Published in final edited form as:
J Health Econ. 2013 September ; 32(5): 863–872. doi:10.1016/j.jhealeco.2013.06.002.

Girls' Education and HIV Risk: Evidence from Uganda

Marcella M. Alsan and **David M. Cutler**[†,*]

Marcella M. Alsan: malsan@fas.harvard.edu; David M. Cutler: dcutler@harvard.edu

[†]Department of Economics, Harvard University, 1805 Cambridge Street, Cambridge MA 01238, U.S.A

Abstract

Uganda is widely viewed as a public health success for curtailing its HIV/AIDS epidemic in the early 1990s. The period of rapid HIV decline coincided with a dramatic rise in girls' secondary school enrollment. We instrument for this enrollment with distance to school, conditional on a rich set of demographic and locational controls, including distance to market center. We find that girls' enrollment in secondary education significantly increased the likelihood of abstaining from sex. Using a triple-difference estimator, we find that some of the schooling increase among young women was in response to a 1990 affirmative action policy giving women an advantage over men on University applications.

Keywords

HIV/AIDS; education policy; gender

While the AIDS epidemic has exacted a terrible price in sub-Saharan Africa, Uganda is widely viewed as a success story and a model for the rest of the continent (Schoepf, 2003). The reduction in AIDS in Uganda was rapid: HIV prevalence fell from an estimated 15 percent of the general population in 1990 to five percent in 2007 (UNAIDS, 2008a). The steepest decline occurred in the early 1990s: between 1990 and 1995 the prevalence of HIV among urban pregnant women dropped from approximately 30 to 15 percent. This fall in HIV prevalence was most impressive for women under the age of 25 and corresponds to fewer pregnancies and less risky sexual behavior in this cohort as reported in the Demographic and Health Surveys (DHS).

Although there were likely several factors that contributed to Uganda's success (Green et al., 2006; USAID, 2002), the aim of this paper is to understand whether behavior change and education among women had a role to play.[1] We are motivated to explore the role of education both because of a national policy that gave women preferential treatment in higher

[*]We thank Seth Berkley, Esther Duflo, Max Essex, Erica Field, Ron Gray, Howard Hiatt, Guido Imbens, Michael Kremer and Maria Wawer. We are also grateful to the editor and two anonymous reviewers who provided comments that substantially improved the paper.

[1]The working paper of this article (Alsan and Cutler, 2010) included an epidemiological section incorporporating behavioral changes reported in several waves of the Uganda Demographic and Health Surverys into a generalized model of the HIV epidemic. The results indicate that reduction in premarital sex among women was the most important factor contributing to the overall decline in HIV over the time period and motivate the emphasis on that channel in this paper.

education (described below) as well as for theoretical reasons. On the one hand, theory predicts fertility should fall with rising female education as the opportunity cost of a woman's time increases (Becker, 1960). To the extent that increased female education leads to positive assortative matches in the marriage market or raises bargaining power within the household, these should also have implications for reducing coercive sexual behavior.[2] On the other hand, education and the increased socioeconomic status it affords may increase mobility and demand for consumer goods, including transactional sex. Thus the effects of education on sexual behavior are theoretically ambiguous.

Several papers have investigated the causal effect of female education on fertility in Sub-Saharan Africa. Osili and Long (2008) and Keats (2012) use the natural experiment of universal primary education in Nigeria and Uganda, respectively, to show that additional education of young women reduced fertility in the affected cohorts relative to those who were unaffected. Evidence from randomized controlled trials corroborates the findings from natural experiments but show the theoretical effects, which presumably occur over the life-cycle, occur much quicker in practice–inviting alternative interpretations of the results. For example, the contemporaneous correlation between enrollment and pregnancy of young women documented in Baird et al. (2011) Bandiera et al. (2012) and Duflo et al. (2011) suggests that there might be an incarceration effect to schooling (as suggested in Black et al. (2008)). Alternatively, women could obtain better knowledge about contraception or develop different aspirations as a result of school exposure (Lavy and Zablotsky, 2011).[3]

In our context, the time period of rapid HIV decline among young women in Uganda coincided with a notable rise in secondary school enrollment. The percent of never married females between the ages of 15–24 who ever attended secondary school jumped by 12 percentage points, from 24 to 36 percent (DHS 1988, DHS 1995).[4] To identify whether there is a causal relationship between these contemporaneous trends (e.g., schooling and postponed sexual debut), we instrument for enrollment in school with distance to secondary school, conditional on a rich set of demographic and locational controls. There are two obvious problems with the use of this measure to identify exogenous variation in schooling: endogenity of the location of the index respondent and of the school itself. Regarding the former, we use the usual approach of restricting the sample to nonmovers and note that it is not distance of the individual, but distance from a village or group of small villages to secondary school that is used as the instrumental variable in this study. Regarding the latter, we argue and present qualitative evidence that placement of schools in rural Uganda was determined primarily by Missionaries whose focus was on converting the hinterland population and is orthogonal to many omitted variables usually of concern when using distance as an instrument for services. As further evidence on this point, we document that distance to market center does not have a strong first stage (in other words, it does not predict schooling attainment). Moreover, there are no significant differences on observables between individuals near versus far from a secondary school after conditioning on district fixed effects. Our instrumental variable estimates imply a girl enrolled in secondary education is 80 to 90 percentage points more likely to abstain from sex than one who is not.

What was driving the trend towards increased secondary schooling among young Ugandan women over this time period? One could argue that girls stayed in school because they were fearful of contracting HIV. Although this may be partly true, we find that some of the

[2]Furthermore, studies have shown that maternal education reduces child mortality (see Schultz (2002) for a review), which may also influence fertility decisions if households have a target family size.

[3]Baird et al. (2011) test the use of conditional versus unconditional cash transfers for educational outcomes among 13–22 year old never married females in Malawi. They find that though conditional cash transfers (CCT) improved atttendance and scores relative to unconditional transfers (UCT), rates of pregnancy and marriage were lower in the UCT arm.

[4]This figure is 6 percentage points for women of any marital status in the same time period.

schooling increase among young women was in response to a 1990 affirmative action policy giving women an advantage over men on University applications. Using men as a control group and exploiting heterogeneity in birth year and distance of birthplace to public Universities, we show that the University preference policy was effective in recruiting women into higher levels of education. This, in turn, reduced HIV among young girls.

The rest of the paper is structured as follows. First we review details of Uganda's HIV epidemic and the trends in sexual activity among young women. Next we turn to the data on why and how education and sexual activity are related. Finally we present the triple-difference estimates of the effects of the affirmative action policy and conclude.

I Uganda's Generalized HIV Epidemic and Behavior Change in Young Women

Uganda's early control of its generalized HIV epidemic has been pointed to as a model for the rest of the Sub-Saharan Africa.[5] In this section, we review the evidence on the HIV reduction over the early to mid-nineties.

The most complete data on HIV status over the time period of interest comes from antenatal clinics (ANC); most pregnant women attend such clinics, and many Ugandan clinics have standard HIV screening (UNAIDS, 2008b).[6] Although the ANC data have been widely criticized for not being representative of the trends in the general population (for example, among nonpregnant women) we cross-check estimates of prevalence in the ANC with those from a population based survey on HIV prevalence in Uganda in 1989 (Konde-Lule and Downing, 1989). We verify that the rates of HIV among young women were remarkably high–16 percent for women between 15 and 24 years of age compared to eight percent for men–suggesting the trends in the ANC are relevant for the wider population in our context.[7] Figure 1 shows HIV positive rates in Uganda between 1987 and 2005. In 1987, about one-quarter of pregnant women in urban areas in Uganda tested positive for HIV. Between 1987 and 1990, the HIV positive rate rose by 5 percentage points. It then fell markedly. The cumulative reduction in HIV in urban areas of Uganda was approximately 20 percentage points, or about two-thirds of the pre-reduction peak. The majority of this decline occurred between 1990–1995. This is the time period of focus in our analysis. Notably, the decline in HIV in Uganda was not restricted to urban areas suggesting that "epidemic burn out" from exceedingly high mortality was not the primary driver of the decline.

