his wife levels of education on the number of children of the couple (equation (17)). In equation (17), n_i denotes couple i's total number of children ever born, $E1_i$ denotes the level of education of the husband and $E2_i$ his wife's level of education:

$$n_i = \beta_0 + \beta_1(E1_i \times E2_i) + \epsilon_i \tag{17}$$

We restrict the sample to couples in which the wife is aged $40 - 49$, because they are the most likely to have already completed their fertility. Estimates of the interaction effects of husband level of education and his wife's age at first marriage on their number of children are reported in column (I) of Table 8. All estimates are negative and statistically significant, indicating that a household in which the husband and the wife have higher levels of education

has less children than one in which the husband and the wife have low levels of education. When we do not include any control, we find that a couple in which both spouses have primary education has on average 1.1 children less compared to one in which spouses have no education (Column I). Similarly, a couple in which the husband and the wife both have secondary education has on average 2.4 children less compared to one in which both have no education (Column I).

To test the second part of the mechanism, we use an OLS regression to estimate the interaction effects of a husband's and his wife's levels of education on their child quality (equation (18)). In equation (18), q_{ifm} denotes the quality of child i (measured by her/his level of educational attainment), born to father f and mother m; E_f denotes the level of education of her/his father and E_m denotes the level of education of her/his mother:

$$q_{ifm} = \beta_0 + \beta_1(E_f \times E_m) + \epsilon_i \tag{18}$$

The test is performed by restricting the sample to children aged 17-18. Results are reported in Table 8, column (II). We find that all estimates are positive and statistically significant, indicating that a household in which both spouses have higher levels of education has more educated children than the one in which the husband and the wife have low levels of education. For instance, when we do not include any control, we find that a household in which the husband and the wife both have primary education is associated with 4.6 extra years of child's schooling on average compared to the one in which they both have no education (Column II). Similarly, a household in which the husband and the wife both have secondary education is associated with 5.8 extra years of child's schooling on average compared to one in which both have no education. We check the robustness of this mechanism by restricting the sample to children aged 18 in column (III). We find larger effects that are all statistically significant.

These results are corroborated by an additional analysis showing that the interacting effect a father's education and whether the mother was a child bride is negative for the number of children and positive for the quality of children (Table 9). Overall, these findings follow

from the fact that marriage involving a child bride lead to larger quantity and less quality of offspring.

6 Conclusion

Public policy addressing the issue of adolescent marriage has exclusively targeted women and girls. While the focus on girls and women is intuitively compelling, it remains that in patriarchal societies, such policy may yield a low payoff if it ignores the potential role men play as husbands, fathers, and political and community leaders, wielding a tremendous amount of decision-making power over many aspects of females' lives. To our knowledge, this paper is the first to systematically explore the role men, as husband, play in driving down adolescent marriage. Specifically, we analyse the effect of a male's education on the likelihood that he marries an adolescent girl.

Analyzing micro-level data from Nigeria, we find that a male's education negatively affects the probability that he marries an underage girl. This effect is causal. Moreover, sensitivity analyses reveal that this effect is stronger in urban areas and in Southern Nigeria, suggesting male education matters more in areas where cultural norms that cast women and girls in submissive roles are weaker. We also provide evidence that this effect is not mechanical.

To better understand the mechanism explaining the relationship between a male's education and the likelihood that he marries a child girl, we develop a theoretical model. We show that this relationship is governed by a strategic complementarity between paternal and maternal education in the production of child quality. When this strategic complementary is sufficiently strong, it combines with the quantity-quality trade-off characterizing parental investment in children to create a positive assortative mating on the basis of spousal education. We provide empirical evidence in support of this mechanism. In particular, we find that the interacting effect of the father's and the mother's education is negative for the number of children they have, and positive for the level of education of these children. The implication, which follows from the model, is that grooms with less education are most likely to marry underage girls.

