ECONOMIC POLICY RESEARCH CENTRE

HIV/AIDS Sero-prevalence and Socioeconomic Status: Evidence from Uganda

Ibrahim Kasirye

September 2012

Abstract

Although Uganda reported large reductions in HIV/AIDS prevalence during the 1990s, recent evidence suggests that country's rate of new HIV infections is on the rise. This study explores the factors that are correlated with HIV/AIDS status using a unique dataset of 9,981 individuals from the 2004/05 Uganda HIV/AIDS Sero-Behaviour Survey. This survey tested individuals 15-49 years of age for sexually transmitted infections, including HIV/AIDS. The same survey also collected background information for all tested individuals. This information is similar to what is collected in a typical demographic and health survey (DHS). We estimate probit models for the determinants of HIV/AIDS infection status: having been tested, condom use, and extramarital sex. In addition, we estimate the joint determination of extramarital relations and condom use using bivariate probit models. We find that education and access to health facilities are important determinants of HIV/AIDS prevalence, as is the adoption of safe sex practices.

1. Introduction

HIV/AIDS remains a significant development problem in sub-Sahara Africa (SSA), and understanding the factors that can halt the spread of the disease is both an economic and a public health priority. According to the joint United Nations Programme on AIDS (UNAIDS), at the end of 2010, an estimated 34 million persons were infected with HIV globally, and at least 68 percent of victims were in SSA—a region with only 12% of the global population (UNAIDS, 2011). Worse still, the region had 70 percent of the estimated 2.7 million new HIV infections during the same period. Clearly, the HIV/AIDS situation in SSA remains dire despite the increased resources devoted to control of the disease. In the literature, such risky sexual behaviors as having multiple sexual partners and not using a condom are highlighted as the main drivers of HIV/AIDS infections. Among policymakers and researchers, it is now recognized that without sustained behavioral change, SSA is unlikely to reverse the tide of increasing HIV/AIDS infections. Although some studies have examined whether sexual behaviors are indeed changing due to HIV/AIDS (e.g. Glick and Sahn, 2008; Fortson, 2008), the evidence is still inconclusive, and many of the previous cross-country studies have been plagued by comparability issues.

This paper seeks to add to the existing evidence on this issue by studying the determinants of HIV/AIDS status in Uganda, a country that is considered exemplary because of its proactive strategy for combating of the spread of HIV/AIDS. Uganda managed to reduce its HIV/AIDS prevalence rate from 30 %in the early 1990s to approximately 7 % by 2004/05 (Government of Uganda, 2006). This reversal is partly attributed to the behavioral change campaign that was code named ABC—Abstinence, Being faithful and using Condoms. This campaign was implemented beginning in the late 1980s (Green *et al*., 2006). Furthermore, spending on new HIV/AIDS care and prevention programs has increased the overall significance of the health sector in Uganda's national budget. Between 1997/98 and 2001/02, health spending in Uganda averaged 7 %of the national budget (Government of Uganda, 2008). In contrast, for the periods 2002/03 and 2005/06, average health spending was more than 12 %of the national budget.[1] Indeed, the recent surge in health spending is attributed to the global initiative to combat the spread of HIV/AIDS, which includes the Global Fund for AIDS, Malaria and Tuberculosis, the Global Alliance for Vaccines and Immunization (GAVI), and the US President's Emergency Plan for AIDS Relief (PEPFAR).

Although Uganda has achieved some commendable results in combating the spread of HIV/AIDS, challenges remain. First, despite a significant decrease in the national HIV/AIDS prevalence rates, the country has failed to meet its own HIV targets. For example, the current Health Sector Strategic Plan

[1] Actual spending on HIV/AIDS intervention programs increased from US$ 38.4 million in 2003/04 to US$ 170 million in 2006/07 (MFPED, UAC, and UNDP, 2008).

(HSSP) reports that the sero-prevalence among Ugandans, at 6.4%, has consistently remained above the national target of 5 %(Government of Uganda, 2005a). Second, in the recent past, the country has seen a reversal in the trend in new HIV/AIDS infections. According to the Uganda AIDS Commission, the new infections rates nearly doubled from 73,000 in 2002 to over 130,000 by 2009 (UAC, 2009).[2] Third, only a small proportion of Ugandans know their HIV status. Thus, a substantial proportion of infected individuals have never been tested, and such individuals have an increased risk of spreading the disease. Overall, the increase in new HIV infections may be partly explained by complacency due to the recent availability of antiretroviral therapies (GoU, 2010). Nonetheless, such reversals not only highlight internal inefficiency in the health system but also cast doubts on Uganda's ability to attain its HIV control targets. Against the backdrop of increased spending on HIV/AIDS prevention and care, the correlates of HIV status must be examined, and we must consider how these correlates vary within various populations.

In this paper, we investigate the association between individual HIV/AIDS status, sexual behavior, and socioeconomic status. Specifically, we consider the following questions: (a) What are the socio-economic determinants of HIV positive status?; (b) What factors are correlated with the adoption of the key HIV/AIDS prevention strategy condom use?; (c) What are the determinants of risky sexual behaviors, particularly extramarital sex?; and (d) What are the determinants of an individual's having ever been tested for HIV/AIDS?

Uganda is of special interest in this research given its long history of implementing HIV/AIDS prevention programs. For some time, the country was heralded as a leader in HIV/AIDS prevention programs. Consequently, it would be wise to consider how the country managed to reverse the increase in HIV/AIDS—at least in the 1990s. Second, anecdotal evidence suggests the increase in new infections could be due to the complacency generated by the new availability of antiretroviral (ARV) drugs. The current study indicates some of the potential reasons for the recent changes.

Although other studies have examined the determinants and impacts of HIV/AIDS prevalence in Uganda, the majority focuses on the medical aspects of the disease (see, e.g., Ciantia *et al*., 2004; Quinn *et al*., 2000; and Serwadda *et al*., 1995). Furthermore, there has been no nationally representative study that combines regular socioeconomic and demographic information with information on HIV testing in the Uganda literature. Indeed, prior to the 2004/05 survey by the Uganda Bureau of Statistics and ORC Macro International, all of the previous estimates of HIV/AIDS prevalence in Uganda were based on sentinel sites and thus may not nationally representative.

[2] These recent changes should be interpreted with caution because they are not based on nationally representative surveys/assessments, as mentioned earlier, but are instead based on information from sentinel sites that test for HIV/AIDS among expectant mothers. Thus, they may produce unreliable data that may have been affected by self-selection bias.

Furthermore, despite the advent of DHS type surveys, which also test for HIV/AIDS status, all of the previous cross-country studies examining correlates of HIV/AIDS status have not involved Uganda (see, e.g., Fortson, 2008; de Walque, 2006, 2007b). Consequently, using the 2004/05 Uganda Sero-Behavioural Survey, which is nationally representative, this paper investigates the effects of individual- and household-level factors on HIV/AIDS status. The current debates on the effectiveness of Uganda's HIV/AIDS prevention programs (highlighted below) provide another reason for undertaking this research.