The trend in HIV in Uganda over this time period stands in stark contrast to those in other sub-Saharan African countries (figure 2). Kenya, just east of Uganda, had an urban ANC-based HIV prevalence rate of about 16 percent from 1993 to 2001 and has only recently experienced a decline. Tanzania, a Southern neighbor of Uganda, likewise has not seen an appreciable decline. The ANC rates of Southern African countries hardest hit by the epidemic (for example, Botswana and South Africa) continued to climb over this time period. These figures suggest that changes at the country-level must therefore be responsible for the Uganda's progress, not a regional secular trend. There has been much debate over what caused Uganda's decline. Considerable attention has been paid to the ABC policy of abstinence, be faithful and use condoms consistently. While space prohibits a full literature

[5]Despite the recent uptick in prevalence, the startling decrement in HIV prevalence in the mid-nineties still is regarded as a major public health success.

[6]In the 1980s, the majority of Kampalan women attended an antenatal clinic at least once during their pregnancy.

[7]The screened prevalence rates from antenatal clinics are typically sent to the Joint United Nations Programme on HIV/AIDS (UNAIDS), which compiles them. In compiling the data, UNAIDS uses the median percentage rate of all antenatal clinics reporting in a given year, since some of the clinics do not include the number of women tested. The trends are the same, however, when looking at clinics present over the entire time period or forming a chain index linking clinics in adjacent years.

review of all the relevant epidemiological studies, a particularly useful summary can be found in Green et al. (2006). The major criticism in drawing conclusive evidence from epidemiological modeling is the lack of high quality data over this time period.

Despite this limitation, a few facts emerge from the available DHS and ANC data and are gathered in table 1. First, based on serial cross-sections in the DHS, the number of never married women who had never had sex rose significantly over the time period 1988 to 1995 from 56 to 64 percent (MEASURE DHS, 1995).[8] The share of women in this cohort who had ever had a child also declined from 14 to 12 percent suggesting this was not simply misreporting due to social desirability bias. In addition, for those women who did debut between the ages of 15–24, either because they married or because they had premarital sex, the age at first sex increased by about three months. When examining the ANC data, Figure 3 demonstrates some of these trends in sexual activity may have translated into lower HIV infection rates for women at risk. For example, the HIV rate fell most dramatically at younger ages, and was relatively unchanged among older women. Indeed, the rate was flat among women aged 25 and older. In our analysis, therefore, we concentrate on explaining the trend for women 15 to 24 in the early nineties.

II Why Did Young Women Abstain? The Role of Education

In this section we examine what could have motivated such changes in sexual activity among young women. According to the Ugandan DHS, secondary education rose by 12 percentage points among 15–24 year-old women over the period 1988 to 1995. A similar trend was not noted in Kenya (32 to 31 percent between the 1989 and 1993 Kenya DHS) or Tanzania (10 to 12 percent between the 1991 and 1996 Tanzania DHS) over approximately the same time period. The notion that female education may be causally linked to risk reduction and sexual behavior change has been demonstrated in several studies in Sub-Saharan Africa (Baird et al., 2011; Duflo et al., 2011; Bandiera et al., 2012). However, specifically with respect to HIV, findings by Fortson (2008) and Hargreaves and Glynn (2002) have shown that education, potentially as a marker of greater socioeconomic status and mobility, is correlated with *higher* rates of HIV in Africa. Case and Paxson (2009) reconcile these findings noting that education can only be useful to individuals if information is available. Case and Paxson argue that in the early years of the HIV epidemic, before knowledge of the mechanism of spread of the virus was known, female education and premarital sexual activity were positively correlated with HIV. They argue this effect should attenuate and even reverse direction over time as more educated women have access to information to protect themselves against the virus. The authors indeed find evidence to support their predictions about the dynamic relationship between behavior change, current regional HIV prevalence and education from repeated cross-sections of DHS surveys from a sample of African countries.[9]

In Uganda, many individuals were made aware of the HIV epidemic relatively early due to the national information campaign spearhead by President Yoweri Museveni. Indeed, by 1995 almost all young women (97 percent) in the DHS had heard of AIDS and the majority knew that it was a disease spread by sex. This knowledge varied by educational status, approximately 85 percent of women between ages 15–24 with a secondary education knew that HIV could be transmitted sexually whereas only 25 percent of those without education expressed knowledge of this (DHS 1995). We now turn to examining whether some of the

[8]Given that the percent attending secondary school in this cohort (never married 15 to 24), increased 12 percentage points over the same time period–one percentage point gain in women attending secondary school is correlated with a 3/4 percentage point reduction in sexual debut.

[9]Both the Fortson (2008) and Case and Paxson (2009) surveys exclude Uganda which does not make its 2004 AIDS Indicator Survey readily available.

behavior change documented in the previous section might be explained by the trends in female education.

OLS Estimates

To examine the link between education and sexual activity for young Ugandan women in the early 1990s, we estimate an equation of the form:

$$Virgin_{icd}=\beta_0+\beta_1 School\ Enrollment_i+X_i^{'}\beta_2+X_c^{'}\beta_3+\gamma_d+\varepsilon_{icd} \quad (1)$$

where i indicates individual, c indicates cluster and d indicates district. β_1 tests whether school enrollment is correlated with virginity. We include all women aged 15–24 in the 1995 Uganda DHS in our sample.

We first present the OLS results in table 2. As can be seen, in column 1, women who are still in school are three-fifths more likely to be virgins than those who are not. The R-squared is relatively large (0.27) given this is a cross-sectional, univariate analysis. Since education is not randomly assigned we may be picking up selection bias in that girls who choose to attend school, or whose parents choose to send them, will be different in potential outcomes than girls who do not attend school. To mitigate the effects of selection bias, we take three steps.

Our first approach is to control for observables that might be correlated with schooling choices. In column 2 we include individual characteristics such as individual ethnic and religious covariates as well as year of birth fixed effects. We also include fixed effects for district of residence and distance to urban center since locational characteristics (such as being near a trade route) may influence the level of sexual activity in that area. We also include a proxy for healthcare access (a binary indicator for whether the area was covered by a trained healthcare provider). Adding these controls reduces the magnitude of our effect by about a third, to 0.41 (s.e. 0.03), though it remains highly statistically significant and the variation due to school enrollment is larger than those of all other added covariates combined.[10] Another way to benchmark the results of school enrollment on sexual debut is to compare its coefficient to cultural factors, such as the effect of being Catholic or being from the Baganda ethnic group (both of which are negligible).

As discussed above, the evidence on the relationship between socioeconomic status and HIV risk in Africa is mixed. Fortson (2008) finds a positive relationship whereas data from randomized controlled trials suggests that sexual activity responds negatively to income (Baird et al., 2011; Duflo et al., 2011; Bandiera et al., 2012). To investigate whether household wealth is an omitted variable biasing our results, we include an indicator for whether the head of the household is a woman.[11] Though are results are identical when using the quintiles of the DHS compiled wealth index (specifically, the point estimate is 0.39 with a s.e. of 0.03), this index has been criticized for conflating involvement in the cash economy with wealth and downweighting traditional forms of wealth in East Africa (Bingenheimer, 2007). On the other hand, households headed by a woman (usually due to abandonment or widowhood) are considered relatively poor based on consumption patterns or when ranked by neighbors (Alatas et al., 2012).[12] Our point estimates barely respond to

[10]Controlling more flexibly for the five religions and 25 ethnic groups in Uganda by including dummy variables for each yields a point estimate of 0.41 (s.e. 0.028) on school enrollment; the R-squared is 0.47.

[11]Using the DHS asset index gives similar results, but is less useful in rural settings where wealth is often measured in livestock and agricultural products as opposed to durable goods.

[12]Widows and divorced females are evenly distributed across all quantiles of the 1995 DHS Wealth Index.

the addition of this measure of poverty. Interestingly, households that are female-headed are more likely to have a young female respondent who is a virgin.

Next, in column 4, we examine whether information about HIV may be confounding the effects of education on sexual behavior. For instance, education could just be a proxy for being more informed or school could expose one to HIV prevention messages. To disentangle these effects, we include an indicator for whether the respondent knows that HIV is transmitted sexually. Again, the point estimate on school enrollment is not affected by this additional covariate, but the sign on "information" is opposite to what we anticipated. If a respondent knows HIV is transmitted sexually, she is actually less likely to be a virgin.

