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HIV/AIDS and Sexual Behaviour in Botswana

by

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Abstract

Using three waves of the Botswana AIDS Impact Survey (BAIS) collected by Statistics Botswana, we investigate how sexual behaviour, measured by number of partners and condom use, responds to objective and perceived risk; objective risk is captured by the HIV prevalence rate and perceived risk is represented by concern about the likelihood of being infected by HIV. Indicators of knowledge about HIV, which may affect behaviour and risk perceptions, are included. Endogeneity is addressed through instrumental variables, with HIV prevalence rate instrumented by the distance from respondent`s area of residence to the district with the highest rate, while perceived risk is instrumented by duration (in months) between antiretroviral therapy (ART) rollout and the survey date. The HIV prevalence rate has no significant effect on the number of sexual partners or use of condoms but behaviour responds to changes in perceived risk: those who report becoming more concerned about infection or those who perceive their partners to be unfaithful are more likely to report condom use whereas those who report becoming less concerned are less likely to abstain and use a condom. The effectiveness of advice on health behaviour may be undermined by moral hazard.

JEL Classification: I20, J24, O15

Keywords: HIV/AIDS, Health Risks, Sexual Behaviour, Botswana

Centre for Research in Economic Development and International Trade, University of Nottingham

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Outline

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1. Introduction

Public health measures to address disease, epidemics and pandemics typically require providing information to increase knowledge on prevalence, sources and risks of infection and prevention measures. The efficacy of such knowledge is influenced by how individuals respond and take actions to reduce risk. These responses are to some extent shaped by previous experience, just as the 'history of sexual and reproductive health provides a window onto patterns of African resistance … to medicalized forms of surveillance, treatment and control – which may have persisted or become re-articulated in the HIV/AIDS context' (Lee, 2021, p147). How individuals respond to public health information will be important for the Covid-19 pandemic, especially in sub-Saharan African countries where maintaining lockdowns (essential initially given the severity of the pandemic) is too costly and adequate vaccination coverage is unlikely to be achieved before 2023 (IMF, 2021, pp. 1-3). Even with extensive vaccination, although prevalence will be easier to manage the likelihood of variants emerging implies transmission and risk will continue and responses to public health knowledge will be important. In the absence of data on responses to knowledge of Covid-19, evidence on risky behaviour and HIV/AIDS may be informative insofar as responses to knowledge on HIV may suggest how individuals will respond to information on Covid-19 risks and mitigations.

Research on HIV/AIDS shows that risky sexual behaviour (typically using a condom or having multiple partners) plays an important role in HIV infection (Oster, 2005; Francis, 2008). High prevalence may motivate susceptible individuals to behaviour that reduces exposure to risk (Laxminarayan and Malani, 2011; Geoffard and Philipson, 1996; Philipson and Posner, 1993). Although Oster (2012) notes the absence of evidence that risky sexual behaviour declined in SSA in response to HIV she finds that risky behaviour is lower for married individuals in areas where prevalence is high and for individuals in areas whereas life expectancy is higher, suggesting that individuals have more incentive to reduce risk if they expect to live longer and/or have a stable partner.

An individual's behavioural response will depend on prior beliefs and perceptions about the likelihood of being infected (Boozer and Philipson, 2000; Baird, Gong, McIntosh and Ozler, 2014), which in turn is affected by the quality of information. Better educated individuals may be better able to interpret and respond to information. In an analysis of Demographic and Health Survey (DHS) data for 32 SSA countries, Lucas and Wilson (2019) suggest some stylized facts on the relationship between education, income and risky behaviour. More educated individuals are less likely to engage in risky behaviour or to be HIV positive; whereas females in richer households seem less risky; results are mixed for males (more likely to have multiple partners but also more likely to use a condom). Paula, Shapira and Todd (2014), in the case of Malawi, identify a potential adverse effect of better knowledge as individuals who believe they are not infected (as a result of having had a negative test result) are more likely to engage in risky behaviour (this effect is mitigated if not offset where prevalence is known to be high).

This paper considers the effect of risk perceptions and knowledge of HIV/AIDS on two indicators of risky sexual behaviour - multiple partners and condom use (at first and last sex for the previous 12 months) using three waves of the Botswana AIDS Impact Survey (BAIS) conducted by the National AIDS Coordinating Agency (NACA), the Central Statistics Office (CSO) [now Statistics Botswana] in 2004, 2008 and 2013. Botswana is a useful case given the high prevalence and a policy to promote awareness of antiretroviral therapy (ART) that began with four sites in 2002 and reached 19 by 2006 (these sites roughly correspond to the 27 districts in BAIS). Since Botswana`s first AIDS case in 1985, monitoring prevalence has

mainly been through the Sentinel Surveillance of pregnant women utilising antenatal care services (UNDP, 2000) and national HIV/AIDS assessment surveys since 2001. From a rate of 18% in 1992 (the first year of surveillance), since 1995 the national median HIV prevalence rate was consistently above 30% and reached 38% in 2003 (NACA, 2003). The assessment surveys suggest lower prevalence rates of 17-19% between 2004 and 2013 (NACA and CSO, 2005; CSO and NACA, 2009; Statistics Botswana and NACA, 2016).[1]

Risk perceptions are captured by HIV prevalence rate at district level as an objective indicator and concern about HIV/AIDS (individual's perceived likelihood of infection as a result of the roll-out of ART in Botswana) as a subjective indicator. Reverse causality has to be addressed as while the risk affects sexual behaviour perceived risk could be due to previous risky sexual behaviour (Oster, 2012; Paula et al., 2014). To address potential endogeneity, prevalence is instrumented by distance to the hotspot in Botswana (motivated by the approach in Oster, 2012) and concern is instrumented by time since the ART rollout in the district. Knowledge about HIV is captured through two measures – responses to questions on ways of preventing infection (prevention knowledge) and being able to correctly reject misconceptions about HIV. We also avail of questions (in 2008 and 2013) asking if respondent's concern about being infected with HIV has changed as a result of the roll out of ART.

The analysis for Botswana shows that although the majority of respondents were knowledgeable about HIV, sexual behaviour was not affected by district-level prevalence; education and knowledge of HIV were associated with having multiple sexual partners but also with using a condom. Those who became less concerned as a result of ART seemed more likely to have multiple sexual partners and to use a condom for first sex. Those who became more concerned seemed more likely to use a condom but there was no significant effect on multiple partners. However, controlling for endogeneity of prevalence and concern in condom use, HIV prevalence was insignificant and the more concerned were more likely to use a condom for first sex but the less concerned were less likely to use a condom for first sex (neither had a significant effect on use for last sex). There are some positive findings: more knowledge of HIV is associated with less risky behaviour, especially among those who become more concerned about infection as a result of the roll out of ART. However, those who become less concerned, perhaps because they believe ART is addressing the problem, are more likely to engage in risky behaviour. As the proportions becoming less and more concerned are similar, at around a quarter of the sample, this implies the potential for an adverse behavioural response by a significant proportion of the population if public health actions are perceived to be reducing risk of infection. An analogous concern for Covid-19 is that the roll out of vaccination may encourage a sizeable number of people to become less concerned and engage in more risky behaviour.

Section 2 discusses the existing evidence on how HIV/AIDS risks affect behaviour for Botswana within the context of SSA literature, elaborating on concepts of risk and how they are measured. Section 3 presents the Botswanan data and descriptive statistics. The empirical strategy is discussed in section 4 and results are in section 5. Robustness checks are presented in the Appendix. Section 6 discusses the implications of the analysis of HIV/AIDS for public health strategies.

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[1] These rates derived from surveys may not be comparable to the ones obtained through surveillance reports which estimated prevalence for males by multiplying the female prevalence by a male-female infection ratio, and further by the male population (NACA, 2003). The virus has been among the top three indirect causes of maternal deaths; between 1992 and 1997, AIDS related deaths rose from 2.4% to 9% of the total hospital deaths for those aged 15-44 (UNDP, 2000; Ministry of Health, 2013; 2015).