The paper is organized as follows. In the next section, we present a theoretical framework for analyzing the determinants of HIV/AIDS status and review the recent literature on the determinants of HIV status in SSA. Section 3 provides the methodology and data used. Section 4 presents the findings of the study, and the discussions and conclusions are presented in Section 5.

2.0 Theoretical framework and review of the literature

Given the numerous ways in which an individual can contract HIV/AIDS—which range from sexual intercourse to blood transmissions, mother-to-child blood transmissions and intravenous drug use—there is no single theoretical framework that has been used to explain the determinants of HIV/AIDS status. Rather, a number of authors identify a number of major pathways through which an individual can contract HIV/AIDS (see, e.g., Glick, 2010, 2007; de Walque, 2007a; Oster, 2012, 2005). Using the unique characteristics of SSA—which, as mentioned previously, is the region with the highest HIV infection rates—Glick (2007) identifies two major pathways linking socioeconomic status to HIV prevalence: sexual behavior and knowledge of HIV/AIDS; and the poor state of general reproductive health services, which leads to a large number of sexually transmitted infections (STIs) and the poorly developed health services, because of which a large proportion of the population do not know their HIV status; and.

One of the most highlighted reproductive health characteristics of SSA is the large number of untreated non-HIV STIs. It is argued that untreated diseases, such as syphilis and herpes, increase the susceptibility of an individual to HIV/AIDS infections. Indeed, such authors as Oster (2005) posit that this increased susceptibility is one of the major explanations for the differences in the HIV/AIDS transmission rates in the United States and SSA.[3] According to the author, SSA has experienced more rapid HIV transmission due to the large number of untreated STIs. Other concerns related to reproductive health include the issues of male circumcision and pregnancy. According to Ferry *et al.*

[3] HIV/AIDS was first identified in the gay community in the USA in the early 1980s; however, the spread of disease in the USA has been very limited compared to its spread in SSA (Oster, 2005).

(2001), male circumcision rates may partly explain the differences in the HIV/AIDS prevalence rates within SSA. For instance, HIV/AIDS prevalence rates are much lower in West African countries, which have a large Muslim population, than in East and Central Africa countries, which have much lower rates of male circumcision.[4] In addition, pregnant women have higher rates of HIV/AIDS prevalence compared to other sexually active women, possibly due to reduced immunity during pregnancy. The state of overall health services can also aid the spread of HIV. Glick (2007) notes that the majority of the adult population in SSA has never been tested for HIV/AIDS despite the outbreak of the disease more than 20 years ago. Thus, there is limited knowledge about HIV/AIDS status, which exacerbates the spread of the disease, as mentioned earlier.

According to Glick (2007), sexual behavior (and in particular, sex with multiple partners) is seen as the major reason why the countries in SSA have the highest rates of HIV infection. Although the average lifetime number of sexual partners in SSA is similar to that in other regions, due to the region's history of polygamy, men in SSA normally have a number of concurrent sexual partners, which creates what is known as the "sexual network" in the HIV/AIDS literature. The susceptibility to HIV infections increases with both the number of people in the sexual network and the duration of sexual relationships. Other sexual behaviors noted as key drivers of HIV/AIDS in SSA include the practice of cross-generational sexual relationships, particularly between older men and young girls. This practice explains the large gender differences in HIV/AIDS infection rates among teenagers. Thus, sexual behavior, coupled with knowledge, attitudes and beliefs about HIV/AIDS, can be a key determinant of infection.

A key determinant of access to and comprehension of HIV/AIDS knowledge and information is education. de Walque (2007a) posits that education is negatively related to HIV infection rates and identifies various pathways through which education impacts HIV/AIDS infection: the use of condoms, particularly during sex with non-regular partners; the use of HIV/AIDS facilities, particularly voluntary counseling and testing centers; and the empowerment of women to negotiate sex. Based on longitudinal data from a district in Southwestern Uganda, de Walque (2007a) shows that increased education attainment has large payoffs in terms of HIV/AIDS reduction. In particular, after the introduction of an HIV/AIDS information campaign in Southwestern Uganda, HIV/AIDS infections decreased by 6 % for individuals with primary education and 12 % for individuals with secondary education.

[4] Muslim believers practice circumcision on male children as part of their religious rights of passage.

Another important socioeconomic factor in HIV/AIDS prevalence is gender: females have far higher rates of HIV/AIDS infection than men. Even among sero-discordant couples[5], women are more likely to be infected (de Walque, 2007b). No conclusive explanation has been provided for these higher rates of HIV/AIDS infection; however, the literature points to a number of contextual factors that may increase female susceptibility to HIV/AIDS infection. First, women become sexually active much earlier than men in SSA, which may increase their lifetime chances of contracting the disease. Second, because of the unequal power relations within most households in developing countries, most women cannot exercise control over their sexuality. Furthermore, because of the lack of empowerment of women in many SSA societies, some are forced to engage in transactional sex. Also, with the exception of expectant mothers, who are regularly tested at sentinel sites, women in SSA are less likely than men to be tested for HIV/AIDS (Gersovitz, 2005).

One of the most examined determinants of HIV/AIDS is poverty. Such authors as Oster (2012) postulate that another reason for the higher HIV/AIDS infection rates in SSA is the generally high level of poverty and low expected future incomes. This supposition is based on the premise that sexual behavior in SSA has not changed drastically despite the onset of the HIV/AIDS epidemic more than 20 years ago. According to Oster, because of the lower valuation of life (at least in monetary terms), most Africans engage in risky sexual behavior despite adequate knowledge of the potential consequences. However, empirical support for the higher poverty-higher HIV/AIDS prevalence hypothesis is very limited; most authors do not find a significant impact of poverty on HIV/AIDS prevalence (de Walque, 2009; Lachaud, 2007). In fact, some studies in SSA find that HIV/AIDS prevalence is linked to higher incomes. However, this finding is mainly explained by the higher HIV/AIDS infection rates in urban areas, where most of the well-to-do individuals reside, rather than by incomes per se. In the next subsection, we describe some of the empirical results of the studies that investigate the determinants of HIV/AIDS status.

2.2 Empirical evidence of the determinants of HIV/AIDS status.

There is a vast and growing body of literature on the determinants of HIV/AIDS prevalence and associated sexual behaviors in SSA. Examples of empirical studies from the recent past include de Walque and Kline (2010), Fortson (2008), Glick and Sahn (2008), de Walque (2007a, 2007b), Oster (2005), and Gersovitz (2005). The main focus for most of these studies is why SSA has the highest rates of HIV/AIDS infection in the world. The evidence from these (mainly cross-country) studies is mixed. For example, a number of studies show that the expected relationship between poor health status and low income does not hold for HIV infections (see, e.g., Mishra *et al.*, 2007; and Fortson,

[5] These are sexual relationships in which one partner is HIV positive and the other is HIV negative.