In addition to conditioning on several important factors, our second attempt to mitigate selection bias is to limit the sample to women who are more alike on unobservables. In column 5, we exclude women who dropped out of school due to pregnancy and those who recently moved. In the DHS data, we do not have district of birth, so we use a variable on tenure at current residence and eliminate all those women who moved within the last twelve months or who are reportedly visitors. Column 5 reports these results of the restricted sample with all covariates added. This reduces our sample size considerably but the point estimate on school enrollment is not significantly different from column 2.

Instrumental Variables approach

Despite the relative stability of the estimates of school enrollment on virginity in table 2, some unobservable factor(s) might still be driving the results undermining their validity. In this subsection, we instrument for school enrollment using distance of the girls' survey cluster to the nearest secondary school (Z_C).[13] The distance metric is taken from the Service Availability component of the DHS and is measured in kilometers. In poor countries such as Uganda, distance to school has been shown to negatively predict school enrollment (Bommier and Lambert, 2000; Glewwe and Jacoby, 2004), and therefore clearly satisfies the requirement of instrument relevance. In order for our instrument to be valid, however, it must be that $cov(Z_c, \varepsilon_{ikc}) = 0$. There is legitimate concern that women who are located near as opposed to far from a secondary school may be somewhat different in terms of their propensity to engage in risky sexual behavior. This threat to the validity of the instrument is predicated on the notion that location of the school or the location of the respondent in relation to the school is endogenous–and therefore the instrument is not orthogonal to potential assignment and outcomes.

We defend the exclusion restriction in several ways. First, since the distance is measured at the cluster level, individuals must have moved between clusters (groups of villages) in order to be closer to a school. Although that kind of migration is possible, given the importance of social networks and village-level insurance we think this is much less of a threat than had distance been measured using GPS coordinates from a girls' current residence. Furthermore, we are able to restrict our sample to women who have not recently changed residencies and are not self-identified as visitors and find similar results.[14]

Regarding the second issue, that the schools themselves are not randomly located in the country, we review the history of the development of the education sector in Uganda. The literature suggests that the location of many schools, especially in rural Africa, is plausibly orthogonal to potential outcomes of sexual activity among women conditional on certain

[13]These questions were asked of "knowledgable informants" living within the cluster

[14]Note also that there is no significant difference in the length of tenure at current residence between women based on distance from a secondary school (table 2, row 1).

locational features. Christian Missionaries played an enormous role in the establishment of educational institutions throughout East Africa. The objective of the Missionaries was not necessarily to locate in the most centralized areas. Their location choice was influenced by access to agriculturally suitable land and supplies as well as targeting groups participating in the slave trade (which the Missionaries sought to abolish) (Nunn, 2010). That religious groups were crucial to the introduction of widespread formal education in Uganda is argued by (Ssekamwa, 1997, p. 240)

> Missionaries, the Ugandan chiefs and their subjects played a key role in establishing the new Western type of schools and in financing them…the Phelps-Stokes Commission, 1924–25 from the USA thus wrote, 'An educational system which branches out into the whole Protectorate has been brought into being.'

The concern that distance to school is picking up something about urbanization or desirable locations can also be handled econometrically. As in the OLS estimates, we control for any general location specific factors that may influence school access and sexual norms. Also from the DHS Service Availability data set, we know the distance of the girls' survey cluster to the closest urban center which we include as a control. As above, we include a measure of health care provision (whether there is a trained health professional in the area) since Missionaries helped establish health as well as educational facilities and access to contraception might also influence sexual behavior.

Table 3 presents a balance test and demonstrates that after controlling for locational factors that might have influenced Missionaries' initial choice of location, distance to secondary school does not predict respondent's information about HIV, religious or cultural background or length of residence in her current locale. We also show that in the first stage, distance to the nearest urban center has an insignificant effect on school attendance once controlling for district fixed effects across most specifications (table 4 panel B). This likely reflects the path dependence of the educational system's development and the positive but modest correlation between the two distance measures in our sample ($\rho = 0.44$).[15]

In general, the IV estimates of school enrollment on virginity are slightly bigger than the OLS estimates, consistent with measurement error in the self-reported schooling variable (Ashenfelter and Krueger, 1994). The coefficient on school enrollment is large; being enrolled in school increases the probability of being a virgin by about 86 percentage points in column 5, though the standard errors are larger as well and the overall pattern of coefficients in table 4 is within one or two standard deviations of the OLS estimates.

Thus, it seems clear that staying in school has a large effect on sexual debut. Coincident with the reduction in HIV demonstrated in figures 1 through 3, figure 4 shows a steady rise in secondary education for young girls in 1990.

Affirmative Action and Higher Education

We are not able to open the black box of why education reduces sexual activity (whether it is an incarceration effect, changes in discount factor or aspirations for a career outside the home) with the data that is available, but we can explore why young women stayed in school. We now turn to explaining this trend.

The rule of Idi Amin, Uganda's military dictator from 1971–1979, was particularly detrimental for women. His militia frequently used rape to suppress dissent and banned all independent women's organizations (Tripp, 2002). Following Museveni's rise to power,

[15]We do not have distance to worship center or intensity of religious beliefs in our data set–therefore we cannot exclude the possibility that distance to school may be conflated with religiosity.

women gained the right to organize and sought elected office. One of their priorities was gender equality in education. These efforts led to the institution of an affirmative action policy in 1990 that gave women 1.5 extra points on their entrance exam to public Universities (the Uganda Advanced Certificate of Education Examination)(Muhewzi, 2003). Most students will sit for either three or four subjects in their area of study (arts or sciences). Their scores on the various subjects are then weighted based on the requirement of individual programs within faculties, and the top-scoring students are admitted. Although the governmental documents only report letter grades and pass/fail, the average numerical score for an accepted candidate based on media reports and key informant interviews is around 20 today (Kanyesigye, 2013). David (2007, p.20) describes the policy as follows:

> For a long time, there was only one University in Uganda, Makerere University.[16] This limited opportunities for both boys and girls. Even then, boys were more favoured by the system until the famous 1.5 was introduced to enable eligible females to access University education. The 1.5 was added to the total score of all individual girls as an affirmative action policy. This has increased girls enrolment from about 20 percent to nearly half the total number of students currently at Makerere University.

The response to the policy occurred rather quickly. Female enrollment in Makerere increased from 24 percent in 1989/1990 to 35 percent by 1993/1994 (MOES, 2001). Although only a small percentage of girls were actually admitted into University, the cultural value of girl's education and/or the possibility of attending beyond secondary school may have influenced behavior. The latter is an example of an "aspiration gap" as defined by Debraj Ray (2003)— it is the difference between what one believes can be attained and one's current situation that drives future-oriented investment behavior. The policy was well-known and may have affected the perceived returns to girls' higher education, especially for those living near a public University.[17]

Using data from the 2002 Uganda Census (10 percent sample, (Minnesota Population Center, University of Minnesota, 2011)), we examine whether the rise in attendance at secondary school was associated with the introduction of the affirmative action policy. In addition to timing and gender, we utilize the differential impact of the policy on individuals born closer to a public University versus those further away. Our setup is similar to that of Duflo (2001):

$$\begin{aligned} S_{idk} = \beta_0 + \sum_k \alpha_k age_i + \sum_d \delta_d district_i + \beta_1 female_i + \beta_2 \left[young_i * \ln(dist)_i^{-1} \right] \\ + \beta_3 \left[\ln(dist)_i^{-1} * female_i \right] + \beta_4 [young_i * female_i] + \beta_5 \left[female_i * \ln(dist)_i^{-1} * young_i \right] \\ + \beta_6 P_{dk} + \varepsilon_{idk}, \end{aligned} \quad (2)$$

where S_{idk} is an indicator variable for whether individual i in district d of age k completed secondary school or obtained more than seven years of schooling. Age is a set of cohort dummies. *dist* refers to distance from the centroid of the district the respondent was born in to the nearest public University.[18] We use the district of birth to avoid endogenous mobility.