2 HIV/AIDS Risks and Behaviour

There are various direct measures of HIV risk, defined as factors 'that could directly influence a person's perceived or objective risk of infection from the disease' (Guillen and Thuilliez, 2015: 14), distinguished between objective (external) or subjective (self-reported and perceived) measured at either the individual or population level. Objective measures at a population level include: (i) HIV prevalence rate, the share of the population affected at a point in time; (ii) incidence, the number of new cases at the time; and (iii) mortality rates, the number who died as a result of infection. At the individual level, the objective measure is confirmed HIV status (Godlonton and Thornton, 2013) and informing people about their HIV status is expected to encourage less risky behaviour by reducing uncertainty (Delavande and Kohler, 2012), unless individuals derive utility from risky activities (Philipson and Posner, 1993: 41).

Subjective measures include perceived likelihood of being infected, knowledge about the virus and prevalence in the community, and are usually measured at the individual level. Such perceptions are determined by several factors, including previous sexual behaviour, perceived partner`s behaviour, beliefs about factors that affect transmission (such as male circumcision or using a condom), and existence of programmes such as antiretroviral therapy (ART) aimed at reducing the likelihood or severity of objective risk (Godlonton, Munthali and Thornton, 2016; Gregson, Zhuwau, Roy and Chandiwana, 1998). Behaviour may be affected by prior beliefs about the likelihood of infection (Boozer and Philipson, 2000); although perceptions could be due to incorrect information (Delavande and Kohler, 2012), higher perceived risk of infection should encourage less risky sexual behaviour (Tenkorang, Maticka-Tyndale and Rajulton, 2011).

Some trends in Botswana suggest that (knowledge of) HIV/AIDS has affected behaviour. Family health surveys show increasing rates of contraceptive use from 16% to 67% over 1984-2017 (CSO, 1999; 2001; 2009; Statistics Botswana, 2018). While this may have facilitated the policy objective to reduce the total fertility rate, it might have led to a neglect in controlling HIV/AIDS infection, which was increasing over this period. In contrast, AIDS impact survey reports suggest an increase from 3.5% to 4.4% in the proportion of those who had sex before age 15 and a decline from 78% to 65% in the use of a condom at last sex with a non-regular partner between 2008 and 2013 for the 15-24 age cohort while condom use at last sex for the 15-49 age cohort fell from 90% to about 80% (NACA, 2015). While 77% of respondents indicated that they ceased sexual intercourse if infected with a sexually transmitted disease (STD) and 17% reported continuing to engage in unsafe sex in 2001 (CSO, 2002), the latter fell to 9% by 2004 (NACA and CSO, 2005). Furthermore, the proportion of women living with HIV who became pregnant increased from 50% in 2007 to 70% in 2009 and 2011 (Schaan, Taylor and Marlink, 2014), suggesting a pattern of possible fatal behaviour (Kremer, 1996; Sterck, 2013).

Studies for SSA provide mixed evidence on how knowledge of risks of HIV infection influence behaviour. In a comprehensive analysis, Oster (2012) uses DHS data for 14 SSA countries to investigate the findings in the literature that Africans do not appear to have reduced risky sexual behaviour in response to HIV. A major reason is that earlier studies did not control for endogeneity. Reverse causality creates a bias as places where risky behaviour is relatively high will also have higher HIV prevalence so that any response may not be observed. Accounting for endogeneity with distance to the origin of HIV (the straight-line distance from the cluster where the household is located to the centre of the Democratic Republic of Congo) she finds that married individuals in areas with higher prevalence are

more likely to reduce risky behaviour.[2] A second reason is that there may be weak incentives to reduce risk because of low life expectancy. Using various measures of (non-HIV) mortality as proxies, there is evidence for this as risky behaviour declines where life expectancy is greater. The third reason explored is that individuals have insufficient knowledge about risks therefore do not adjust behaviour. Oster (2012) finds no evidence that more knowledge (the share of individuals who know that using a condom or only a single partner can reduce infection risk) is associated with less risky behaviour, perhaps because knowledge is measured at the country level (so fails to capture the situation of individuals or clusters) and may be positively associated with risky behaviour if campaigns are targeted on high prevalence regions or risky groups.

Individual responses to knowledge of risk are likely to be influenced by education and income (correlated with education but in addition capturing incentive to remain healthy). Lucas and Wilson (2019) use DHS data for 32 SSA countries to investigate the relationship between education (level completed – none, primary or secondary) and household welfare (material standard of living based on number of types of consumer durables owned) on risky behaviour (using a condom, multiple partners and paying for sex). More educated males are more likely to report using a condom and are less likely to pay for sex; other relationships are insignificant except that males with primary education (but not that completed secondary) are more likely to report multiple partners. The same results are observed controlling for knowing that condom use and fewer partners reduces HIV risk (the effect of knowledge is not reported). Females in richer households exhibit less risky behaviour – they are more likely to use a condom and less likely to have multiple partners. Although richer males are also more likely to use a condom, they are more likely to have multiple partners but less likely to pay for sex. Based on the subset of respondents who were tested for HIV, individuals in richer households and those who completed secondary education are less likely to be HIV positive although completing primary education increased the likelihood of being HIV positive (Lucas and Wilson 2019, p2188). Overall, the evidence suggests that, at least beyond some threshold, more educated and richer individuals are less likely to engage in risky behaviour if they are aware of the risk involved.

There is mixed evidence for the association between education and HIV status. Fortson (2008) finds that education is positively associated with HIV status in five Africa countries (Ghana, Burkina Faso, Kenya, Cameroon and Tanzania) although, using the same data, De Walque (2009) finds that education has no effect on HIV infection. A negative association between education and HIV status has been found in Botswana (DeNeve, Gunther Fink, Subramanian and Bor, 2015) and Zimbabwe (Aguero and Bharadwaj, 2014), where it also reduces number of sexual partners.

2.1 Subjective Risk Indicators

Many studies investigate the association between subjective risk and behaviour although they are often limited by the tendency of self-reported sexual behaviour to be susceptible to reporting bias, either under-reporting risky behaviour or over reporting protective behaviour (Akwara et al., 2003). Various measures of subjective or perceived risk have been employed. In a review, Crepaz, Hart and Marks (2004) found no association between receiving highly

[2] Three measures of sexual behaviour, with separate estimates for married and unmarried women and men, are used: whether the individual has multiple sexual partners; multiple partners with no condom use and the number of non-marital partners (Oster, 2012, p36). The binary measures for multiple sexual partners are preferred as the number of partners is more likely to be under-reported (Oster, 2012, p39).

active ART (HAART) and unprotected sex: people who believe HAART reduces HIV transmission and those less concerned about engaging in unsafe sex were more likely to engage in risky behaviour (endogeneity was not addressed in the studies, most of which were for the US). Oster (2012) accounts for endogeneity and finds that knowledge on HIV transmission has no effect on sexual behaviour in the 14 SSA countries. Allowing for the possibility that beliefs about the likelihood of being infected with HIV can be updated overtime, Paula et al. (2014), availing of panel data for a sample of only men, find that in Malawi men who believe they have higher likelihood of HIV infection are less likely to report either being in extramarital sex relationships or having multiple sex partners, while those who believe the likelihood is low are more likely to report risky behaviour.

Evidence that higher perceived risk is associated with less risky behaviour has been found for Kenya (Akwara et al. 2003) and South Africa (Tenkorang et al., 2011, who also find that knowing someone who died of HIV reduces risky sexual behaviour among men but increases it among women). Dupas (2011), also for Kenya, finds that providing risk information to teenagers was associated with increased sexual activity coupled with a reduction in unsafe sex. Existing studies for Botswana only considered respondents that reported being sexually active and provide mixed evidence on the effect of perception on sexual behaviour. Keetile and Letamo (2015) use the 2008 BAIS and find that those who believe that ART cures AIDS are more likely to report inconsistent condom use (i.e., did not always use a condom with most recent three sexual partners), whereas Letamo, Keetile and Navaneethan (2017) for the 2013 BAIS find that those who believe this (or are unsure) were less likely to report inconsistent condom use (and less likely to report multiple partners). In investigating the effect of ART on sexual behaviour, Keetile and Kgosidintsi (2018), using the 2013 BAIS, find no association between enrolment in ART and condom use or multiple partners (but do not account for non-random assignment to treatment). However, assignment to ART is not random and is preceded by testing which can affect behaviour (Baird et al., 2014; Gong, 2015), whilst inability to observe the exact time of being enrolled in the programme may lead to incorrect attribution of behaviour to ART. None of these studies accounts for endogeneity.[3]

2.2 Objective risk indicators

A few studies have access to an objective measure of individual risk (the result of being tested) and find that the effect depends on whether individuals are surprised by HIV positive test results. Gong (2015), for Kenya and Tanzania, finds that those surprised by HIV positive test results increase their risky sexual behaviour, while those surprised by negative HIV test reduced their risky behaviour. Baird et al (2014) observe a similar pattern in Malawi whereas Delavande and Kohler (2012) find that a positive result reduces the likelihood of risky behaviour, but a negative result has no effect on either the reported number of sexual partners or condom use. Thornton (2008) finds that those who learnt their HIV positive status are more likely to purchase condoms than those who do not know their status (there is no effect among those who learnt their HIV negative status).