2008). Fortson (2008) uses 5 DHS surveys that tested individuals for HIV/AIDS status to determine that individuals from well-to-do households and those with higher education levels are more likely to be HIV positive. According to Fortson, highly educated men and women are more likely to engage in pre-marital sex, which may increase their susceptibility to HIV infections. Other studies based on both cross-country analysis and country surveys also point to the positive relation between HIV infection status and both risky sexual behaviors and economic status. For instance, Gregson *et al.* (2001) find a significant relationship between national HIV/AIDS prevalence rates and literacy. Similarly, based on a survey in the Kisumu district in Western Kenya, Luke (2008) finds that wealthier men make proportionally larger monetary or other payments to non-steady sexual partners and that this practice may exacerbate the incidence of unsafe sexual activities, such as unprotected sex, within this population subgroup.

One of the challenges of understanding the causes and impacts of HIV/AIDS using regular surveys has been the identification of HIV-positive individuals. Due to the stigma attached to the disease, only a small proportion of the African population has ever been tested for HIV/AIDS. As such, most of the earlier analysis of HIV/AIDS prevalence relied on sentinel data that were collected mainly from women attending antenatal clinics. Starting in the late 1990s, the DHS surveys pioneered the collection of nationally representative information on HIV knowledge, and more recently, the surveys have tested individuals to more accurately establish sero-prevalence (Mishra *et al.*, 2007).[6] This recent availability of data has spurred research examining an array of issues, and some of the results dispel earlier preconceived notions about the disease. As mentioned earlier, Glick and Sahn (2007) show that the limited testing for HIV among Africans is not due to fear of knowing one's HIV/AIDS status but rather to constrained access to HIV/AIDS testing facilities. de Walque (2009), based on DHS surveys from Burkina Faso, Cameroon, Ghana, and Kenya, finds that male circumcision has no significant impact on HIV/AIDS status. In a related study, focusing only on couples, de Walque (2007b) finds that at least two thirds of infected couples are sero-discordant. In a more recent study, Fortson (2009) finds no significant impact of HIV prevalence on the fertility of women in 12 African countries.

Gersoritz (2005) uses ten DHS surveys for Kenya, Tanzania, Uganda, and Zambia to identify evidence of behavioral change in response to the pandemic. For example, women in Zambia are having sex later because of the fear of HIV/AIDS. In contrast, Glick and Sahn (2008) examine a much larger sample of 16 DHS surveys from eight countries in SSA[7] and do not find consistent reduction in this regard for women or men. In particular, for women, such results are found only for Benin, Ghana, Mozambique, and Nigeria, while only Uganda and Zambia show a significant increase in the average

[6] By 2009, the following countries in SSA had DHS type surveys with an HIV/AIDS testing component: Burkina Faso, Cameroon, Ghana, Kenya, Malawi, Tanzania, and Uganda.
[7] The countries covered are Benin, Burkina Faso, Ghana, Kenya, Mozambique, Nigeria, Uganda, and Zambia.

age of women at their first instance of sexual intercourse. Nonetheless, Glick and Sahn (2008) find consistent favorable changes in at least one indicator of sexual behavior—condom use among unmarried individuals—for both women and men. For women, with the exception of Nigeria, all of the countries studied show significant increases in condom use. For men, the only significant increases in condom use are identified for Benin, Burkina Faso, Ghana, and Mozambique. For the other indicators of (non)-risky sexual behavior, such as abstinence and fidelity to one sexual partner, the results vary by country.

3. Methodology and Data

3.1 Probit estimation of determinants of HIV/AIDS status and sexual behavior

Because of the nature of the cross-sectional dataset available and because of econometric concerns, such as omitted variable bias (e.g., preferences in sexual behavior), we do not claim to establish a causal relationship between HIV/AIDS infections and socioeconomic status. Instead, we estimate the association between HIV/AIDS status and such factors as educational attainment, spatial location, and marital behavior (i.e., whether a person has ever married or has had multiple marriages). Following previous studies that examined the determinants of HIV status in Africa (see, e.g., de Walque and Kline 2010; Corno and de Walque, 2007), we estimate a probit model for HIV/AIDS positive status. The reduced-form equation can be formally represented as

$$(1) \qquad \Pr(HIV_i = 1) = \beta_o + \sum_j \beta_{1j} A_{ji} + \sum_m \beta_{4m} D_{mi} + \varepsilon_i$$

where HIV_i represents whether or not an individual i is HIV positive, A_{ji} are individual-level factors, such as age, gender, marital experience, and educational attainment, D_{mi} are household-level and location factors, such as welfare status and residence in an urban area, and ε_i are unobservable determinants of HIV/AIDS. In the above specification, we do not include variables related to direct sexual behavior (e.g., condom use and extramarital relations), as these would be endogenous. Instead, we estimate similar regressions for the determinants of condom use, extramarital sex and HIV/AIDS testing. Specifically, we estimate the following additional models:

$$(2) \qquad \Pr(Condom_i = 1) = \beta_o + \sum_j \beta_{1j} A_{ji} + \sum_m \beta_{4m} D_{mi} + \varepsilon_i$$

$$(3) \qquad \Pr(Extra\_Marital_i = 1) = \beta_o + \sum_j \beta_{1j} A_{ji} + \sum_m \beta_{4m} D_{mi} + \varepsilon_i$$

$$(4) \qquad \Pr(HIV\_test_i = 1) = \beta_o + \sum_j \beta_{1j} A_{ji} + \sum_m \beta_{4m} D_{mi} + \varepsilon_i$$

where $Condom_i = 1$ represents the use of condoms during the person's last instance of sexual intercourse, $Extra\_Marital_i = 1$ indicates extramarital sex among individuals who reported being married, and HIV_test_i represents whether an individual has ever been tested. The above estimations are undertaken separately for women and men. The above four specifications help to show whether the determinants of HIV/AIDS infections are similar to the determinants of preventive or risky sexual behaviors related to HIV/AIDS.

If the determinants of HIV/AIDS infections and sexual behavior are all presented by a vector X, then equations (1)-(4) can be jointly rewritten as

(5) $$\Pr(S_i = 1) = \Phi(\beta' X_i)$$

where $S_i = \{HIV_i, Condom_i, Extra\_Sex_i\}$ and Φ represent a standard normal cumulative distribution and β' represents the parameters to be estimated. To more accurately interpret the results of the probit estimations, we estimate the marginal effects of the specification in Eq. (4). The marginal effects model is specified as

(6) $$\frac{\partial[\Phi(\beta' X_j)]}{\partial X_{ij}} = \phi(\beta' X_i)\beta_j$$

The interpretation of the estimations from Eq. (6) is as follows; for example, it indicates the effect of a change in the regressor at the mean on HIV prevalence in the HIV/AIDS infection specification.