From a public policy point of view, this research provides evidence that not including boys and men in interventions aimed at eliminating adolescent marriage may yield a low payoff. In combination with existing research showing that female education matters for the elimination of child marriage (e.g., Field and Ambrus (2008)), our paper can be taken to suggest that public policy that also targets boys in their formative years can enhance the fight against this harmful practice.

Table 1: Summary Statistics

	Prevalence of Child Marriage	
Variables	Mean	SD
Early marriage	0.594	0.491
Husband Education		
No education	0.821	0.383
Primary education	0.605	0.489
Secondary education	0.439	0.496
Higher education	0.336	0.473
Husband Religion		
Christian	0.319	0.466
Muslim	0.745	0.436
Other religion		
Region		
North Central	0.491	0.500
North East	0.729	0.445
North West	0.826	0.379
South East	0.224	0.417
South South	0.293	0.455
South West	0.214	0.411
Place of residence		
Urban	0.362	0.481
Rural	0.713	0.452

Table 2: Correlation between professional occupation and wealth index

	Wealth index					
Prof. occupation	Poorest	Poorer	Middle	Richer	Richest	Total
Agriculture	39.65	31.41	18.66	8.14	2.13	100
Unskilled	20.59	21.84	17.48	19.72	20.37	100
Skilled	9.77	16.33	18.51	27.99	27.41	100
Professional	3.43	6.77	18.54	26.60	44.67	100

Table 3: Determinants of Demand for Adolescent Brides

	Linear probability model (LPM)				
Variable	(I)	(II)	(III)	(IV)	(V)
Education: in single years	-0.034***	-0.016***	-0.013***	-0.010***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Muslim		0.179***	0.123***	0.118***	0.116***
		(0.014)	(0.014)	(0.014)	(0.014)
Living in northern region		0.199***	0.115***	0.107***	0.106***
		(0.015)	(0.016)	(0.015)	(0.015)
Living in rural area		0.162***	0.112***	0.082***	0.081***
		(0.012)	(0.012)	(0.012)	(0.012)
Prop. of ado. marriage in older co-ethnics			0.381***	0.352***	0.351***
			(0.022)	(0.021)	(0.021)
Age at first marriage				-0.020***	-0.020***
				(0.001)	(0.001)
Current age				0.003***	0.003***
				(0.001)	(0.001)
Sex ratio					0.016
					(0.011)
Unskilled worker					0.013
					(0.012)
Skilled worker					-0.015
					(0.013)
Professional worker					-0.026
					(0.018)
Constant	0.809***	0.320***	0.215***	0.630***	0.609***
	(0.007)	(0.015)	(0.017)	(0.034)	(0.037)
N. obs	8394	8394	8054	8054	7945
R-squared	0.153	0.268	0.295	0.335	0.335
Heteroskedasticity-robust standard errors are in parentheses. * p<.1; ** p<.05; *** p<.01					

Table 4: IV Estimation of the Effect of Males' Education on the Demand for Adolescent Brides