[3] As circumcision is known to reduce susceptibility to infection (Lee, 2021, p143), a few studies address if male circumcision affects sexual behaviour in Botswana. Agiya and Letamo (2011) using the 2008 BAIS found no association between male circumcision and condom use whereas Balekang and Dintwa (2016), also for the 2008 BAIS, find that more educated uncircumcised men aged 30-34 years are less likely to report multiple partners (both studies used similar logistic regressions and neither accounts for selection or endogeneity). This is not an issue we address.

In a comprehensive study to try and reconcile the conflicting evidence on the effect of knowing one's HIV status in Malawi, Paula et al (2014) use panel survey data (2006 and 2008) for a sample of almost 600 males to investigate responses (captured by multiple sexual partners or extramarital sex) to changes in perceptions of one's HIV status (self-reported but with information on test results from two years before the survey).[4] Endogeneity is highly likely as there is a positive correlation between risky behaviour and believing one is HIV positive. Controlling for this, and allowing for misreporting, 'estimates indicate that downward revisions in beliefs lead to a higher propensity to engage in risky behaviors and that upward revisions in beliefs lead to a lower propensity … [hence]… credibly informing people that they are HIV-negative [positive], for example, through testing campaigns, can increase [reduce] risky behavior' (Paula et al 2014, p962). Although changes in beliefs are not necessarily consistent with the test result (e.g., some who receive a positive result subsequently report a low belief of being infected) the results suggest a challenge that those who know they are infected may 'throw caution to the wind' although it seems likely, if prevalence is relatively high, those who know they are not infected will act more safely.

Two studies in Botswana suggest that having ever been tested for HIV is associated with risky behaviour. Malema (2012) investigates condom use with the 2004 BAIS and finds that employed females are less likely to use condoms than the unemployed, while among males only those in relatively high income employment (professionals and legislators) are less likely to use condoms, and partly attributes this finding to the observation that the employed reported having had more HIV tests. Keetile (2014) uses the 2008 BAIS and finds that having ever been tested is associated with less regular condom use but also having fewer partners. None of these studies addressed endogeneity of prevalence and risk perceptions. A limitation of the 2008 BAIS is that the test result is not reported (there was a question on whether respondents were told their test result). In the 2013 BAIS respondents were asked whether the results were positive or negative.

3 Data and Descriptive Statistics

We use individual data from the 2004, 2008 and 2013 waves of the Botswana AIDS Impact Survey (BAIS) conducted by NACA and Statistics Botswana. The first wave (2001) is not used because it has no information on the risk measures we consider. To control for the possible vertical transmission of HIV (Oster, 2005), we restrict the sample to those aged 15 years and above. These surveys provide information on individual demographics, knowledge of HIV/AIDS and related diseases, attitudes towards those affected by the virus, sexual behaviour, alcohol consumption and drug use, male circumcision, reported incidents of STDs, childbearing and antenatal care (for women only) as well as availability of social and medical services (NACA and CSO, 2005; CSO and NACA, 2009; Statistics Botswana and NACA, 2016). Under the sexual history and behaviour component, respondents were asked about the number of people with whom they had a sexual relationship in the past 12 months before the survey, although information on the type of relationship and use of condom in the first and last time of intercourse was only requested for the last three sexual partners. Respondents were asked about their level of concern of being infected with HIV due to ART in 2008 and 2013. Specifically, the question asked was "*how has your personal concern*

[4] Paula et al (2014, p948) do not include condom use due to lack of data in 2008 but note that in a study using the 2004 and 2006 surveys in Malawi, Delavande and Kohler (2012) found that receiving a positive test result was associated with increased condom use and fewer sexual partners.

about getting HIV changed since the introduction of ART" with possible responses of less concerned, more concerned, no change in concern level and do not know.

The objective measure of risk is the HIV prevalence rate for the district in which the respondent resides, with distance (in kilometres) from the respondent`s area of residence to the single HIV hot spot (Selebi-Phikwe, the area with the highest HIV prevalence rate in Botswana at the time of the survey) used as an instrument. This variable is plausibly exogenous to sexual behaviour (Oster, 2012). We construct a HIV Prevention Knowledge (*PK*) variable with a score ranging between zero and two by adding together the binary responses to two questions: (i) can people reduce their chances of getting HIV by using condoms correctly every time they have sex; and (ii) can people reduce their chances by having only one uninfected partner who has no other partners. Our other knowledge indicator is based on accuracy in rejecting HIV misconceptions from four questions (whether it is possible for a healthy-looking person to have HIV, HIV being transmitted through mosquitoes, sharing meal with infected person and through witchcraft) with a score of 1 for each misconception rejected correctly. The scores for '*Reject*' range from zero (no true rejection) to four (reject all misconceptions). Although these questions were only asked of those who indicated ever having heard of HIV, that represents 97% of the sample.

There are data limitations to be acknowledged. The surveys are repeated cross sections, not panels, with different sampling frames over time so there is variation in sample composition. Many of the questions are sensitive so responses may be vague or incomplete (Glick and Sahn, 2008) and could change over time due to changes in public awareness and respondent`s experience. Questions on sexual behaviour or partners must be carefully phrased and asked and, even then, respondents may refuse to answer (CSO, 2002: 22). We don't use responses to the question whether tested for HIV as the result is not known (unless self-reported but only in 2013).

Table 1 provides definitions of the variables and Table 2 gives summary descriptive statistics for the pooled data (see Appendix Table A1 for each survey wave). More than 50% of respondents are females; over 60% are aged between 15 and 34; almost half have secondary education; the majority are Christians. The never married account for more than 50% and cohabiting partners account for the second highest share. Almost 85% report having had sexual intercourse, but 70% report being sexually active during the 12 months prior to the survey and of these 14% reported more than one partner. Conditional on reporting being sexually active in the past 12 months before the survey, information was sourced on the three most recent partners.[5] Table 2 only reports responses to questions regarding the first most recent partner: the most common relationship type is *boyfriend/girlfriend* and the least common is *other relationship* (such as casual acquaintance or paid for sex). The reported use of condom at first and last sex with the partner appears to have increased over time, although the share always using a condom appears to have declined. The latter indicator may be preferable to capture the frequency of use between first and last sex (Tenkorang et al., 2011) but we consider both as respondents may over report use of condoms. For HIV prevention knowledge the mean score was 1.8 (out of 2) and the mean score for 'reject misconceptions' was 3 (out of 4); respondents had good prevention knowledge and were alert to misconceptions (Table 2).

[5] Appendix Table A2 shows that mean age and proportion of males, married, cohabiting and those with higher education reporting sexual activity is higher than for those reporting no sexual activity. The proportions of never married and those with less than higher education is higher for reporting no sexual activity.

Perceived risk is the answer to the question on change in concern since the introduction of ART with responses of less concerned, more concerned, no change in concern and do not know. There appears to have been a notable increase in concern about the likelihood of HIV since the introduction of ART: between 2004 and 2008, 26 per cent were more concerned but 32 per cent were less concerned, whereas between 2008 and 2013, 34 per cent were more concerned and only 16 per cent were less concerned (Table A1). Although no change in concern since the introduction of ART could include several possibilities, such as still concerned and still not concerned, how respondents formulate concern is beyond the scope of this paper as focus is on the impact of having reported an update of risk perception.