3.2 Bivariate probit models for extramarital sex and condom use

In addition to the probit analysis of the factors in extramarital relations and condom use, we conduct a joint estimation of extramarital affairs and condom use. As highlighted by previous authors, such Kazianga (2005) and Djemai (2009), there are important reasons why extramarital sex and condom use may be jointly determined. First, condom use is heavily determined by the nature of one's sexual partners: the desire for procreation may limit the use of condoms with regular partners. Secondly, the traditional probit model for condom use may not adequately account for the degree of HIV-related risk taking.

In its most generic form, the bivariate probit model assumes that the "treatment"—in our case, condom use—has a direct causal effect on the "outcome": i.e., extramarital relations. The model also assumes that both behaviors are influenced by similar unobservable factors. Formally, these concepts can be represented as

(7) $$y_1^* = \beta_1 X_1 + \varepsilon_1 \qquad y_1 = 1 \text{ if } y_1^* > 0, \ 0 \ otherwise$$

$$y_2^* = \alpha y_1^* + \beta_2 X_2 + \varepsilon_2 \qquad y_2 = 1 \text{ if } y_2^* > 0, 0 \text{ otherwise}$$

where y_1^* and y_2^* represent the latent variables for extramarital relations and condom use, respectively. X_1 and X_2 refer to individuals and household factors relating to sexual behaviors, respectively. Finally, the error terms follow a bivariate normal distribution and can be approximated by $(\varepsilon_1, \varepsilon_2) \approx BVN[0,0,\sigma_1^2,\sigma_2^2,\delta]$, where σ_1^2 and σ_2^2 are standard deviations and δ is the correlation coefficient. As indicated in the formulation (Eq. 7), the dummy variable for extramarital relations appears in the regression equation for condom use. Following Green (2003), the bivariate probit model is estimated using full information maximum likelihood (FIML) estimation, and the results are presented in Tables 6 and 7.

3.3. Data

As mentioned earlier, this study uses the only available nationally representative survey of HIV prevalence in Uganda: the Uganda HIV/AIDS Sero-Behaviour Survey 2004/05, conducted by the Ministry of Health in Uganda and Macro International (GoU, 2006).[8] The objective of this survey, which was supported by the US government, was to understand the HIV/AIDS problem in Uganda and to aid in the recalibration of the regular sentinel sites that were testing for sexually transmitted infections (STIs). In particular, the survey sought to test for the following STIs: HIV, syphilis, herpes simplex, and hepatitis b. This survey was undertaken during a period of 6 months (August 2004-January 2005) and employed a two-stage cluster sampling design. In the first stage, clusters or enumeration areas were the principal sampling unit, and at least 417 clusters were selected across the country. In the second stage, 25 households were randomly selected from each cluster.

Furthermore, the survey coverage was expansive, with 5,981 households selected for analysis. The survey targeted individuals in the sexually active age category: people aged 15-49 years. Within the selected households, at least 6,304 women and 5,265 men were in the reproductive age group and were thus eligible for interview and STI testing. All eligible women and men were asked to voluntarily provide a blood sample for testing STIs. For children ages 15-17 years, consent for testing was sought from parents or guardians. Of all individuals eligible for interview and testing, 89 % of the women and 83 % of the men could be tested.[9] Of the eligible individuals who could not be tested, approximately half declined to be tested, and the rest were absent at the time of the survey. Overall, 9,981 individuals (5611 women and 4370 men) were tested, and this is the sample that was used in our analysis. In addition to determining HIV status, the survey also addressed the regular DHS

[8] According to the DHS website, no HIV testing was undertaken for Uganda in the latest (2006) Demographic and Health Survey.

[9] The variance between women and men is because men were more likely to be absent from home than women.

indicators, including educational attainment, reproductive history, sexual activity, and knowledge and attitudes regarding STIs. Below, we describe the particular variables used in our analysis.

3.4 2 Variables used.

3.4.1 Dependent variables

HIV/AIDS status: As noted earlier, the survey tested eligible women and men for HIV and other STIs. The results of the laboratory tests indicate which individuals are HIV positive, and this is our indicator of HIV prevalence.

Condom Use: For individuals who had had sex in the past 12 months, the survey asked whether they used a condom during their last sexual encounter. We use this information as the dependent variable, condom use.

Extramarital relations: The sero-prevalence survey asked questions about the number of partners with whom the respondents had had sex in the 12 months preceding the survey, the types of relationships that they had with these partners, and the overall number of sexual partners that they had had in their lives. An individual is considered to have had extramarital relations if he or she is married and has had more than one sexual partner in the past 12 months.

HIV/AIDS test: The respondents were also asked if they had ever requested an HIV/AIDS test and whether they had collected the results. In addition, women are asked if they had received the test as part of their antenatal services.

3.4.2 Independent variables

Demographics: To capture each individual's demographic characteristics, we consider the following indicators: age and marital status (widowed, divorced, separated, and so on). The age of the individual is meant to indicate the extent of the person's susceptibility to STIs. The other demographic variable, marital status, is meant to reflect polygamy, which increases the number of regular sexual partners. In addition, we include variables related to reproductive health, such male circumcision. As noted in the literature review, some studies suggest that individuals who are circumcised will be less likely to contract HIV.

Socioeconomic characteristics: The major socioeconomic characteristics are related to educational attainment and wealth status. Apart from representing the accumulated human capital of the individual, the education variables may also signal an individual's ability to receive and process

health information. The sero-behavioral survey, similar to the regular DHS surveys, did not solicit information on household income and did not capture information on household consumption, an effective income proxy. Following earlier studies that have utilized DHS-type surveys without income information (e.g., Ssewanyana and Younger, 2008; Sahn and Stifel, 2003), we use an asset index as a proxy for household income or wealth.

Location variables: To capture the environment faced by the individual, we include dummies for urban location. We also include regional dummies to capture location heterogeneity and ethnicity. The means of the key variables, disaggregated by gender, are provided in Table 1.