[16] Makerere opened in 1922. Mbarara University of Science and Technology opened in 1989. No other public Universities opened until the late nineties. Three small private institutions also opened over this time period (two of which had an enrollment of approximately 80 students each).

[17] We do not anticipate *a priori* that aspirations should be higher for girls of different SES background, and do not find differences between the two groups when dividing the sample by median wealth in the DHS data (though there are several problems with this measure of household wealth, as discussed in the text). Perception of the returns to schooling has been found to be particularly important in determining years of schooling completed in developing countries (Jensen, 2010). Furthermore, (Niederle et al., 2013) finds that gender specific affirmative action increases the entry of women into competition above that which would be expected based on their probability of winning. This "over-reaction" may partly be due to changes in women's perceptions about what they can achieve.

In particular, parents would have had to have anticipated this policy by about a decade in order to have their (girl) children born closer to the University for selection on dynastic human capital preferences to be strongly biasing our estimates. Young refers to children aged 8–12 in 1990, on the cusp of entering secondary school the time when the policy was initiated. The control group includes individuals ages 19 to 23 in 1990, who, on average, would have been too old for secondary school.[19] P_{dk} is the (normalized) district-cohort population.

Table 5 panel A shows the results of the coefficient on the triple interaction between female, young, and the inverse log of distance. The triple interaction is positive and statistically significant–that is, secondary school completion rates rose more for young girls near the Universities than for older girls in those areas, or for boys living in those same areas. The same is true for the alternative measure of higher education, obtaining more than seven years of schooling (panel A, column 2).

Table 5 panel B presents the results of the placebo experiment (comparing women aged 19–23 in 1990 to those aged 24–28). Using either measure of higher education, the triple difference fails to achieve significance at conventional levels and is significantly different from the estimates in panel A.

We can extend the analysis by allowing the treatment intensity to vary for each birth cohort. Specifically, we replace the young dummy variable with a set of age dummies in each of the parts of equation (2):

$$\begin{aligned} S_{idk} = \beta_0 + \sum_k \alpha_k age_i + \sum_d \delta_d district_i + \beta_1 female_i + \sum_k \zeta_k \left[age_i * \ln(dist)_i^{-1} \right] \\ + \beta_2 \left[\ln(dist)_i^{-1} * female_i \right] + \sum_k \mu_k [age_i * female_i] + \sum_k \lambda_k \left[age_i * \ln(dist)_i^{-1} * female_i \right] \\ + \beta_3 P_{dk} + \varepsilon_{idk} \end{aligned} \quad (3)$$

Individuals age 30 in 1990 are considered the control and this dummy is omitted from the regression.

The coefficients of interest are the $\lambda_k' s$, which show the secondary schooling completion rates for girls versus boys, near versus far from the public Universities, before and after the policy was put in effect. The $\lambda_k' s$, as well as their three year moving average, are graphed in figure 5. The vertical lines represent the approximate age of entry into primary school, secondary school, and University in 1990. There is a steep upward slope in female secondary school attendance between ages 12 and 18 (lines 2 and 3), the age groups where University admissions would be increasingly important. The effect flattens out for those in primary school at the time of the policy change.

The one anomalous feature of the chart is a decline in relative secondary school completion for girls less than 6 years old in 1990. This is likely because many young children have not yet reached the age of secondary school completion at the time of the 2002 Census. In addition, Uganda implemented a Universal Primary Education initiative in 1997, which led

[18] Distance is measured in meters (so there are no distances ≤ 1). We use the inverted log of this distance so that we are capturing the effect of being relatively close to a public University. Unfortunately, due to changes in the district boundaries and the creation of new districts over the time period 1995–2002, we cannot add distance to secondary school as a control in the analysis.

[19] Primary school usually starts around age 6 though some children in Africa start later. Secondary school starts around age 13 until age 18.

to compositional changes in the students enrolled in primary school, and this may have had spillover effects for those in secondary school.

III Implications

The evidence presented in this study suggests that education policies targeting women can account for some of the increase in secondary education during the early nineties. To evaluate the impact of the education policy on HIV we need three estimates: the impact of the policy on female enrollment, the impact of enrollment on virginity and how abstinence affects HIV ($\frac{\partial Enroll}{\partial Policy}\frac{\partial Virgin}{\partial Enroll}\frac{\partial HIV}{\partial Virgin}$). For the first of these, we modify equation (2), changing the educational outcome to be a dummy for whether an individual was still in school at a given age. We focus on those who stayed in school past primary age (e.g., in school for at least 7 years). The coefficients on the triple interaction by age are shown in table 6, column (2). We find an increase in enrollment of about fourteen percentage points among the "young" cohort as defined in equation (2).[20] We multiply this number by the two-stage least squares estimate of the impact of enrollment on virginity (86 percentage points, column 5 in table 4, reproduced as column 4 in table 6) to calculate that the policy increased virginity by about 12 percentage points among those girls on the cusp of entering secondary school in 1990.[21]

The last part of the equation, $\frac{\partial HIV}{\partial Virgin}$, depends crucially on the elasticity of men's demand for sex. The price of sex is predicted to rise as the supply of female partners declines. If this demand is relatively inelastic, then the effect of delayed debut may be muted; HIV positive men will simply have sex with other women. Anthropological literature suggests that men's demand for sex is relatively inelastic, at least in the short run. Luke (2001) reports that "sugar daddies" prefer sex without a condom. However, if age and economic disparities are not great enough to impose this preference on their partner, these same men will use a condom and have sex with older, less impoverished women or commercial sex workers.

Unlike the first two estimates, which are regression estimates (see table 6), the effect of delayed sexual debut (or prolonged virginity) on the lifetime risk of HIV ($\frac{\partial HIV}{\partial Virgin}$), is best obtained by simulation. Lifetime risk is defined as the expected probability at birth that an individual will have been infected with HIV by their 55th birthday. Epidemiologic modeling has suggested the effect of abstinence can reduce lifetime HIV risk by between three to eight percentage points depending on the elasticity of male sexual behavior (Hallett, 2007). In other words, if men are able to recoup all their sexual activity through sex with other (older) women, then the efficacy of delayed sexual debut among young women in reducing lifetime HIV risk is only three percent (see the appendix to Hallett et al., 2007).[22]

Using this estimate in our simulation implies that the policy change would amount to between a two and six percentage point reduction in HIV prevalence among this cohort. Based on the ANC data in figure 6, HIV prevalence fell by 13 percentage points between 1990 and 1995. Therefore, the policy can explain between one-sixth and one-half of this overall decline, if most of the lifetime risk for acquisition is in the premarital period.

IV Conclusion

Uganda is viewed as a public health success for its ability to curtail the HIV/AIDS epidemic in the 1990s. Although much has been written about the informational campaign of ABC,

[20]The average of coefficents evaluated at the mean in column (3) is about fourteen.
[21]The effect will be smaller for those already in secondary school in 1990, see figure 5.
[22]In our working paper version, our epidemiological model predicted that the effect of delayed debut/prolonged virginity on HIV would lead to about a eight percentage point reduction in HIV prevalence among this cohort (Alsan and Cutler, 2010).

we review the role of education, particularly among women, in abetting this decline. Our study was motivated by several facts that emerged from the available data during the time period. First, as indicated in figure 3 using data from urban antenatal clinics, the decline in HIV prevalence over this time period was most impressive for young women. Second, reviewing the DHS, young women became less risky in their sexual behavior.

We next explored why young women changed their behavior. We found that the percentage of females enrolled in secondary school increased greatly in Uganda as compared to other East African countries over this time period. Instrumenting for school attendance with distance to secondary school, enrollment was strongly predictive of (reported) virginity. Exploiting heterogeneity by gender, birth year and location, we found girls stayed in school longer partly in response to the increased opportunities for higher education brought about by an affirmative action policy.

There are two natural extensions to our work. First, it would be useful to extend our analysis to later years to explain the second phase (albeit much less steep) of Uganda's HIV decline. Researchers tackling more recent periods have to contend with the introduction of HIV treatment and the complexities (moral hazard, decreasing transmission due to reduced viral load) that the expectation and distribution of antiretroviral therapy introduces into the analysis (see Friedman (2013)). Further, HIV prevalence may mechanically rise as more people with HIV are kept alive on treatment.