Table 1: Description of Variables

Variable	Description
Dependent Variables	
Had sex relations	Whether the individual reports sexually active 12 months before survey
Sexual partners	Indicators for the reported number of sexual partners in the past 12months 0 for no partners, 1 for 1 partner and 2 for more than 1 partner
First Sex	Indicator for condom use at first sex in past year (1=Yes)
Last Sex	Indicator for condom use at last sex in past year (1=Yes)
Explanatory Variables	
Age	Age in years
Age squared	Age in years squared
Male	An indicator for a male respondent (1=Yes)
Education	
No education	An indicator for no education (1=Yes)
Non formal	An indicator for non-formal education (1=Yes)
Primary	An indicator for primary education (1=Yes)
Secondary	An indicator for secondary education (1=Yes)
Higher	An indicator for higher education (1=Yes)
Christianity	An indicator for Christianity as main religion (1=Yes)
Current Marital Status	
Married	Whether individual is married (1=Yes)
Never married	Whether individual has never been married (1=Yes)
Cohabitation	Whether individual is cohabiting (1=Yes)
Other marital status	Whether individual is widowed, divorced, separated (1=Yes)
Area of residence	
Rural	An indicator for rural area residence (1=Yes)
Relationship to the most recent partner	
Husband/Wife	Individual is husband/wife to the most recent sexual partner (1=Yes)
Cohabitation	Individual is cohabiting with the most recent sexual partner (1=Yes)
Girlfriend/Boyfriend	Individual is a boy/girl friend to the most recent sexual partner (1=Yes)
Other relation type	Other relationship (casual, paid sex) with most recent partner (1=Yes)
Perceived Unfaithfulness	Whether individual believes the partner has other partners (1=Yes)
Partner drunk at last sex	Whether partners were drunk at last sex (1=Yes)
Personal concern on likelihood due to ART changed	
No change	No change in the level of concern about likelihood of HIV infection
Less concerned	Less concerned about the likelihood of HIV infection (1=Yes)
More concerned	More concerned about the likelihood of HIV infection (1= Yes)
HIV prevalence rate	Percentage shares of those HIV positive in a district
Prevention Knowledge (PK)	Sum of two dummies on HIV prevention
Correctly Reject	Sum of four dummies on true rejection of HIV misconceptions
Instrumental Variables	
Distance	Distance to district with highest HIV prevalence rate
ARVMBS	Number of months for ART rollout before the survey

Table 2: Descriptive Statistics, Pooled data (shares unless otherwise stated)

Variable	Share		Share
Panel A. Demographics		**Panel B. Behaviour**	
Male	0.449	Ever had sexual intercourse (1=Yes)	0.846
Age (mean years)	32.312	Had sex in the past 12 months	0.709
(standard deviation)	12.494	*No of sexual partners*	
15-24	0.329	One Partner (1=Yes)	0.864
25-34	0.294	Two partners (1=Yes)	0.099
35-44	0.186	Three or more (1=Yes)	0.037
45-54	0.122	*Relation to the first recent sexual partner*	
55-64	0.068	Husband/Wife	0.228
		Cohabiting	0.300
		Girlfriend/Boyfriend	0.448
Education Level		Other relationship type	0.024
No Education	0.118		
Non-Formal	0.013	Always use condom (1=Yes)	0.678
Primary	0.219	Condom used at first sex	0.722
Secondary	0.490	Condom used at last sex with partner	0.658
Higher	0.160	Partner drunk at last sex	0.078
		Perceived partner unfaithfulness	0.248
Current Marital Status			
Married	0.181	*HIV Knowledge*	
Never Married	0.533	Ever heard of HIV (1=Yes)	0.968
Cohabitation	0.239	HIV Prevention knowledge	1.777
Other Marital Status	0.046	Correctly rejects misconceptions	2.948
Main Religion		*Change Concern due to ART*	
Christianity	0.781	No change	0.452
Residence		Less concerned	0.257
Rural	0.379	More concerned	0.290

Notes: Pooled BAIS 2004, 2008 and 2013 covering 31948 individuals (in 30 districts). Change in concern due to ART is average for 2004-08 and 2008-13. Summary statistics for all waves are reported in Appendix Table A1.

The ART roll out dates in various districts will be used to instrument for the perceived risk. The programme was rolled out in four sites in 2002, six in 2003 and 19 in 2004 (Republic of Botswana, 2009). In the context of our data, rollout dates were before the first national AIDS impact survey that conducted blood tests. The earlier the rollout, the more we expect the extent of knowledge on the existence of ART, and its impact on risk perception, although direction of effect is ambiguous. We assume the rollout is not directly correlated with sexual behaviour but affects the perception on the likelihood of being infected with HIV. Introduction of ART may increase HIV prevalence through prolonged life of the infected rather than incidence (new infection) so assessing the impact on incidence requires the ability to distinguish between old and new infections (Friedman, 2018). There could be concern that the non-random placement of ART facilities may introduce omitted variable bias. However, it does not appear to be the case that placement was informed by prevalence; Selebi-Phikwe, arguably the hot spot according to prevalence, was not among the first to have received the programme. To address a potential issue that earlier roll out could have been influenced by non-rurality of the districts, we control for rural-urban status following Friedman (2018) and use number of months before the survey rather than roll out dates.

4 Conceptual Motivation

The conceptual framework within which we conduct this investigation is based on Philipson and Posner (1993), who argue that HIV incidence increases during the early stages of prevalence when the *subjective* probability of infection is low (so people do not adopt preventive behaviour). As prevalence increases over time, the cost of risky sexual behaviour rises, resulting in a possible reduced demand for risky sexual activities. This is because increasing prevalence can depreciate sexual capital, the 'present value of the flow of benefits from sexual enjoyment over the remaining lifetime' (Michael, 2004: 644). With the objective to maximise expected utility from sexual activities, an individual runs the risk of contracting HIV according to (Michael, 2004):

$$P_r(1) = P.I.E \tag{1}$$

The probability of infection from one sexual act, $P_r(1)$, is determining by the combined probability that the partner is infectious (P), the infectivity rate of the disease (I), and the effectiveness of the practice in preventing disease transmission (E). For an individual involved in N sexual activities with different partners (S), the probability of being infected becomes:

$$P_r(N,S) = 1 - (1 - P.I.E)^N \tag{2}$$

Key in (2) is that behavioural decisions can minimise the probability of contracting HIV. Hence, we investigate whether and how individuals respond to the risk of contracting HIV/AIDS through their behaviour. Behaviour includes both risky and non-risky actions which can be measured, such as rate of partner change (Kremer, 1996) or use of condoms (Geoffard and Philipson, 1996). Following Paula et al. (2014), the perception/concern about the likelihood of being infected with HIV due to ART can be represented as:

$$C_1 = C_0 + (1 - C_0)k(ART) \tag{3}$$

Where C_0 and C_1 are the previous and updated levels of concern respectively and k captures perception of ART (where 0 is no updating and 1 is full updating).

4.1 Empirical Strategy

Following Oster (2012), our basic model is specified as:

$$S_i = \alpha_0 + \alpha_1 X_i + \varepsilon_i \tag{4}$$

In (4) S_i is sexual behaviour (measured as indicators of sexual partners[6] and reported condom use at first and last sex) and X_i is a vector of controls. Given the binary nature of condom use, we specify a probit regression model. Previous work on sexual behaviour in Botswana only considers those who report being sexually active. However, given the possible underreporting of risky behaviour and over reporting of protective behaviour (Corno and Paula, 2019; Paula et al., 2014), consideration of only those that report being sexually active may bias the results. The potential unobservable effect surrounding the reported sexual inactivity (abstinence) should be accounted for.[7] To address selection bias we estimate an ordered probit model for the number of sexual partners, which allows us to include those who report to have abstained from sexual relations (Glick and Sahn, 2008). Thus, the dependent variable differentiates those with zero, one and more than one reported sexual partner. Indicator variables for the number of sexual partners minimises bias in reporting the true number of sexual partners (Oster, 2012).