Table 1: HIV Prevalence based on selected characteristics

	Women	Men
Education		
No Education	0.054	0.068
Some Primary	0.059	0.050
Completed Primary	0.086	0.069
Secondary and higher	0.086	0.061
Wealth status		
poorest	0.042	0.052
poorer	0.039	0.045
middle	0.060	0.049
richer	0.102	0.074
richest	0.111	0.090
Age category		
15-19 years	0.027	0.025
20-24 years	0.057	0.055
25-29 years	0.090	0.069
30-34 years	0.124	0.081
35-39 years	0.113	0.090
40-44 years	0.086	0.118
45-49 years	0.052	0.074
Individual in polygamous union	0.088	0.049
Male circumcision= No		0.065
Male circumcision= Yes		0.064
Individual has been married more than once	0.135	0.106
All individuals ages 15-49 years	0.074	0.064
Number of observations		

Source: Author's calculations from the 2004/5 Sero Survey

4. Results

4.1 HIV/AIDS prevalence

Table 2 reports the marginal probit results that estimate the determinants of HIV/AIDS prevalence for women and men. The results indicate that higher educational attainment is a key determinant of reductions in HIV/AIDS prevalence, mainly for men. For men, educational attainment, even at the primary level, is significantly associated with a reduced incidence of HIV/AIDS; however, only the attainment of secondary education significantly reduces the prevalence of HIV/AIDS among women. Higher education is also a key determinant of whether an individual had ever been tested prior to the survey. Secondary education increases the probability of a person's ever having been tested for HIV/AIDS by 9.1 and 7.2 percentage points for women and men, respectively. Finally, education does not have a significant effect on condom use for women but significantly reduces the probability of extramarital affairs among men. In particular, some primary schooling, completion of primary schooling, and secondary education reduce the probability of extramarital sex among men by 6.5, 8.6, and 15.6 percentage points, respectively. The probability of extramarital sex is reduced by approximately 5 percentage points if women complete at least their primary schooling.

Similar to other studies on HIV/AIDS status in SSA (see, e.g., Corno and De Walque 2007 for Lesotho), our results indicate that HIV/AIDS prevalence increases with household wealth status. Specifically, the probability of being HIV positive decreases by approximately 5 percentage points for individuals from the bottom three quintiles compared to those in the top two quintiles of the welfare distribution. Also, as expected, individuals from the richest quintiles are most likely to be tested for HIV/AIDS. This particular result may be partly explained by the superior access of well-to-do households to health facilities, given that HIV/AIDS testing is free in public health facilities in Uganda. In addition, the use of condoms during recent sexual intercourse is concentrated among women from the richest quintiles. Finally, wealth status is associated with a higher probability of extramarital sex during the previous year, but the magnitude of the effect for men is typically double that for women. For instance, for the poorest quintile, the probability of extramarital sex decreases by 15.5 percentage points for men compared to 7.1 percentage points for women.

Women and men who have been married previously differ significantly in their sexual behavior. Having had a previous marriage is associated with a 5-percentage-point increase in the probability of being HIV positive for women, whereas the effect for men is insignificant. However, men who have had a previous marriage are more likely than women to have been tested for HIV/AIDS, and having had had a previous marriage increases the probability of extramarital sex by 3.4 percentage points for women, whereas no significant effect is found for men. Being in a polygamous marriage significantly reduces the probability of being HIV positive for both women and men. However, being in a polygamous union significantly reduces the probability of ever having been tested for HIV/AIDS (by 11.3 and 7 percentage points for women and men, respectively).

Table 2: Determinants of HIV Prevalence in Uganda

(Dependent variable=1 if HIV positive)				
	All aged 15-49 years		Individuals aged 30 years and below	
	Men	Women	Men	Women
Education [No education is the base]				
Some Primary	-0.034**	-0.020	-0.023	-0.025
	(0.013)	(0.012)	(0.014)	(0.015)
Completed Primary	-0.050**	-0.015	-0.032	-0.024
	(0.017)	(0.012)	(0.018)	(0.015)
Secondary and higher	-0.052***	-0.037**	-0.035*	-0.020
	(0.015)	(0.014)	(0.015)	(0.016)
Wealth status quintiles [Richest is base]				
poorest	-0.046**	-0.065***	-0.018	-0.049**
	(0.014)	(0.015)	(0.018)	(0.016)
poorer	-0.055***	-0.072***	-0.029*	-0.052***
	(0.015)	(0.016)	(0.014)	(0.015)
middle	-0.047***	-0.054***	-0.033*	-0.037*
	(0.013)	(0.016)	(0.015)	(0.015)
richer	-0.024	-0.023	0.003	-0.017
	(0.013)	(0.013)	(0.016)	(0.014)
Urban	-0.011	-0.002	0.016	0.008
	(0.013)	(0.013)	(0.016)	(0.015)
Mstat2	-0.041	-0.115***	-0.079*	-0.161***
	(0.022)	(0.027)	(0.033)	(0.040)
Mstat3	0.039	0.016	0.054	0.108**
	(0.027)	(0.018)	(0.036)	(0.034)
Individual has been married more than once	0.025	0.055***	0.042	0.113***
	(0.014)	(0.017)	(0.030)	(0.031)
Individual in polygamous union	-0.052*	-0.047*	-0.187**	-0.165***
	(0.022)	(0.019)	(0.068)	(0.036)
Central Region	-0.028*	-0.018	-0.019	-0.006
	(0.011)	(0.012)	(0.010)	(0.012)
Eastern Region	-0.034**	-0.015	-0.026**	0.004
	(0.011)	(0.012)	(0.009)	(0.014)
Northern Region	-0.039**	-0.039***		
	(0.012)	(0.011)		
Age category				
15-19 years	-0.057***	-0.086***		
	(0.012)	(0.016)		
20-24 years	-0.032*	-0.051***		
	(0.012)	(0.012)		
25-29 years	-0.027**	-0.022		
	(0.010)	(0.012)		
30-34 years	-0.022	-0.001		
	(0.011)	(0.015)		
35-39 years	-0.013	-0.009		
	(0.013)	(0.014)		
Number of observations	4,370	5,611	2,668	3,567

4.2 HIV/AIDS testing and other sexual behaviors

As mentioned previously, the limited knowledge that individuals have about their HIV/AIDS status is seen as one reason why the virus spread at fast pace in SSA. Thus, the survey asks whether the individual was tested for HIV/AIDS prior to the survey, either at a voluntary counseling and testing center or during a routine antenatal visit (for women). The marginal effects of the determinants of HIV/AIDS testing are reported in Table 3. The poorest individuals are significantly less likely to have HIV/AIDS tests, regardless of gender. This fact may be partly explained by the concentration of testing services at the time of the survey (2004/5) in urban centers and major hospitals—which are predominantly used by the wealthy. Indeed, the results for women indicate that urban women are significantly more likely to report having been tested for HIV/AIDS than their rural counterparts due to their proximity to major health facilities. Finally, only higher education attainment matters for HIV/AIDS testing: women and men who have attained secondary or higher education are 7% more likely to have an HIV/AIDS test than are individuals without any education.

Table 3 shows that currently married individuals are significantly less likely to be tested for HIV/AIDS than individuals who are single. We also find that individuals in polygamous unions are significantly less likely to report being tested for HIV/AIDS prior to the survey. More specifically, polygamous men and women, respectively, are 7% and 11% less likely to have been tested than their counterparts in monogamous marriages. In contrast, men who have been previously married are 5% more likely to have been tested.