IV regressions: Dependent variable is bride type			
	(I)	(II)	(III)
	D-ethnic IV	Co-ethnic IV	Both
Education	-0.038***	-0.026***	-0.035***
	(0.009)	(0.003)	(0.005)
Muslim	0.060*	0.066***	0.070***
	(0.031)	(0.017)	(0.024)
Living in northern region	0.128***	0.102***	0.128***
	(0.023)	(0.016)	(0.022)
Living in rural area	0.076***	0.060***	0.080***
	(0.023)	(0.013)	(0.021)
Prop. of ado. marriage in older co-ethnics	0.180***	0.307***	0.192***
	(0.044)	(0.023)	(0.036)
Age at first marriage	-0.016***	-0.018***	-0.017***
	(0.002)	(0.001)	(0.002)
Current age	0.003**	0.002***	0.003***
	(0.001)	(0.001)	(0.001)
Sex ratio	-0.017	0.012	-0.015
	(0.016)	(0.011)	(0.016)
Unskilled worker: ref. agriculture	0.080***	0.040***	0.072***
	(0.030)	(0.013)	(0.023)
Skilled worker	0.051	0.023	0.041
	(0.034)	(0.015)	(0.025)
Professional worker	0.164**	0.088***	0.138***
	(0.071)	(0.028)	(0.045)
Constant	0.819***	0.751***	0.792***
	(0.087)	(0.046)	(0.066)
N. obs	3340	7945	3340
R-squared	0.322	0.316	0.334
Haussman test: statistic (p-value)	20.04 (0.000)	92.72 (0.000)	57.21 (0.000)
Sargan-Hansen test:	-	-	0.019 (0.9)
Weak ident. test (Cragg-Donald Wald F statistic):	202.208	1223.989	283.872
Stock-Yogo weak ID test critical values:			
5% maximal IV relative bias	16.38	16.38	19.93
10% maximal IV relative bias	8.96	8.96	11.59
20% maximal IV relative bias	6.66	6.66	8.75
30% maximal IV relative bias	5.53	5.53	7.25

Notes: Heteroskedasticity-robust standard errors and p-values for Haussman and Sargan tests are in parentheses. p<.1; ** p<.05; *** p<.01

Table 5: IV First-Stage regressions

IV First-Stage regressions: Dependent variable is males' years of schooling			
Variable	(I)	(II)	(III)
	D-ethnic IV	Co-ethnic IV	Both
Av. level of education (Other ethnic groups)	0.229***	-	0.079***
	(0.020)		(0.021)
Av. level of education (Co-ethnics)	-	0.502***	0.421***
		(0.015)	(0.025)
Muslim	-2.083***	-1.675***	-1.317***
	(0.199)	(0.128)	(0.196)
Living in northern region	0.225	-0.008	0.210
	(0.213)	(0.138)	(0.204)
Living in rural area	-0.651***	-0.370***	-0.134
	(0.189)	(0.117)	(0.184)
Prop. of ado. marriage in older co-ethnics	-2.527***	-0.570***	-1.003***
	(0.302)	(0.206)	(0.304)
Age at first marriage	0.116***	0.088***	0.105***
	(0.015)	(0.009)	(0.015)
Current age	-0.014	-0.013**	-0.004
	(0.011)	(0.007)	(0.011)
Sex ratio	-0.458***	-0.159	-0.289*
	(0.161)	(0.115)	(0.155)
Unskilled worker: ref. agriculture	2.121***	1.150***	1.675***
	(0.202)	(0.124)	(0.196)
Skilled worker	2.457***	1.469***	1.835***
	(0.204)	(0.125)	(0.199)
Professional worker	6.444***	5.771***	5.611***
	(0.256)	(0.157)	(0.251)
N. obs	3337	7938	3337
R-squared	0.503	0.508	0.542
Notes: Heteroskedasticity-robust standard errors are in parentheses. * p<.1; ** p<.05; *** p<.01			

Table 6: Heterogeneous Effects of Males' Education by Regions

	Estimation Strategy: OLS		
	(I)	(II)	(III)
		North	
Education: in single years	-0.025***	-0.019***	-0.009***
	(0.001)	(0.001)	(0.001)
Muslim	-	0.227***	0.147***
		(0.016)	(0.017)
N. obs	5824	5824	5579
R-squared	0.098	0.135	0.229
		South	
Education: in single years	-0.020***	-0.020***	-0.007***
	(0.002)	(0.002)	(0.002)
Muslim	-	-0.027	-0.022
		(0.024)	(0.024)
N. obs	2570	2570	2366
R-squared	0.035	0.035	0.167
All Baseline Controls	No	No	Yes
	Estimation Strategy: IV		
	D-ethnic IV	Co-ethnic IV	Both
		North	
Education: in single years	-0.031***	-0.024***	-0.026***
	(0.011)	(0.004)	(0.006)
Muslim	0.123***	0.094***	0.135***
	(0.041)	(0.021)	(0.031)
N. obs	2313	5579	2313
R-squared	0.239	0.207	0.254
		South	
Education: in single years	-0.072*	-0.017**	-0.051***
	(0.037)	(0.160)	(0.013)
Muslim	-0.089	-0.035	-0.061
	(0.060)	(0.025)	(0.038)
N. obs	1027	2366	1027
R-squared	-0.065	0.160	0.089
All Baseline Controls	Yes	Yes	Yes