Empirically, evidence on whether individuals respond to HIV risk is complicated by the challenge of reverse causality between these risks and sexual behaviour - HIV prevalence rates could be the outcome of more cases of risky sexual relations and reported sexual behaviour may be due to HIV prevalence. According to Oster (2012) inadequate control of such reverse causality may be one factor explaining the mixed evidence on behavioural response to HIV. Endogeneity has been addressed through the use of indirect measures of risk such as knowing someone infected by HIV (Tenkorang et al., 2011) or having a relative with AIDS (Francis, 2008) and the type of relationship (Gerber and Berman, 2008). We follow the reasoning of Oster (2012) using a 'distance to origin' instrument with two-stage estimation (structural equation and reduced form equation) as follows:

$$S_i = \alpha_0 + \alpha_1 X_i + \alpha_2 HIV_i + \varepsilon_i \quad (5)$$

$$HIV_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_i + u_i \quad (6)$$

Addressing endogeneity of perceived risk results in the following:

$$S_i = \alpha_0 + \alpha_1 X_i + \alpha_2 concerned_i + \varepsilon_i \quad (7)$$

$$Concerned_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_i + v_i \quad (8)$$

In equations (6) and (8) Z_i is an instrumental variable, while *concerned* in (7) and (8) represents those who updated their concern level (either less concerned or more concerned) since the introduction of ART. While equation (5) can be considered an instrumental variable probit (IVProbit) model, such is not the case with equation (7) since the endogenous

[6] This variable is in line with what Francis (2008) refers to as economics of sexuality and differs from the biological theories according to which sexual behaviour is exogenous.

[7] In Botswana biomarkers are not used to validate responses provided by respondents. Biomarkers may be inaccurate; for example, a negative test for an STD does not mean there was no risky behaviour (Corno and Paula, 2019).

regressor is binary so we estimate the IV probit by maximum likelihood as opposed to the two-step procedure (Wooldridge, 2010).

As noted previously, the instrument for HIV prevalence is distance (in kilometres) from the respondent`s district to the HIV hot spot. To allow for the possibility that migration affects the validity of this instrument we control for rural/urban residence since in Botswana migration is mainly from rural to urban areas (CSO, 2009) and the latter consistently have higher HIV prevalence rates in all three waves. We also estimate regressions for the rural and urban subsamples separately. We use ART rollout dates in various districts to instrument for the perceived risk (but do not observe whether the initiative was expected prior to rollout or when a respondent accessed information on ART or the drug itself for those enrolled). Although the non-random placement of ART facilities may introduce omitted variable bias, our examination of the data does not suggest that placement was informed by prevalence. To address a potential issue that earlier roll out could have been influenced by non-rural districts, we control for rural-urban status (Friedman, 2018).

5 Results and Discussion

The analysis covers two measures of risky behaviour, an indicator for multiple sexual partners and condom use. Objective risk is captured by the HIV prevalence rate and perceived (or subjective) risk is captured by indicators constructed from answers to questions on HIV prevention knowledge (*PK*), knowing which myths about HIV are wrong (*Reject*) and the change in concern about HIV as ART is rolled out (*Concern*). Results are provided for both ordered and binary probit marginal effects and accounting for endogeneity of risk perceptions and condom use. Interaction terms between education and *PK* and *Reject* are included given the evidence that knowledge increases with increasing levels of education: those with higher levels of education have higher prevention knowledge and are much more likely to correctly reject misconceptions (Appendix Table A3).

5.1 Risk and Sexual Partners

Comparing the characteristics of those reporting multiple (more than one) partners, as the indicator of risky behaviour, to those with only one partner (including zero partners to capture the sexually inactive) allows an assessment of the effects of HIV knowledge. Table 3 presents ordered probit marginal effects (without controlling for endogeneity or selection). The coefficient on HIV prevalence is insignificant. HIV prevention knowledge (*PK*) and correct rejection of HIV misconceptions (*Reject*) are significant and associated with increased likelihood of multiple partners (and reduced likelihood of abstinence). Being educated (compared to no education) also increases (reduces) the likelihood of multiple (no) partners and the significant effects increase with the level of education. This is consistent with more education being associated with more HIV knowledge (confirmed in Table A3) and, to the extent education is correlated with earnings, that richer individuals are more likely to have multiple partners. The only significant interaction with education is for primary education and *Reject*: the coefficients suggest that those with primary education only and who correctly reject misconceptions are less (more) likely to have multiple (no) partners. In general, education and knowledge of HIV appear to increase risky behaviour.

Males are about three percentage points more likely to report more than one sexual partner than females and about eight percentage points less likely to report no partner. Estimating for each gender separately shows that the likelihood of multiple (no) partners is significant and increasing (decreasing) with education for males (Table A6). Coefficients are

insignificant for females except for primary education only which is associated with increased (lower) likelihood of multiple (no) partners (Table A7).

Table 3: Marginal Effects (at means) for Sexual Partners (Ordered Probit)

Variables	0 Partner	1 partner	>1 partner
Male	-0.079***	0.045***	0.033***
	(0.004)	(0.002)	(0.002)
Age	-0.052***	0.030***	0.022***
	(0.002)	(0.001)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.065***	0.037**	0.027***
	(0.025)	(0.014)	(0.010)
Secondary	-0.081***	0.047***	0.034***
	(0.021)	(0.012)	(0.009)
Higher	-0.095***	0.055***	0.040***
	(0.035)	(0.020)	(0.015)
Christianity	0.042***	-0.024***	-0.018***
	(0.005)	(0.003)	(0.002)
Cohabitation	-0.021***	0.012***	0.009***
	(0.008)	(0.005)	(0.003)
Never married	0.158***	-0.091***	-0.067***
	(0.012)	(0.007)	(0.005)
Other Marital status	0.294***	-0.170***	-0.124***
	(0.021)	(0.013)	(0.009)
HIV Rate	0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)
Rural	0.011	-0.006	-0.005
	(0.009)	(0.005)	(0.004)
HIV Prevention Knowledge	-0.036***	0.021***	0.015***
	(0.011)	(0.007)	(0.005)
Correct Reject	-0.012**	0.007**	0.005**
	(0.006)	(0.003)	(0.002)
Primary*PK	0.009	-0.005	-0.004
	(0.011)	(0.006)	(0.005)
Secondary*PK	-0.012	0.007	0.005
	(0.013)	(0.008)	(0.006)
Higher*PK	-0.009	0.005	0.004
	(0.016)	(0.009)	(0.007)
Primary*Reject	0.014**	-0.008**	-0.006**
	(0.007)	(0.004)	(0.003)
Secondary* Reject	0.013	-0.007	-0.005
	(0.008)	(0.004)	(0.003)
Higher*Reject	0.003	-0.002	-0.001
	(0.009)	(0.005)	(0.004)
Wave 3 (2008)	-0.017**	0.010***	0.007**
	(0.007)	(0.004)	(0.003)
Wave 4 (2013)	-0.078***	0.045***	0.033***
	(0.009)	(0.005)	(0.004)
District FE	Yes	Yes	Yes
Observations	29601	29601	29601

Notes: Omitted categories are: female; no education; married; and urban. PK is prevention knowledge and (correct) Reject is correctly rejects misconceptions. Standard errors clustered at district level in parentheses: significant at the 1 per cent (***), 5 per cent (**) or 10 per cent (*) level.

Although *Reject* is insignificant for males the likelihood of multiple (no) partners is significantly higher (lower) with *PK* (no interaction terms are significant). In the case of females all knowledge and interaction coefficients are insignificant. This suggests that the effects of knowledge on multiple partners are attributable to the behaviour of males (especially in rural areas).[8] Other factors that increase the likelihood of having multiple partners are cohabitation (compared to married, but insignificant for females) and being older. Christianity and never married are associated with lower (higher) likelihood of multiple (no) partners (for males and females). The likelihood of multiple (no) partners appears to increase over time given the significant coefficients on Waves 3 and 4; both are significant for females but only Wave 4 is significant for males (Tables A6 and A7).