Given that use of condoms has been a major component of Uganda's ABC strategy, the survey asks whether the individual used a condom during his or her last sexual encounter. Unfortunately, the only consistent information is collected from women; as such, the results regarding the determinants of condom use reported in the table are restricted to women, whether they have spouses or non-regular partners. For sexual relations within a marriage, the results indicate that poorer women are significantly less likely to use condoms than are women from the top asset quintile. In addition, middle-aged women are significantly less likely to use condoms with their spouses. This finding may be partly explained by the desire for procreation within this age category. In sex with non-regular partners, women from the poorest quintile are approximately 40% less likely to report using condoms compared to other women. As mentioned previously, this finding may suggest that there is limited access to and knowledge about condoms among poorer individuals located in rural areas.

Table 3: Determinants of being tested for HIV

	Men	Women	Women at antenatal
Education			
Some Primary	-0.029	0.005	0.025
	(0.022)	(0.019)	(0.031)
Completed Primary	0.026	0.027*	0.023
	(0.018)	(0.014)	(0.022)
Secondary and higher	0.072*	0.091**	0.010
	(0.031)	(0.028)	(0.040)
Wealth status			
poorest	-0.119***	-0.118***	-0.134**
	(0.022)	(0.021)	(0.045)
poorer	-0.106***	-0.123***	-0.150**
	(0.022)	(0.021)	(0.048)
middle	-0.071**	-0.110***	-0.123**
	(0.022)	(0.020)	(0.041)
richer	-0.070***	-0.051**	-0.058
	(0.019)	(0.018)	(0.031)
Urban	-0.018	0.045*	0.111**
	(0.019)	(0.019)	(0.037)
Mstat2	-0.094**	-0.111***	-0.076
	(0.033)	(0.031)	(0.050)
Mstat3	-0.006	0.016	-0.037
	(0.030)	(0.022)	(0.031)
Individual has been married more than once	0.045*	0.004	0.042
	(0.018)	(0.016)	(0.030)
Individual in polygamous union	-0.070**	-0.113***	0.017
	(0.025)	(0.028)	(0.031)
Central Region	-0.020	-0.044**	-0.040
	(0.019)	(0.015)	(0.028)
Eastern Region	-0.017	-0.026	-0.029
	(0.020)	(0.016)	(0.025)
Northern Region	-0.001	-0.029	-0.037
	(0.021)	(0.016)	(0.024)
Age category			
15-19 years	-0.165***	-0.091***	-0.057
	(0.024)	(0.019)	(0.031)
20-24 years	-0.064***	-0.016	-0.074*
	(0.017)	(0.020)	(0.032)
25-29 years	-0.026	0.002	-0.054
	(0.018)	(0.022)	(0.036)
30-34 years	-0.026	-0.012	-0.053
	(0.020)	(0.021)	(0.034)
35-39 years	-0.019	-0.051**	-0.129***
	(0.022)	(0.016)	(0.029)
Number of observations	4,370	5,611	2,346

Table 4: Determinants of using a condom in the last intercourse

Dependent variable=1 if condom used		
	With spouse Females	Not with spouse Females
Education		
Some Primary	-0.011	0.007
	(0.011)	(0.106)
Completed Primary	-0.022	0.061
	(0.013)	(0.092)
Secondary and higher	-0.020	0.234
	(0.015)	(0.293)
Wealth status		
poorest	-0.075***	-0.398*
	(0.020)	(0.174)
poorer	-0.079***	-0.224
	(0.021)	(0.155)
middle	-0.070***	-0.263
	(0.019)	(0.158)
richer	-0.059***	-0.076
	(0.017)	(0.157)
Urban	-0.038**	-0.190
	(0.014)	(0.122)
Individual has been married more than once	0.003	0.007
	(0.012)	(0.081)
Individual in polygamous union	-0.012	-0.059
	(0.013)	(0.104)
Central Region	-0.049**	-0.080
	(0.015)	(0.129)
Eastern Region	-0.018	-0.061
	(0.011)	(0.137)
Northern Region	-0.032*	-0.062
	(0.013)	(0.128)
Age category		
15-19 years	-0.016	0.268
	(0.015)	(0.167)
20-24 years	-0.017	0.276
	(0.012)	(0.166)
25-29 years	-0.038**	0.318*
	(0.013)	(0.155)
30-34 years	-0.038**	0.171
	(0.013)	(0.188)
35-39 years	-0.049***	0.175
	(0.013)	(0.200)
Number of observations	3,472	1,680

In addressing individuals who are currently married, the survey asks whether the individual engaged in sex with casual partners in the year prior to the survey. In this analysis, we define non-marital sex as having had at least one casual partner during the previous year. The marginal effect results for women and men are reported in Table 5. The results indicate that higher education attainment is significantly associated with a reduced risk of extramarital sex. For men, attaining some primary education is associated with a 6% reduction in extramarital sex, the completion of primary schooling reduces non-marital sex by approximately 9%, and attaining secondary or higher education is associated with a 15% reduction in the likelihood of extramarital relations compared to no education. For women, the completion of at least primary schooling significantly reduces the likelihood of extramarital sex. Table 5 also indicates that extramarital relations increase with wealth status; women and men from the top quintile are significantly more likely to engage in extramarital sex. Nonetheless, based on the magnitudes of the marginal effect coefficients, it seems that women are far less likely to engage in extramarital sex. This finding may suggest that men who are having extramarital relations are engaging in commercial sex and that those individuals who can afford to procure sex services engage in extramarital liaisons.

Table 5: Determinants of having non marital sex in the last 12 months (currently married)

(Dependent variable=1 if the number of non marital partner>0 in the last 12 months)		
	Men	Women
Education		
Some Primary	-0.065*	-0.014
	(0.031)	(0.011)
Completed Primary	-0.086**	-0.045**
	(0.030)	(0.016)
Secondary and higher	-0.156***	-0.052**
	(0.034)	(0.018)
Wealth status		
poorest	-0.155***	-0.071***
	(0.033)	(0.021)
poorer	-0.170***	-0.070***
	(0.033)	(0.018)
middle	-0.146***	-0.073***
	(0.032)	(0.022)
richer	-0.090**	-0.069**
	(0.031)	(0.022)
Urban	-0.129***	-0.049**
	(0.029)	(0.016)
Individual has been married more than once	0.031	0.034*
	(0.023)	(0.014)
Individual in polygamous union	0.001	0.026
	(0.038)	(0.016)
Central Region	0.067*	-0.005
	(0.033)	(0.012)
Eastern Region	-0.034	-0.033*
	(0.032)	(0.014)
Northern Region	0.024	0.004
	(0.031)	(0.013)
Age category		
15-19 years	0.096	-0.031*
	(0.129)	(0.012)
20-24 years	0.137**	-0.047**
	(0.050)	(0.016)
25-29 years	0.055	-0.064***
	(0.040)	(0.019)
30-34 years	-0.002	-0.059***
	(0.033)	(0.016)
35-39 years	-0.035	-0.054***
	(0.031)	(0.016)
Number of observations	2,329	3,640

5. Discussions and conclusions

This paper examines the factors associated with HIV/AIDS prevalence and sexual behavior in Uganda, which is a country that has been heralded as exemplary in the fight against HIV/AIDS but that has recently seen an increase in the rate of new HIV infections. We use a nationally representative survey that tested individuals ages 15-49 years for HIV/AIDS and other STIs. As expected, we find significant gender differences in terms of sexual behavior. Highly educated women are more likely to be tested for HIV/AIDS outside of routine antenatal services and are also less likely to be unfaithful. We also find that individuals who engage in risky sexual behavior are normally aware of the risk of contracting HIV/AIDS. In addition, we find that education attainment is a key determinant of HIV/AIDS prevalence and sexual behavior, such as casual sex and unprotected sex. In particular, higher educational attainment is associated with the avoidance of risky sexual behavior, although highly educated individuals have the highest rates of HIV/AIDS infections. The findings suggest that Uganda's investment in primary and secondary education through the UPE and USE programs will not lead to higher incomes but may lead to lower HIV/AIDS infections in the long term, as more educated individuals avoid risky sexual behavior.