Notes: Heteroskedasticity-robust standard errors are in parentheses. * p<.1; ** p<.05; *** p<.01

Table 7: Heterogeneous Effects of Males' Education by Urban/Rural

	Estimation Strategy: OLS		
	(I)	(II)	(III)
		Urban	
Education: in single years	-0.026***	-0.020***	-0.008***
	(0.002)	(0.002)	(0.002)
Muslim	-	0.249***	0.072***
		(0.018)	(0.021)
N. obs	2718	2718	2486
R-squared	0.075	0.139	0.288
		Rural	
Education: in single years	-0.028***	-0.015***	-0.010***
	(0.001)	(0.001)	(0.001)
Muslim	-	0.301***	0.143***
		(0.015)	(0.019)
N. obs	5676	5676	5459
R-squared	0.107	0.180	0.259
All Baseline Controls	No	No	Yes
	Estimation Strategy: IV		
	D-ethnic IV	Co-ethnic IV	Both
		Urban	
Education: in single years	-0.049***	-0.041***	-0.043***
	(0.016)	(0.007)	(0.009)
Muslim	0.006	0.017	0.018
	(0.040)	(0.024)	(0.031)
N. obs	1328	2486	1328
R-squared	0.176	0.200	0.208
		Rural	
Education: in single years	-0.033***	-0.019***	-0.030***
	(0.012)	(0.004)	(0.006)
Muslim	0.124**	0.109***	0.131***
	(0.048)	(0.023)	(0.037)
N. obs	2012	5459	2012
R-squared	0.226	0.252	0.235
All Baseline Controls	Yes	Yes	Yes

Notes: Heteroskedasticity-robust standard errors are in parentheses. * p<.1; ** p<.05; *** p<.01

Table 8: Interaction Effects of Father's and Mother's Education on Child's Quantity and Quality

	Child Quantity	**Child Quality: Education**	
	(I)	**(II)**	**(III)**
	N. of children	Child educ. (17-18)	Child educ. (18)
Father educ*Mother educ	Coef.	Coef.	Coef.
Noeducation*Noeducation: Ref			
Noeducation*Primary	-0.327**	2.487***	2.140***
	(0.163)	(0.397)	(0.602)
Noeducation*Secondary	-1.620***	5.403***	5.474***
	(0.299)	(0.714)	(0.996)
Noeducation*Higher	-2.226*	-	-
	(1.233)		
Primary*Noeducation	-0.378**	3.328***	3.486***
	(0.149)	(0.340)	(0.464)
Primary*Primary	-1.111***	4.563***	4.591***
	(0.111)	(0.277)	(0.401)
Primary*Secondary	-2.117***	6.206***	6.262***
	(0.159)	(0.395)	(0.575)
Primary*Higher	-3.184***	6.338***	6.000***
	(0.354)	(0.799)	(1.035)
Secondary*Noeducation	-0.615***	3.893***	3.244***
	(0.197)	(0.503)	(0.716)
Secondary*Primary	-1.469***	5.193***	5.146***
	(0.136)	(0.368)	(0.542)
Secondary*Secondary	-2.412***	5.815***	5.601***
	(0.122)	(0.317)	(0.446)
Secondary*Higher	-3.158***	6.720***	6.381***
	(0.266)	(0.641)	(0.961)
Higher*Noeducation	-0.272	5.181***	4.381***
	(0.261)	(0.588)	(0.961)
Higher*Primary	-0.719***	5.503***	5.667***
	(0.212)	(0.463)	(0.633)
Higher*Secondary	-2.340***	6.209***	6.024***
	(0.163)	(0.404)	(0.625)
Higher*Higher	-3.227***	6.722***	6.779***
	(0.144)	(0.389)	(0.537)
Other controls	No	No	No
N. obs	7075	1796	923
R-squared	0.135	0.372	0.358