Second, our results support the view that encouraging girls to stay in school delays their sexual debut and reduces their lifetime risk of acquiring HIV. Do these results imply that gender-targeted education policies are especially effective ways to curtail HIV? A complete answer to this question would involve additional research on the costs and benefits of such policies for both men and women in the long run. For example, a greater supply of educated women may lead to more female policymakers promoting an agenda of gender equity (Duflo and Chattopadhyay, 2004). On the other hand, if men prefer less-educated spouses, this could tighten the marriage market and lead to more pre-marital sexual activity (marital shopping). This, too, we leave to future research.

References

Alatas V, Banerjee A, Olken HRB, Tobias J. Targeting the Poor: Evidence from a Field Experiment in Indonesia. American Economic Review. 2012; 102:1206–1240.

Alsan, M.; Cutler, D. NBER Working Paper. 2010. Why Did HIV Decline in Uganda?; p. 16171

Ashenfelter O, Krueger A. Estimates of the economic returns to schooling from a new sample of twins. American Economic Review. 1994; 84:1157–1173.

Baird S, McIntosh C, Ozler B. Cash or Condition: Evidence from a Cash Transfer Experiment. The Quarterly Journal of Economics. 2011; 126:1709–1753.

Bandiera, O.; Buehren, N.; Burgess, R.; Goldstein, M.; Gulesci, S.; Rasul, I.; Sulaiman, M. LSE mimeo. 2012. Empowering Adolescent Girls: Evidence from a Randomized Control Trial in Uganda.

Becker, G. NBER. Demographic and Economic Change in Developing Countries. UMI; 1960. An Economic Analysis of Fertility.

Bingenheimer J. Wealth, Wealth Indices and HIV Risk in East Africa. International Family Planning Perspectives. 2007:83–84. [PubMed: 17588852]

Black S, Devereux P, Salvanes K. Staying in the Classroom and Out of the Maternity Ward? the Effect of Compuslory Schooling on Teenage Births. Economic Journal. 2008; 118:1025–1054.

Bommier A, Lambert S. Education demand and age at school enrollment in tanzania. Journal of Human Resources. 2000; 35:177–203.

Case, A.; Paxson, C. NBER Working Paper 15000. 2009. The impact of the aids pandemic on health services in africa: Evidence from demographic and health surveys.

David, M. Development Policy Management Forum. 2007. Gender policies in Uganda: The thorny Road to Gender Equality.

Duflo E. Schooling and labor market consequences of school construction in indonesia: Evidence from an unusual policy experiment. American Economic Review. 2001; 91:795–813.

Duflo E, Chattopadhyay R. Women as policymakers: Evidence from a randomized policy experiment in India. Econometrica. 2004; 72:1409–1443.

Duflo, E.; Dupas, P.; Kremer, M. Stanford mimeo. 2011. Education, HIV and Early Fertility: Experimental Evidence from Kenya.

Fortson J. The Gradient in Sub-Saharan African: Socioeconomic Status and HIV/AIDS. Demography. 2008; 45:303–322. [PubMed: 18613483]

Friedman, W. UC Berkley mimeo. 2013. Antiretroviral Drug Access and Behavior Change.

Glewwe P, Jacoby H. Student achievement and schooling choice in low-income countries: Evidence from Ghana. Journal of Human Resources. 2004; 29:843–864.

Green E, Halperin D, Nantulya V, Hogle J. Uganda's Hiv Prevention Success: The Role of Sexual Behavior Change and the National Response. AIDS Behavior. 2006:335–346. [PubMed: 16688475]

Hallett, Timothy, et al. Behavior change in generalized hiv epidmics: impact of reducing cross-generational sex and delaying sexual debut. Sexually Transmitted Infections. 2007:i50–i54. [PubMed: 17314125]

Hargreaves JR, Glynn JR. Educational attainment and HIV-1 infection in developing countries: A Systematic Review. Tropical Medicine and International Health. 2002 Jun; 7(6):489–498. [PubMed: 12031070]

Jensen R. The (perceived) returns to education and the demand for schooling. The Quarterly Journal of Economics. 2010; 125:515–548.

Kanyesigye, F. The Independent Kampala. Mar 11. 2013 Uganda: Same gender, different gains.

Keats, A. Wesleyan University mimeo. 2012. Women's Schooling, Fertility, and Child Health Outcomes: Evidence from Uganda's Free Primary Education Program.

Konde-Lule, Joseph SB.; Downing, R. Knowledge, attitudes and practices concerning AIDS in Ugandans. AIDS. 1989; 3:513–518. [PubMed: 2508712]

Lavy, V.; Zablotsky, A. Hebrew University mimeo. 2011. Mother's Schooling and Fertility under Low female Labor Force Participation: Evidence from a Natural Experiment.

Luke N. Confronting the 'Sugar Daddy' Stereotype: Age and Economic Asymmetries and Risky Sexual Behavior in Urban Kenya. International Family Planning Perspectives. 2001; 31:6–14. [PubMed: 15888404]

MEASURE DHS. Uganda Demographic and Health Surveys. 1988, 1995. online at http://www.measuredhs.com/

Minnesota Population Center, University of Minnesota. Integrated Public Use Microdata Series v 6.1 Uganda 2002 Census 10 percent sample. 2011.

MOES. The Development of Education in Uganda in the last Ten Years. 2001.

Muhewzi, D. UNESCO background paper prepared for Education for All Global Monitoring Report. 2003. Gender Sensitive Educational Policy and Practice: A Uganda Case Study.

Niederle, M.; Segal, C.; Vesterlund, L. Management Science. 2013. How Costly is Diversity? Affirmative Action in Light of Gender Differences in Competition?. forthcoming

Nunn N. Religious Conversion in Colonial Africa. American Economic Review Papers and Proceedings. 2010; 100:147–152.

Osili UO, Long BT. Does Female Schooling Reduce Fertility? Evidence from Nigeria. Journal of Development Economics. 2008; 87:57–75.

Ray, D. New York University mimeo. 2003. Aspirations, Poverty and Economic Change.

Schoepf BG. Uganda: Lessons for AIDS control in Africa. Review of African Political Economy. 2003; 30:553–572.

Schultz TP. Why Governments Should Invest More to Educate Girls. World Development. 2002; 30:207–225.

Ssekamwa, J. History and the Development of Education in Uganda. Fountain Publishers; 1997.

Tripp, AM. A New Generation of Womens Mobilisation in Uganda. Fountain Publishers; 2002.

UNAIDS. UNAIDS Epidemiological Fact Sheets. Geneva: 2004, 2006 & 2008b.

UNAIDS. Report on the Global HIV Epidemic. Geneva: 2008a.

USAID. What Happened in Uganda?. Washtington D.C: 2002.

VI Appendix

1. Access to a Healthcare Provider: This variable is binary and equal to one if the area (sample cluster unit) was covered by a trained healthcare provider and zero otherwise-variable (c133). Source: UDHS 1995 (Service Availability Dataset)
2. Distance to Public Universities: This was calculated using coordinates for Makerere (0.35, 32.68) and for Mbarara University of Science and Technology (−0.62, 30.66). A map of Ugandan districts was projected into Africa_Equidistant_Conic. The centroid of each individual's birth district (BPLUG) was then used. Distance was calculated in meters using the Near tool in ArcMap 10, as the distance between the centroid of the respondent's birth district and the nearest public university. Source: Uganda 2002 Census.
3. Distance to Secondary School: This variable is defined as distance from a girls' cluster to secondary school and is measured in kilometers -variable (c111b). Source: UDHS 1995 (Service Availability Dataset)
4. Distance to Urban Center: This variable is defined as distance from a girls' cluster to an urban center with greater than 20,000 inhabitants and is measured in kilometers -variable (c103). Source: UDHS 1995 (Service Availability Dataset)
5. HIV Information: Knows that AIDS is transmitted by sex. Source: UDHS 1995.
6. Secondary School Attendance: This variable is an indicator equal to one if the individual completed secondary school. Specifically, EDATTAND must be equal to 221 or 311 in the data set, corresponding to completion of lower or upper secondary general school. Secondary technical track was excluded since this would not have been affected by the 1990 affirmative action policy (technical training is a substitute for university education). Source: Uganda Census 2002.
7. Virginity: This variable equals zero if the respondent gives an age to a question on age of first intercourse (v525). Source: UDHS 1995.