Our results also highlight the issues of access to and the cost of health facilities. For instance, individuals from well-to-do households are more likely to be tested for HIV/AIDS than poorer individuals. Although the majority of HIV/AIDS testing services are free, these facilities are mainly located in urban centers and major hospitals patronized by richer individuals. Similarly, the use of condoms during sex with casual partners is most common in urban areas, whose residents can afford the cost of condoms. Consequently, it is important for the Ministry of Health to continue to subsidize HIV/AIDS services to to encourage testing" or "to increase the use of these services.

8. References

Ciantia, F. et al. (2004). "HIV Seroprevalence in Northern Uganda: The Complex Relationship between AIDS and Conflict." *Journal of Medicine & The Person* 2:4.

Cleveland, W. S (1993) *Visualising Data* AT&T Bell Laboratories. Hobart Press, Summit, New Jersey.

Corno, L and D. de Walque (2007) "The Determinants of HIV Infection and Related Sexual Behaviours: Evidence from Lesotho". World Bank Policy Research Working Paper No. 4421.

Deaton, A and S. Subramanian (1996) "The Demand for Food and Calories" *Journal of Political Economy* Vol. 104 No.1: 133-62.

Djemai, E (2009) "How do Roads Spread AIDS in Africa? A Critique of the Received Policy Wisdom" Toulouse School of Economics.

de Walque, D. and R. Kline (2010) "The Relationship between HIV Infection and Education: An Analysis of Six Sub-Saharan African Countries" in D. Sahn (ed) *The Socioeconomic Dimensions of HIV/AIDS in Africa: Challenges, Opportunities, and Misconceptions*. Cornell University Press.

de Walque, D. (2009) "Does Education Affect HIV/AIDS Status? Evidence from five African countries" *World Bank Economic Review* Vol 23. No. 2: 209-233.

_____, (2007a). "How does the impact of an HIV/AIDS information campaigns vary with educational attainment? Evidence from rural Uganda." *Journal of Development Economics*, 84:2, pp. 686-714.

_____, (2007b) "Sero Discordant Couples in Five African Countries: Implications for Prevention Strategies." *Population and Development Review*. Vol. 33 No. 3: 501-523.

Fan, J (1992) "Design-Adaptive Nonparametric Regression" *Journal of American Statistical Association*. Vol 87. 998-1104.

Ferry, B (2001) "Comparison of key parameters of sexual behaviour in four urban populations with different levels of HIV infection" *AIDS* Vol 15. S41-50.

Fortson, J. G (2009) "HIV/AIDS and Fertility" *American Economic Journal: Applied Economics*. Vol 1. No.3: 170-94.

_____, (2008) "The Gradient in Sub-Saharan Africa: Socioeconomic Status and HIV/AIDS" *Demography* Vol 45 No. 2: 303-322.

Gersovitz, M (2005) "The HIV Epidemic in Four African Countries seen through the Demographic and Health Surveys." *Journal of African Economies* Vol 14 (June):191-246.

Glick, P (2010) "HIV Prevention in Africa: What Has Been Learned?" in D. Sahn (ed) *The Socioeconomic Dimensions of HIV/AIDS in Africa: Challenges, Opportunities, and Misconceptions*. Cornell University Press.

_____, (2007) "Reproductive Health and Behaviour, HIV/AIDS, and Poverty in Africa" Cornell University CFNPP Working Paper No 219.

Glick, P., J. Randriamamonjy and D. E. Sahn (2009) "Determinants of HIV Knowledge and Condon Use among women in Madagascar: An Analysis Using Matched Household and Community Data" *Africa Development Review* Vol 21. No. 1: 147-179.

Glick, P. J and D. E. Sahn, (2008) "Are African practising Safe Sex: Evidence from Demographic and Health Surveys for Eight Countries" *Economic Development and Cultural Change* Vol 56: 397-439.

_____, (2007) "Changes in HIV/AIDS Knowledge and Testing Behaviour in Africa: How Much and for whom?" *Journal of Population Economics* Vol 20 (April): 382-422.

Government of Uganda (2010a) National Development Plan 2010/11-2014/15 (Kampala: National Planning Authority)

_____, (2008). *Background to the Budget 2008/09 Fiscal Year: Achieving Prosperity for all through infrastructure Development Enhancing Employment and Economic Growth*. Ministry of Finance, Planning and Economic Development, Kampala.

_____, (2006) *Uganda HIV/AIDS Sero-Behavioral Survey 2004-2005* Ministry of Health and ORC Macro. Kampala

_____, (2005a). *Health Sector Strategic Plan II, 2005/6-2009/10*. Ministry of Health.

_____, (2005b) *Annual Health sector performance Report, 2004/5*. Ministry of Health, Kampala.

Green, E. C et al (2006) "Uganda's HIV Prevention Success: The Role of Sexual Behaviour Change and National Response." *AIDS and Behaviour* Vol 10. July: 335-346.

Green, W. H (2003) *Econometric Analysis* 5th Edn: Upper Saddle River, NJ: Prentice Hall.

Gregson, S., H. Waddell, and S. Chandiwana (2001) "School Education and HIV Control in Sub Saharan Africa: From Discord to Harmony" *Journal of International Development* Vol 13: 467-498.

Kazianga, H (2005) "HIV/AIDS Prevalence and the Demand for Safe Sexual Behaviour: Evidence from West Africa".

Lachaud, J. P (2007) "HIV Prevalence and Poverty in Africa: Micro-and macro-econometric evidence applied to Burkina Faso" *Journal of Health Economics* Vol. 26: 483-504.

Luke, N. (2008) "Economic Status, Informal Exchange and Sexual Risk in Kisumu, Kenya" *Economic Development and Cultural Change* Vol 56: 375-396.