Notes: Heteroskedasticity-robust standard errors are in parentheses. * p<.1; ** p<.05; *** p<.01

Table 9: Interaction Effects of Father's Education and Mother's Early Marriage on Child's Quantity and Quality

	Child Quantity	**Child Quality: Education**	
	(I)	**(II)**	**(III)**
Variables	N. of children	Child educ. (17-18)	Child educ. (18)
Interaction Effects	Coef.	Coef.	Coef.
Noeducation*ChildBride: Ref			
Noeducation*AdultBride	-1.682***	0.928***	1.144***
	(0.109)	(0.284)	(0.390)
Primary*ChildBride	-0.797***	4.159***	4.314***
	(0.115)	(0.290)	(0.398)
Primary*AdultBride	-2.353***	4.734***	4.989***
	(0.109)	(0.282)	(0.414)
Secondary*ChildBride	-1.257***	4.969***	4.753***
	(0.131)	(0.373)	(0.518)
Secondary*AdultBride	-2.901***	5.418***	5.455***
	(0.107)	(0.285)	(0.414)
Higher*ChildBride	-0.877***	5.497***	5.545***
	(0.155)	(0.370)	(0.546)
Higher*AdultBride	-3.478***	6.210***	6.348***
	(0.118)	(0.322)	(0.458)
Other controls	No	No	No
N. obs	7075	1796	923
R-squared	0.168	0.327	0.319

Notes: Heteroskedasticity-robust standard errors are in parentheses. * p<.1; ** p<.05; *** p<.01

Table 10: Robustness Check: subset of males aged 30 or higher at the time of marriage

	Est. Strategy: OLS	**Est. Strategy: IV**		
Variable		D-ethnic IV	Co-ethnic IV	Both
Education	-0.013***	-0.040**	-0.030***	-0.045***
	(0.003)	(0.016)	(0.007)	(0.011)
Muslim	0.151***	0.079	0.100***	0.062
	(0.028)	(0.060)	(0.032)	(0.049)
Living in northern region	0.132***	0.128***	0.135***	0.131***
	(0.027)	(0.037)	(0.028)	(0.036)
Living in rural area	0.105***	0.086*	0.074***	0.075*
	(0.024)	(0.049)	(0.027)	(0.045)
Prop. of AM in older co-ethnics	0.256***	0.119*	0.220***	0.105*
	(0.040)	(0.072)	(0.042)	(0.062)
Current age	0.008***	0.010***	0.006***	0.009***
	(0.002)	(0.003)	(0.002)	(0.003)
Sex ratio	-0.005	-0.043	-0.002	-0.043
	(0.024)	(0.030)	(0.024)	(0.031)
Unskilled worker: ref. agriculture	0.019	0.137**	0.045	0.145***
	(0.033)	(0.057)	(0.035)	(0.055)
Skilled worker	-0.036	0.081	0.000	0.091*
	(0.030)	(0.060)	(0.035)	(0.055)
Professional worker	-0.014	0.200*	0.103*	0.234**
	(0.036)	(0.120)	(0.059)	(0.094)
Constant	-0.182*	0.042	0.047	0.110
	(0.093)	(0.243)	(0.127)	(0.195)
N. obs	1466	680	1466	680
R-squared	0.327	0.325	0.303	0.304

Notes: Heteroskedasticity-robust standard errors are in parentheses. * p<.1; ** p<.05; *** p<.01

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