A possible reason for insignificance of HIV prevalence is that respondents are not well informed about this for their district and behaviour is influenced by perceptions. This can be addressed by incorporating how ART affected changes in perceptions. Table 4 presents ordered probit marginal effects for the number of partners replacing HIV prevalence with changes in concern about the likelihood of infection after the introduction of ART - dummies for being Less concerned (=1) or More concerned (=1) compared to no change in concern (=0). As the change in concern is between the waves, the first wave is dropped (hence fewer observations). The knowledge measures (*PK* and *Reject*), education levels and interaction terms are all now insignificant (contrary to Table 3). Controlling for these, risky behaviour is more likely for those with reduced subjective risk: compared to those who have not changed their concern levels, Less concerned are more (less) likely to have multiple (no) partners whereas coefficients for More concerned are insignificant. There are similar effects for males, age, never married, cohabitation and Christianity as in Table 3 and risky behaviour again seems to have increased over time (for wave 4 in 2013). One difference is those in rural areas are less (more) likely to report multiple (no) partners.[9] Results are similar for males and females except that is only for males that Less concerned males are more (less) likely to report multiple (no) partners; concern, cohabitation and rural are insignificant for females (Tables A10 and A11).

We do not explore instrumenting for prevalence as it is never significant, and do not instrument for concern because the estimates include the sexually inactive. The results above suggest that males account for effects of knowledge and changing perceptions (if less concern) on risky behaviour. The finding that more educated were more likely to engage in risky behaviour even though they have more knowledge of HIV is driven by responses in 2004 (wave 2) as risky behaviour increased after then (at least for the less concerned). As more education is strongly associated with more HIV knowledge (Table A3) this may partly reflect a norm of educated males being more likely to have more than one partner being an 'initial condition' (an association observed in 2004). These associations had dissipated by later waves (Table 4).

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[8] While the HIV rate remains insignificant, both *PK* and *Reject* are significant (and associated with multiple partners) in rural areas whereas only *Reject* is significant in urban areas. The interaction of secondary education and *Reject* is significant in rural areas, whereas in urban areas the only significant interaction is primary with *Reject*, in both cases reducing the likelihood of multiple partners. Results for control variables are similar if the sample is split into rural and urban areas, except that only Wave 4 is significant in rural areas while both waves are significant in urban areas (Tables A8 & A9).

[9] Splitting the sample, concern, knowledge and interactions are all insignificant in rural areas but in urban areas those who report Less concern are more likely to report multiple partners (Tables A12 & A13).

Table 4: Marginal Effects (at means), Ordered Probit for Number of Partners

Variables	0 Partner	1 Partner	>1 Partner
Male	-0.090***	0.041***	0.049***
	(0.007)	(0.003)	(0.004)
Age	-0.044***	0.020***	0.024***
	(0.002)	(0.001)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.001	0.000	0.000
	(0.050)	(0.023)	(0.028)
Secondary	-0.026	0.012	0.014
	(0.037)	(0.017)	(0.020)
Higher	-0.047	0.021	0.026
	(0.054)	(0.024)	(0.029)
Christianity	0.032***	-0.014***	-0.017***
	(0.007)	(0.003)	(0.004)
Cohabitation	-0.022**	0.010**	0.012**
	(0.010)	(0.004)	(0.005)
Never married	0.116***	-0.053***	-0.064***
	(0.013)	(0.006)	(0.008)
Other Marital status	0.222***	-0.101***	-0.121***
	(0.021)	(0.009)	(0.012)
Less Concerned	-0.015**	0.007**	0.008**
	(0.007)	(0.003)	(0.004)
More Concerned	-0.004	0.002	0.002
	(0.006)	(0.003)	(0.003)
Rural	0.016**	-0.007**	-0.009**
	(0.008)	(0.004)	(0.004)
HIV PK	-0.023	0.010	0.012
	(0.016)	(0.007)	(0.009)
Correct Reject	0.000	-0.000	-0.000
	(0.006)	(0.003)	(0.004)
Primary*HIV PK	-0.018	0.008	0.010
	(0.021)	(0.009)	(0.011)
Secondary*HIV PK	-0.029	0.013	0.016
	(0.019)	(0.009)	(0.011)
Higher*HIV PK	-0.011	0.005	0.006
	(0.024)	(0.011)	(0.013)
Primary* Reject	0.008	-0.004	-0.004
	(0.009)	(0.004)	(0.005)
Secondary*Reject	0.005	-0.002	-0.003
	(0.008)	(0.004)	(0.004)
Higher*Reject	-0.009	0.004	0.005
	(0.011)	(0.005)	(0.006)
Wave 4 (2013)	-0.058***	0.026***	0.032***
	(0.007)	(0.003)	(0.004)
District FE	Yes	Yes	Yes
Observations	16256	16256	16256

Notes: As for Table 3 except omitted category for Less and More is no change in concern level, sample limited to waves 3 and 4.

The tendency for risky behaviour to increase over time (the significant coefficients on waves for more than one partner) is only partly accounted for by those who became less concerned

about infection. It is of course possible that the tendency to have more partners was offset by other behaviour to reduce risk, such as use of a condom to which we now turn.

5.2 Risk and Condom Use

The number of partners may be a weak indicator of risky behaviour as abstinence is determined by factors other than HIV and those with multiple partners can engage in safer sex, for example by using a condom. Condom use is arguably a preferable indicator of risky behaviour. Table 5 presents the binary probit marginal effects for condom use at both first and last sexual intercourse in the past year. The HIV prevalence rate is associated with a small but significant increase in the likelihood of condom use at first sex (there is no effect for last sex). While HIV knowledge variables significantly increase the likelihood of condom use, the interaction terms suggest that this effect declines with more education for first sex in the case of *Reject* (and for higher education at last sex); for *PK* the only significant interaction is for Secondary with last sex (and reduces the likelihood). Nevertheless, interaction coefficients are small and the likelihood of using a condom at first and last sex increases significantly with education (at least beyond Primary).

Males are more likely to report the use of a condom (both times). The nature of the relationship is relevant: there is less likelihood of condom use among the married and cohabiting, while 'other relation type' (such as casual acquaintance or paying someone for sex) is associated with increased likelihood of condom use at last sexual intercourse. The lower use of condoms among the married and cohabiting could be due to the confidence/trust in relationship, or fatalism (Sterck, 2013). Trust is reasonably high: only nine per cent of married and almost 30 per cent of cohabiting said they do not trust their partners. Those who perceive their partners to be unfaithful are more likely to report condom use at last sex but less likely at first sex suggesting they reduce risky behaviour over time.[10] Those who report having had sex when drunk are less likely to use condom (only asked for last sex). Rural respondents are also less likely to use a condom.[11]

Endogeneity is a concern as the prevalence of condom use could reasonably be expected to affect HIV prevalence in the district where respondents reside. We instrument for prevalence using the distance of the district to the HIV hot spot and Table 6 reports results for IV probit (preferred) and 2SLS estimators.[12] The IV results in Table 6 are similar to Table 5 although the (instrumented) HIV prevalence rate is now insignificant, implying it was not awareness of prevalence that encouraged condom use.

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[10] The likelihood of condom use at both first and last sex for males increases with HIV prevalence but this holds only at first sex among females; knowledge is associated with condom use in all cases for females, but for males PK only significant for last sex and Reject for first sex (Table A14). Perceived unfaithfulness only increases condom use at last sex and the effect is greater for males (females are less likely to use a condom at first sex, although only weakly significant). Condom use is increasing in education for both (except primary insignificant for males). Coefficients on married and cohabiting are similar but only males are more likely to use a condom in 'other relationship'

[11] Estimating rural and urban separately, HIV prevalence is only associated with increased likelihood of condom use in urban areas; *Reject* is associated with condom use in both areas (stronger for rural) but *PK* is only significant in rural areas (Table A15).

[12] The first stage estimates are in Table A4 and the instrument is statistically significant (the null hypothesis that the instrument is weak is rejected by the F statistic while Wald and Durbin-Wu Hausman tests reject the null hypothesis that the HIV prevalence rate is exogenous).