Ministry of Finance Planning and Economic Development, et al (2008) Assessing the Macroeconomic Impact of HIV/AIDS in Uganda: Phase III Report. Analysis of the Macroeconomic Impact. Kampala

Mishra, V et al (2007) "HIV infection does not disproportionately affect the poorest in Sub-Saharan Africa" *AIDS* Vol. 21: S17-S28.

Oster, E (2012) "HIV and Sexual Behaviour Change: Why not Africa" *Journal of Health Economics*, Vol 31. No. 35-49.

_____, (2005) "Sexually Transmitted Infection, Sexual Behaviour and the HIV/AIDS Epidemic" *Quarterly Journal of Economics* Vol. 120. No.2: 467-515.

Quinn, T. C et al (2000) "Viral load and heterosexual transmission of human Immunodeficiency virus type I" *New England Journal of Medicine*. Vol. 342: 921-929.

Sahn, D and D. Stifel (2003) "Exploring Alternative Measures of Welfare in the Absence of Expenditure Data" *Review of Income and Wealth*. Vol. 49. No.4: 463-489.

Serwadda, D et al. (1995) "The Social dynamics of HIV transmission as reflected through discordant couples in rural Uganda" AIDS Vol. 9: 745-750.

Ssewanyana, S and S.D. Younger (2008) "Infant Mortality in Uganda: Determinants, Trends, and Millennium Development Goals" *Journal of African Economies* Vol. 17. No.1: 34-61.

Uganda AIDS Commission (2008) UNGASS Country Progress Report Uganda: January 2006 to December 2007. Kampala Uganda AIDS Commission.

Uganda AIDS Commission (2009) *Uganda HIV/AIDS Control Project: Progress Report of the CHAI Component for the period 2006*. Kampala: Uganda AIDS Commission.

UNAIDS (2011). *World AIDS Day Report 2011*. Geneva: UNAIDS.

Appendix

Table 6: Extramarital sex and condom use: Bivariate Probit Model

	(1)	(2)
	1 if sex with spouse	1 if condom use
Individual knows ways to avoid HIV		0.225**
		(0.081)
Sex with spouse=1		-1.123***
		(0.232)
Education		
Some Primary	-0.184**	0.163*
	(0.063)	(0.072)
Completed Primary	-0.091	0.276***
	(0.053)	(0.063)
Secondary and higher	-0.309***	0.358***
	(0.091)	(0.085)
Wealth status		
poorest	-0.038	-0.153*
	(0.080)	(0.075)
poorer	-0.038	-0.091
	(0.077)	(0.071)
middle	0.003	-0.162*
	(0.075)	(0.068)
richer	-0.072	-0.066
	(0.068)	(0.059)
Urban	-0.204***	0.169**
	(0.058)	(0.052)
Individual has been married more than once	0.479***	0.054
	(0.053)	(0.063)
Individual in polygamous union	-2.362***	-0.209
	(0.038)	(0.175)
Central Region	0.123*	-0.019
	(0.054)	(0.052)
Eastern Region	0.095	-0.145**
	(0.055)	(0.053)
Northern Region	0.071	-0.036
	(0.052)	(0.049)
Age category		
15-19 years	-1.041***	-0.194
	(0.086)	(0.110)
20-24 years	-0.388***	0.363***
	(0.081)	(0.101)
25-29 years	-0.087	0.338***

	(0.081)	(0.099)
30-34 years	0.051	0.271**
	(0.084)	(0.101)
35-39 years	0.051	0.159
	(0.086)	(0.105)
40-44 years	-0.036	0.014
	(0.091)	(0.116)
Score for HIV/AIDS Knowledge	-0.001	0.065***
	(0.011)	(0.012)
Constant	1.720***	-1.340***
	(0.110)	(0.275)
Observations	5691	
Number of clusters	341	
Wald test of rho=0: chi2(1)=15.784- Prob>chi2=0.0209		

Notes: Robust standard errors in parentheses.
*p<0.10, **p<0.05, *** p<0.01. The HIV/AIDS knowledge score is the person's number of correct responses to the questions in a quiz on his or her
knowledge of HIV/AIDS. The specific questions asked are (1) whether an individual reduces his or her chances of contracting AIDS
by always using condoms during sex, (2) whether an individual can reduce his or her chance of contracting AIDS by having one sex
partner only, (3) whether an individual can get AIDS from mosquito bites,
(4) whether one can get AIDS by sharing food with a person who has AIDS, and (5) whether a healthy person can have AIDS. The maximum possible score is 5, and the minimum is 0.

Table 7: Marginal effects of Bivariate Probit Model

	(1)	(2)	(3)	(4)
	P[y1=1,y2=1]	P[y1=1,y2=0]	P[y1=0,y2=1]	P[y1=0,y2=0]
Individual knows ways to avoid HIV	0.0208	-0.0208	0.0092	-0.0092
Having Sex with spouse =1	-0.1334	0.1334	-0.0635	0.0635
Education				
Some Primary	0.0117	-0.0832	0.0149	0.0566
Completed Primary	0.0258	-0.0607	0.0152	0.0197
Secondary and higher	0.0292	-0.1509	0.0373	0.0844
Wealth status				
poorest	-0.0160	0.0013	-0.0058	0.0205
poorer	-0.0102	-0.0044	-0.0032	0.0178
middle	-0.0158	0.0169	-0.0071	0.0060
richer	-0.0086	-0.0193	-0.0011	0.0290
Urban	0.0117	-0.0910	0.0156	0.0637
Individual has been married more than once	0.0188	0.1537	-0.0104	-0.1622
Individual in polygamous union	-0.0773	-0.6773	0.0458	0.7089
Central Region	0.0014	0.0454	-0.0042	-0.0426
Eastern Region	-0.0121	0.0481	-0.0087	-0.0273
Northern Region	-0.0018	0.0289	-0.0036	-0.0235
Age category				
15-19 years	-0.0449	-0.3524	0.0175	0.3798
20-24 years	0.0260	-0.1781	0.0385	0.1136
25-29 years	0.0369	-0.0704	0.0227	0.0108
30-34 years	0.0342	-0.0146	0.0128	-0.0324

	35-39 years	0.0198	-0.0002	0.0064	-0.0260
	40-44 years	0.0004	-0.0143	0.0017	0.0122
Score of HIV/AIDS Knowledge		0.0068	-0.0073	0.0031	-0.0026

Notes: Robust standard errors in parentheses. *p<0.10, **p<0.05, *** p<0.01. The HIV/AIDS knowledge score is the person's number of correct responses to the questions in a quiz on the knowledge of HIV/AIDS. The specific questions asked are as follows: (1) whether an individual reduces his or her chances of contracting AIDS by always using condoms during sex; (2) whether an individual can reduce his or her chances of contracting AIDS by having only one sex partner ; (3) whether an individual can get AIDS from mosquito bites; (4) whether a person can get AIDS by sharing food with a person who has AIDS; and finally (5) whether a healthy person can have AIDS. The maximum possible score is 5 and the minimum 0.