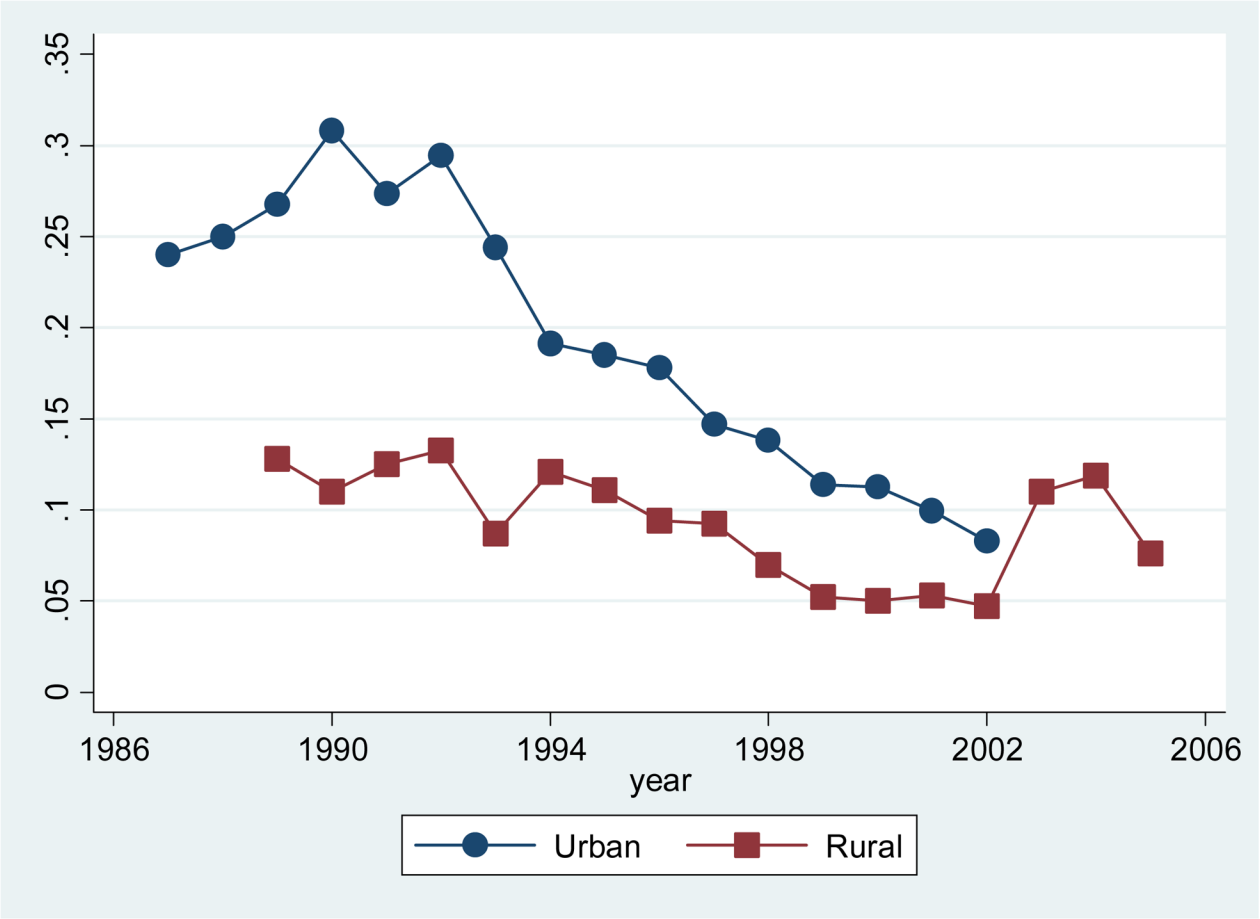

Figure 1. Median HIV Prevalence Among Pregnant Women, Uganda

Notes: Data are from the UNAIDS Uganda Epidemiological Fact Sheets on HIV/AIDS from 2004, 2006 and 2008. Median annual prevalence is from antenatal clinics that performed surveillance HIV testing.

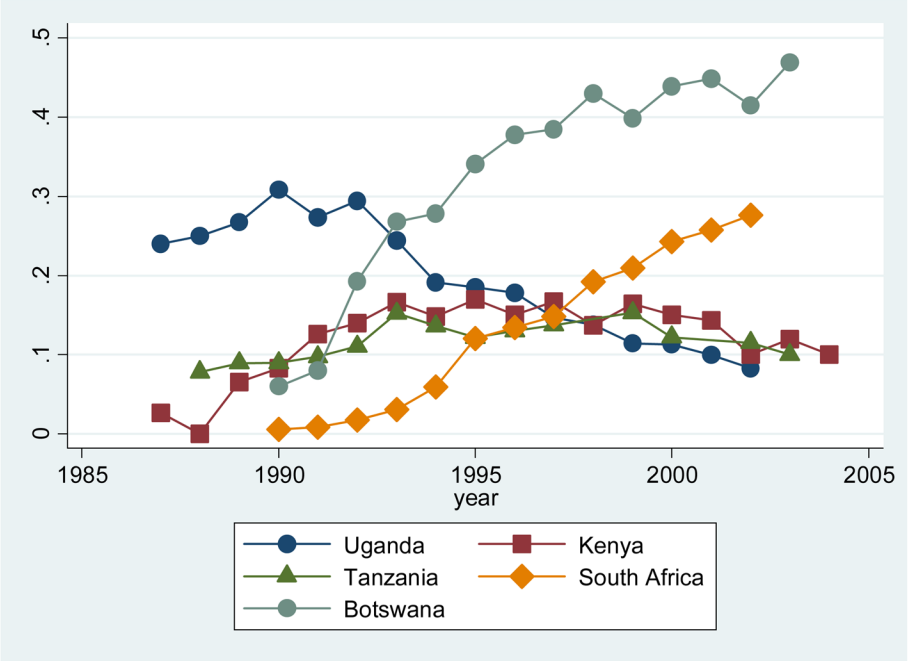

Figure 2. Median HIV Prevalence Among Pregnant Women in Urban Areas, Select Countries in Africa

Notes: Data are from the UNAIDS Epidemiological Facts Sheets on HIV/AIDS for the relevant countries from 2004, 2006 and 2008. Median annual prevalence is from urban antenatal clinics that performed surveillance HIV testing.

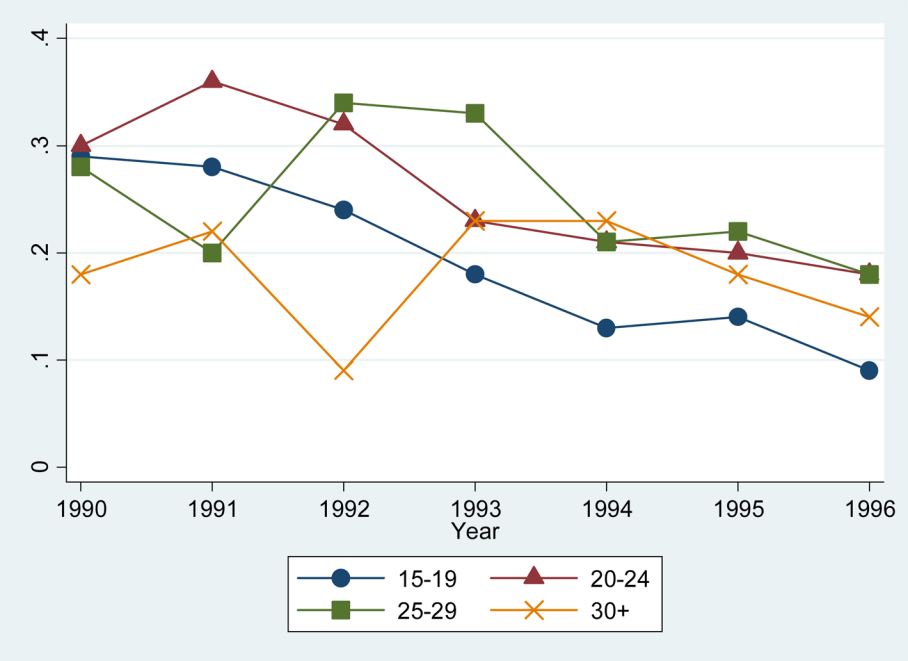

Figure 3. HIV Prevalence Among Pregnant Women by Age Group, Kampala

Notes: Data are from the United States Census Bureau, HIV/AIDS Surveillance website.