Table 5: Probit Marginal Effects for Condom Use (at First and Last Sex)

Variables	CUFS	CULS
Male	0.052***	0.067***
	(0.007)	(0.006)
Age	-0.017***	-0.003
	(0.002)	(0.002)
Age squared	0.000***	-0.000
	(0.000)	(0.000)
Primary	0.096**	0.083**
	(0.041)	(0.038)
Secondary	0.221***	0.345***
	(0.050)	(0.050)
Higher	0.336***	0.338***
	(0.057)	(0.060)
Christianity	0.012	0.012
	(0.008)	(0.011)
Husband/Wife	-0.225***	-0.265***
	(0.007)	(0.016)
Cohabiting	-0.085***	-0.125***
	(0.007)	(0.008)
Other relationship type	0.017	0.088***
	(0.020)	(0.029)
HIV Rate	0.004**	0.003
	(0.002)	(0.002)
Perceived Unfaithful (Yes)	-0.013**	0.042***
	(0.005)	(0.004)
Rural	-0.049***	-0.058***
	(0.004)	(0.008)
One Partner	0.014	-0.014
	(0.009)	(0.009)
HIV Prevention Knowledge	0.045**	0.066***
	(0.018)	(0.017)
Correct Reject	0.023***	0.027**
	(0.006)	(0.011)
Primary*PK	-0.003	0.009
	(0.020)	(0.022)
Secondary*PK	-0.020	-0.077***
	(0.024)	(0.019)
Higher*PK	-0.040	-0.046
	(0.029)	(0.029)
Primary* Reject	-0.013*	-0.008
	(0.008)	(0.011)
Secondary* Reject	-0.014**	-0.020
	(0.006)	(0.013)
Higher* Reject	-0.025***	-0.032**
	(0.009)	(0.014)
Partner drunk at last sex	-	-0.094***
		(0.007)
Wave 3(2008)	0.095***	0.066***
	(0.006)	(0.010)
Wave 4 (2013)	0.173***	0.066***
	(0.010)	(0.011)
District FE	Yes	Yes
Observations	20493	20475
Loglikelihood	-8341.716	-11057.096

Notes: As for Table 3 except omitted category is boyfriend/girlfriend for relation type; CUFS is condom use at first sex and CULS is condom use at last sex.

Table 6: Condom Use instrumenting for HIV Prevalence

	IV Probit		2SLS	
Variables	CUFS	CULS	CUFS	CULS
HIV Rate	-0.010	0.010	-0.007	0.008
	(0.011)	(0.009)	(0.003)	(0.003)
Male	0.224***	0.218***	0.133***	0.161***
	(0.031)	(0.017)	(0.007)	(0.006)
Age	-0.066***	-0.004	-0.015***	0.003
	(0.008)	(0.007)	(0.002)	(0.002)
Age squared	0.000***	-0.000	0.000*	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.360**	0.248**	0.311***	0.192**
	(0.152)	(0.122)	(0.046)	(0.037)
Secondary	1.043***	1.136***	0.972***	0.977***
	(0.200)	(0.171)	(0.057)	(0.054)
Higher	1.571***	1.143***	1.249***	0.988***
	(0.219)	(0.201)	(0.059)	(0.062)
Christianity	0.044	0.016	0.022	0.012
	(0.033)	(0.035)	(0.008)	(0.010)
Husband/Wife	-0.971***	-0.875***	-0.702***	-0.757***
	(0.030)	(0.058)	(0.011)	(0.019)
Cohabiting	-0.341***	-0.400***	-0.186***	-0.315***
	(0.027)	(0.032)	(0.007)	(0.010)
Other relationship type	0.133	0.302***	0.071**	0.161***
	(0.086)	(0.090)	(0.014)	(0.017)
Perceived Unfaithfulness (Yes)	-0.026	0.143***	-0.008	0.106***
	(0.021)	(0.014)	(0.005)	(0.004)
Rural	-0.194***	-0.185***	-0.115***	-0.144***
	(0.025)	(0.029)	(0.006)	(0.009)
One Partner	0.038	-0.049*	0.028	-0.024
	(0.038)	(0.026)	(0.007)	(0.007)
HIV Prevention Knowledge	0.212***	0.226***	0.156***	0.179***
	(0.070)	(0.054)	(0.020)	(0.016)
Correct Reject	0.131***	0.099***	0.106***	0.086***
	(0.022)	(0.034)	(0.007)	(0.012)
Primary*PK	0.020	0.037	0.025	0.051
	(0.074)	(0.071)	(0.022)	(0.022)
Secondary*PK	-0.078	-0.247***	-0.091	-0.195***
	(0.096)	(0.061)	(0.025)	(0.018)
Higher*PK	-0.180	-0.164*	-0.144**	-0.135*
	(0.114)	(0.193)	(0.028)	(0.028)
Primary* Reject	-0.052*	-0.025	-0.046*	-0.021
	(0.031)	(0.035)	(0.010)	(0.012)
Secondary*Reject	-0.059**	-0.064	-0.071***	-0.060*
	(0.027)	(0.040)	(0.008)	(0.014)
Higher*Reject	-0.113***	-0.102**	-0.096***	-0.090**
	(0.038)	(0.046)	(0.010)	(0.015)
Partner drunk at last sex	-	-0.286***	-	-0.222***
		(0.026)		(0.007)
Observations	20493	20475	20493	20475
Exogeneity Test	$\chi^2(1)$ =4.67	P> χ^2=0.031	F(1,25) =3.082	P= 0.091
Instrument Strength			F(1,25)=13.335	P= 0.001

Notes: As for Table 5. Coefficients in columns (3) and (4) are multiplied by the approximate conversion factor of 2.5 (Amemiya, 1981) because the fitted probabilities of a linear regression on a binary dependent variable can be outside the 0-1 range (Lewbel et al., 2012).

HIV knowledge (*PK* and *Reject*) is significantly associated with condom use; interactions terms suggest the effect is reduced with (post-primary) education (for first sex in the case of *Reject* and last sex for *PK*). Males and the more educated are more likely to use a condom while the married and cohabiting and those reporting sex when drunk are less likely. Other relationship types and perceived partner unfaithfulness increase the likelihood of condom use at last sex. Those with one partner are less likely to report condom use (at last sex only). Although, as shown above, the more educated and knowledgeable about HIV are more likely to have more than one partner (and this increased over time) they are also more likely to use a condom (this effect also increases over time as shown by the coefficients on waves). Results are similar estimating for males and females separately except that knowledge tends to have stronger effect on using a condom for females; rural females are more likely to use a condom at last sex (rural males are less likely to use a condom as are females for first sex); males with only one partner are more likely to use a condom at first sex whereas females with only one partner are less likely to use a condom at last sex, but this is offset if the partner is perceived as unfaithful (Table A18). There are some differences comparing rural and urban samples (Table A19): the tendency of condom use to increase with education is much stronger in rural areas and *PK* is only associated with condom use in rural areas (*Reject* is significant in urban and rural).

Perceived Risk Due to ART

The effect of changes in concern about the likelihood of infection after the introduction of ART (as an alternative to HIV prevalence) on condom use is reported in Table 7. The More concerned have an increased likelihood of condom use (increased risk perception discourages risky behaviour). The Less concerned are more likely to use a condom on first but not last sex, perhaps because the reduction in risk perception was after first sex (remaining with a trusted partner). This suggests that (some) responding may consider how their concern level has changed reflecting factors other than ART. As previously, HIV knowledge is associated with higher likelihood of condom use but the effect is declining with post-primary education for last sex (although condom use increases with education). Condom use is more likely for males, Christians and for last sex if a partner is perceived as unfaithful (although for such cases use is less likely for first sex, suggesting perceived unfaithfulness may have arisen after first sex). Condom use is less likely for married and cohabiting partners, those living in rural areas, and for last sex (weakly significant) for those with one partner.

Results are similar for males and females except: it is only Less concerned females that are more likely to use a condom (for first sex only); the effect of perceived partner unfaithfulness on condom use is greater for males; and PK is weakly significant at first sex for males but strongly significant at last sex for females (Table A16). Being Less concerned is only associated with condom use in rural areas; More concerned is associated with condom use in urban areas, and for last sex in rural areas (Table A17).

As (changes in) the level of concern is an indicator of subjective risk it could be influenced by condom use so concern may be endogenous. Endogeneity may arise if users of a condom believe this reduces the risk to them (which may apply whatever the change in concern) so that condom use affects perceived risk. The instrument is intended to avoid this by using awareness of the ART programme, which is independent of their condom use.