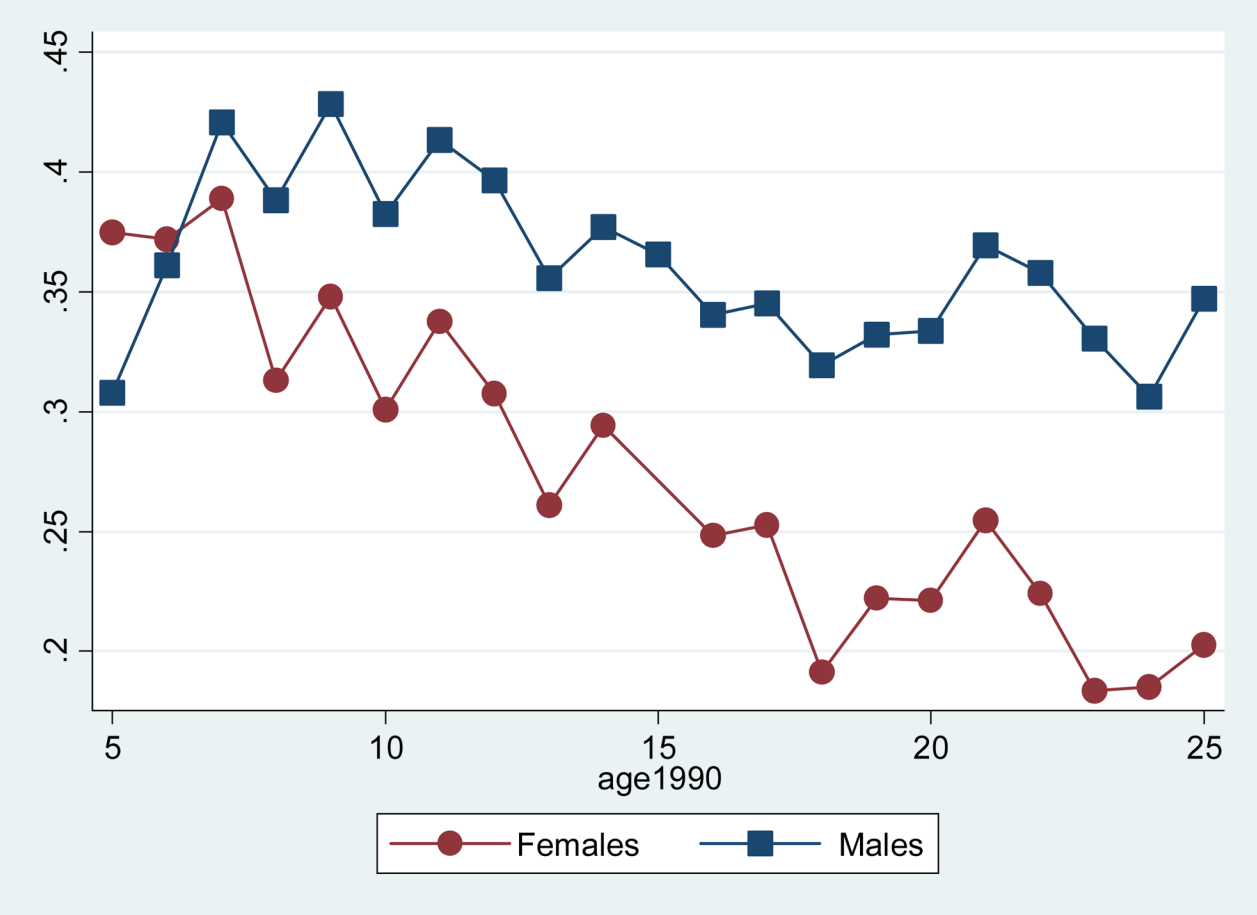

Figure 4. Secondary Schooling by Gender, Uganda

Notes: This figure shows the trend in receipt of greater than seven years of education for Ugandan females and males living near to a public University. Data are from the 2002 Uganda Census.

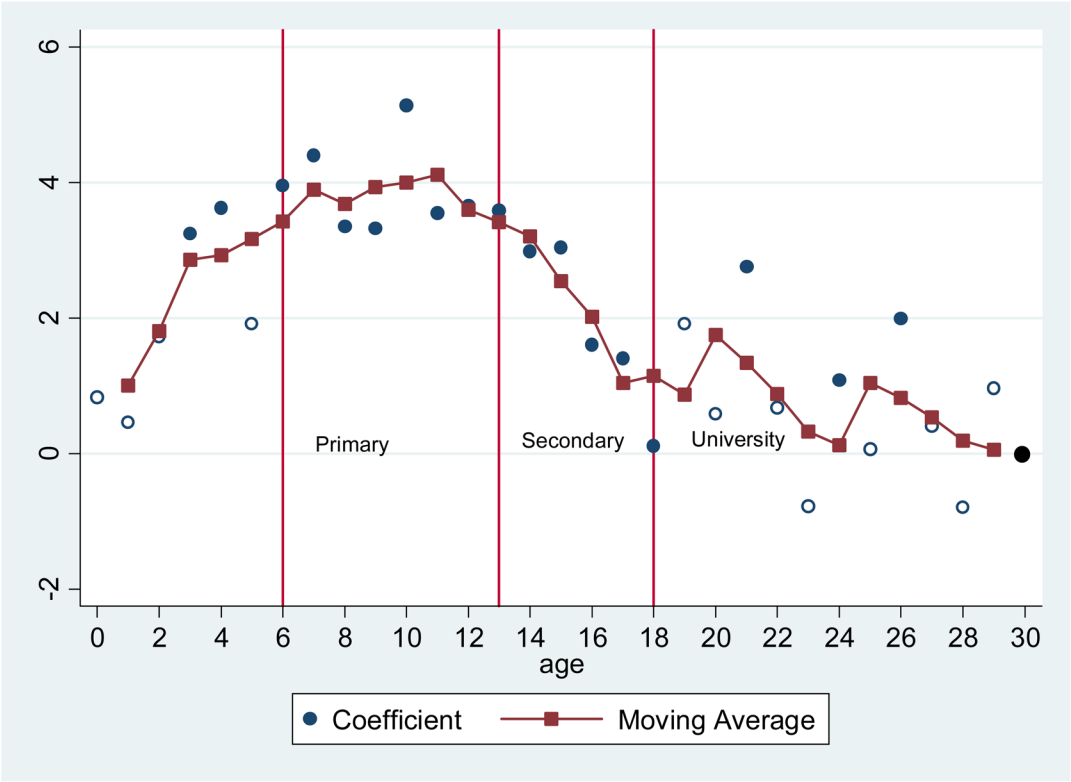

Figure 5. Effect of Affirmative Action on Girls' Secondary School Completion

Notes: This figure plots the triple interaction coefficients and their three year moving average from equation (3). The sample includes all men and women in the 2002 Uganda Census between the ages of 0 and 30 in 1990, the year in which an affirmative action policy granting women preferential treatment in their application to public Universities was enacted. The vertical lines represent the approximate cutoffs between primary secondary and University education. Standard errors are clustered at the district level. Filled in circles are coefficients significant at <10% level.

Table 1

Statistics on Behavior Change among Young Women

(1)	(2)	(3)
Variable	**Change**	**Source**
Secondary School Attendance	+12 %	UDHS 1988 to UDHS 1995
Ever giving birth	−2%	UDHS 1988 to UDHS 1995
Virgin	+8%	UDHS 1988 to UDHS 1995

Notes: Sample includes never married young women between the ages of 15 to 24.

Table 2

OLS Estimates of School Enrollment on Virginity

	(1)	(2)	(3)	(4)	(5)
Specification	**Unconditional**	**Individual and Locational Controls**	**(2) +Wealth proxy**	**(2) + HIV info proxy**	**(2) + Addnl Controls & Sample Restrictions**
School Enrollment	0.613*** (0.025)	0.412*** (0.028)	0.410*** (0.028)	0.412*** (0.028)	0.381*** (0.031)
Distance to nearest Urban center		−0.0002 (0.0003)	−0.0001 (0.0003)	−0.0002 (0.0003)	−0.0002 (0.0004)
Health care access		−0.003 (0.014)	−0.0001 (0.0003)	−0.003 (0.014)	0.004 (0.016)
Catholic		−0.003 (0.013)	−0.002 (0.013)	−0.002 (0.013)	−0.003 (0.015)
Baganda		−0.0009 (0.017)	−0.005 (0.017)	−0.001 (0.017)	−0.023 (0.020)
Female-headed			0.062*** (0.016)		0.069*** (0.020)
HIV Information				−0.016 (0.014)	−0.030* (0.016)
Year of Birth FE	N	Y	Y	Y	Y
District FE	N	Y	Y	Y	Y
Sample	Full	Full	Full	Full	Restricted
No. Observations	3176	3018	3018	3018	2178
No. Clusters	295	282	282	282	279
R-squared	0.27	0.46	0.47	0.46	0.49

Notes : OLS estimates of the effect of being currently enrolled on school on virginity. Full sample includes all those females between the ages of 15–24 in the Uganda 1995 DHS. Restricted sample includes only those females who have not recently moved (in the past year) to their current residence and are not self-identified as visitors. DHS 1995 does not contain district or place of birth of the respondent. Restricted also excludes girls who stated they dropped out of school due to pregnancy. Distances are in kilometers. Standard errors are clustered by survey cluster unit (group of villages).

* p<.1

** p<.05

*** p<.01

Table 3

Balance Test of Instrument

	(1) No Controls	(2) With Controls
Length of time at residence	0.103 (0.051)	0.053 (0.040)
	[6.04]	
Age	0.022** (0.009)	0.016* (0.009)
	[19.39]	
Baganda Ethnic Group	−0.011** (0.003)	−0.001 (0.001)
	[.210]	
Catholic	0.006** (0.003)	0.002 (0.003)
	[.411]	
AIDS information	−0.004** (0.002)	0.0001 (0.002)
	[.809]	
Stopped schooling due to pregnancy	−0.002** (0.0007)	−0.0006 (0.001)
	[.057]	
Female head of household	−0.003** (0.001)	−0.002 (0.002)
	[.212]	
Distance to market/urban center	N	Y
Health care access	N	Y
District FE	N	Y

Notes : Each cell reports the coefficent on the instrument (distance from secondary school in kilometers) on the left-most column variable. Precise definitions found in Appendix A. Data are from the Uganda1995 DHS. Standard errors are clustered by survey cluster unit and are in parentheses. Mean of the dependent variables are located in brackets.

* p<.1

** p<.05

*** p<.01

Table 4

IV Regressions of School Enrollment on Virginity

Panel A: Two Stage Least Square Estimates					
	(1)	(2)	(3)	(4)	(5)
Specification	**Unconditional**	**Individual and Locational Controls**	**(2) +Wealth proxy**	**(2) + HIV info proxy**	**(2) + Addnl Controls & Sample Restrictions**
School Enrollment	0.728*** (0.197)	0.968*** (0.350)	0.937*** (0.350)	0.966*** (0.347)	0.862*** (0.351)
Distance to nearest Urban center		0.0003 (0.004)	0.0003 (0.0004)	0.0003 (0.0004)	0.0003 (0.0006)
Health care access		0.015 (0.019)	0.013 (0.019)	0.014 (0.019)	0.023 (0.022)
Catholic		0.009 (0.017)	0.008 (0.017)	0.009 (0.017)	0.008 (0.019)
Baganda		−0.031 (0.028)	−0.032 (0.027)	−0.031 (0.028)	−0.057 (0.036)
Female-headed			0.051** (0.023)		0.053 (0.027)
HIV Information				−0.027 (0.017)	−0.046 (0.021)
Year of Birth Fixed Effects	N	Y	Y	Y	Y
District FE	N	Y	Y	Y	Y
Sample	Full	Full	Full	Full	Restricted
No. Observations	3176	3018	3018	3018	2179
No. Clusters	295	282	282	282	279
R-squared	0.26	0.28	0.29	0.28	0.39
Panel B: First Stage for School Enrollment					
	(1)	(2)	(3)	(4)	
Distance to secondary school	−0.007*** (0.001)	−0.005*** (0.001)	−0.004*** (0.001)	−0.004*** (0.001)	−0.004*** (0.001)
Distance to urban center		−0.0005 (0.0004)	−0.0005 (0.0004)	−0.0005 (0.0004)	−0.0008* (0.0004)
F- stat	18.7	6.5	6.3	6.5	6.2

Notes : 2SLS estimates of the effect of being currently enrolled on school on virginity using distance to secondary school in kilometers from the DHS Service Provider survey as an instrument. Full sample includes all those females between the ages of 15–24 in the Uganda 1995 DHS. Restricted sample includes only those females who have not recently moved (in the past year) to their current residence and are not self-identified as visitors. DHS 1995 does not contain district or place of birth of the respondent. Restricted also excludes girls who stated they dropped out of school due to pregnancy. Distance to urban center is also in kilometers. Standard errors are clustered by survey cluster unit (group of villages).

* p<.1

** p<.05

*** p<.01

Table 5

Effect of the Policy on Higher Education: Coefficients on the Interaction of Gender, Proximity to Public University and Cohort Dummies

	Secondary School Completion	Completed >7 Years of School
Panel A: Experiment Comparing Educational Outcomes for Girls aged 8–12 versus those aged 19–23 in 1990		
Female * Young * (1/Ln(Distance))	2.79*** (0.361)	3.42*** (0.469)
District FE	Y	Y
Cohort FE	Y	Y
Cohort-Size	Y	Y
No. obs	338545	353782
No. clusters	55	55
R^2	0.11	0.12
Panel B: Placebo Comparing Educational Outcomes for Girls aged 19–23 versus those aged 24–28 in 1990		
Female * Young * (1/Ln(Distance))	0.521 (0.646)	0.568 (0.513)
District FE	Y	Y
Cohort FE	Y	Y
Cohort-Size	Y	Y
No. obs	230502	245130
No. clusters	55	55
R^2	0.11	0.11

Notes : Data are from the 2002 Uganda Census 10 percent sample, (IPUMS International). Robust standard errors clustered at the district level in parentheses. Distance from University measured in meters and calculated (details in Appendix A).

* p<.1

** p<.05

*** p<.01

Table 6

Effect of the Affirmative Action Policy on Enrollment and Virginity

(1)	(2)	(3)	(4)	(5)
dependent variable: enrolled as of age	$\frac{\partial enroll}{\partial policy}$	$\frac{\partial enroll}{\partial policy}$ ***evaluated at mean distance***	$\frac{\partial virgin}{\partial enroll}$	***(3)*(4)***
13	2.70*(1.35)	0.19	0.86	0.16
14	3.48***(0.770)	0.24	0.86	0.21
15	2.75***(0.71)	0.19	0.86	0.16
16	1.53**(0.67)	0.11	0.86	0.09
17	1.29***(0.32)	0.09	0.86	0.08
18	0.62**(0.25)	0.04	0.86	0.03

Notes: Each coefficient in column (2) represents a separate OLS regression of equation (2) where the dependent variable is enrolled at least up to the age noted in column (1). We evaluate the coefficient at the mean inverse distance (0.07) to obtain column (3), the effect of the policy on secondary school enrollment for the average (distance) female. Multiplying each cell in (3) by the corresponding cell in column (4)-the effect of the policy on enrollment, (reproduced from the IV estimates in table 4, column (5)) gives the effect of the policy on virginity at each age. The average effect of the policy overall ages is therefore 0.12. Standard errors for the OLS estimates in column (1) are in parenthesis below the coefficient and are clustered at district level.

* p<.1

** p<.05

*** p<.01.