Table 7: Probit Marginal Effects for Change in Perceived Risk on Condom Use

Variables	CUFS	CULS
Male	0.048***	0.062***
	(0.007)	(0.008)
Age	-0.011***	0.000
	(0.002)	(0.003)
Age squared	0.000	-0.000
	(0.000)	(0.000)
Primary	0.134***	0.095
	(0.047)	(0.066)
Secondary	0.215***	0.395***
	(0.045)	(0.060)
Higher	0.287***	0.358***
	(0.064)	(0.078)
Christianity	0.018**	0.023***
	(0.008)	(0.010)
Husband/Wife	-0.204***	-0.273***
	(0.009)	(0.011)
Cohabitation	-0.079***	-0.113***
	(0.008)	(0.010)
Other relationship type	0.012	0.130***
	(0.027)	(0.032)
Less Concerned	0.020**	0.016
	(0.008)	(0.010)
More Concerned	0.020***	0.037***
	(0.008)	(0.009)
Perceived Unfaithfulness (Yes)	-0.015**	0.038***
	(0.008)	(0.010)
Rural	-0.051***	-0.068***
	(0.009)	(0.011)
One Partner	0.004	-0.021*
	(0.011)	(0.012)
HIV Prevention Knowledge	0.039**	0.069***
	(0.018)	(0.025)
Correct Reject	0.023***	0.032***
	(0.009)	(0.012)
Primary*PK	-0.022	-0.006
	(0.023)	(0.032)
Secondary*PK	-0.026	-0.106***
	(0.021)	(0.029)
Higher*PK	-0.043	-0.070**
	(0.028)	(0.035)
Primary* Reject	-0.016	-0.010
	(0.011)	(0.015)
Secondary*Reject	-0.015	-0.034**
	(0.010)	(0.014)
Higher*Reject	-0.020	-0.041**
	(0.013)	(0.017)
Partner drunk at last sex	-	-0.095***
		(0.014)
Wave 4 (2013)	0.067***	-0.010
	(0.007)	(0.009)
District FE	Yes	Yes
Observations	11704	11675
Loglikelihood	-4461.099	-6192.283
Prob> χ^2	0.000	0.000

Notes: As for Table 5 except omitted category for Less and More is no change in concern level.

Table 8: IV (2SLS) Regressions for Condom Use

Variables	CUFS	CUFS	CULS	CULS
Less Concerned	-0.427***	-	-0.021	-
	(0.074)		(0.081)	
More Concerned	-	1.113***	-	0.055
		(0.307)		(0.211)
Male	0.042***	0.044***	0.060***	0.060***
	(0.008)	(0.012)	(0.008)	(0.008)
Age	0.001	-0.004	0.003	0.003
	(0.003)	(0.004)	(0.003)	(0.003)
Age squared	-0.000***	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.251***	0.138	0.135*	0.129*
	(0.076)	(0.103)	(0.074)	(0.077)
Secondary	0.425***	0.226**	0.453***	0.443***
	(0.063)	(0.096)	(0.062)	(0.072)
Higher	0.483***	0.138	0.434***	0.417***
	(0.077)	(0.149)	(0.081)	(0.105)
Christianity	0.010	-0.007	0.019*	0.018
	(0.010)	(0.017)	(0.010)	(0.012)
Husband/Wife	-0.248***	-0.224***	-0.313***	-0.312***
	(0.013)	(0.020)	(0.013)	(0.014)
Cohabitation	-0.053***	-0.070***	-0.110***	-0.111***
	(0.009)	(0.014)	(0.010)	(0.010)
Other relationship type	0.020	0.023	0.081***	0.081***
	(0.020)	(0.033)	(0.017)	(0.017)
Perceived unfaithfulness (Yes)	-0.008	-0.038**	0.036***	0.034***
	(0.008)	(0.015)	(0.009)	(0.010)
Rural	-0.054***	-0.062***	-0.070***	-0.070***
	(0.008)	(0.013)	(0.009)	(0.009)
One Partner	0.012	-0.006	-0.013	-0.014
	(0.010)	(0.017)	(0.011)	(0.011)
HIV Prevention Knowledge	0.060**	-0.004	0.084***	0.081***
	(0.029)	(0.042)	(0.028)	(0.031)
Correct Reject	0.055***	0.041**	0.037**	0.036**
	(0.015)	(0.020)	(0.015)	(0.015)
Primary*PK	-0.026	0.006	-0.016	-0.014
	(0.038)	(0.051)	(0.037)	(0.038)
Secondary*PK	-0.058*	-0.027	-0.118***	-0.117***
	(0.031	(0.042)	(0.030)	(0.031)
Higher*PK	-0.077**	-0.027	-0.091**	-0.089**
	(0.036)	(0.053)	(0.037)	(0.038)
Primary* Reject	-0.041**	-0.041*	-0.012	-0.011
	(0.018)	(0.024)	(0.018)	(0.017)
Secondary*Reject	-0.045***	-0.030	-0.039**	-0.038**
	(0.016)	(0.022)	(0.016)	(0.016)
Higher*Reject	-0.056***	-0.004	-0.048***	-0.046**
	(0.019)	(0.028)	(0.019)	(0.020)
Partner drunk at last sex	-	-	-0.094***	-0.094***
			(0.015)	(0.015)
Observations	11704	11704	11675	11675
Exogeneity test less concern	χ^2 (1)=42.521	P=0.000		
Exogeneity test more concern	χ^2 (1)=41.126	P=0.000		
Instrument strength	F=164.634	P>F 0.000		

Notes: As for Table 6.

The number of months of ART enrolment for the district before the survey is used as an instrument for the perceived risk and the regression is re-estimated with 2SLS. The first stage results (Table A5) show that concern is greater the longer the time between ART enrolment and the survey (so more likely to be aware of the programme) - a negative sign for Less concerned and positive for More concerned. The instrument is relevant, the null hypothesis that perceived risk is exogenous is rejected (confirmed by the χ^2) and the F statistic rejects a weak instrument (Table 8).

The second stage 2SLS in Table 8 show that change in concern (instrumented) is only significant for first sex: More concerned have an increased likelihood of condom use and Less concerned are less likely to have used a condom at first sex. The finding that concern (instrumented) is not significant for last sex suggests that awareness, even though it affects concern, does not reduce (or indeed affect) risky behaviour for More concerned but removes the initial (first sex) tendency of Less concerned not to use a condom. The positive sign for the Less concerned at first sex in Table 7 is consistent with (some of) those using a condom for first sex being less concerned for that reason. The corresponding negative sign in Table 8 suggests that despite awareness the Less concerned were initially less likely to use a condom (but given awareness were not less likely to use a condom at last sex). The knowledge indicators and interactions and most other controls have the same sign and significance as in Table 7 (except weaker for Christian and unfaithful partner, and one partner insignificant).

Results are similar for males and females estimated separately (Tables A20 and A21). Regardless of gender, Less concerned are less likely to report condom use at first sex, More concerned are more likely to use condoms at first sex, and concern variables are insignificant for last sex. Knowledge is associated with condom use for females, *PK* is significant for last sex and *Reject* for all cases; for males, knowledge is weakly significant at first sex only.

There are some differences between rural and urban areas (Tables A22 and A23): those less concerned about being infected are less likely to report condom use at first and last sex in rural areas, and only at first sex in urban areas, while the more concerned are more likely to report condom use at first sex (but not last sex) in both rural and urban sub-samples. In rural areas, knowledge is associated with condom use for the less concerned but not for the more concerned (except *Reject* at first sex), whereas in urban areas knowledge is insignificant.

5.3 Robustness Analysis

Controlling for the endogenous HIV risk measures we arrive at the same conclusion through both IV probit and two stage least squares. The instruments are relevant and not weak according to conventional tests. Standard tests also confirm that both the HIV prevalence rate and concern about the likelihood of infection due to ART are endogenous in regressions for condom use. As a robustness check we consider potential bias due to including those who report they are not sexually active. The Heckman (1979) sample selection model is used to test the hypothesis that there is no relationship between the unobservables that affect the decision to report being sexually active and the unobservables that affect the decision to use condoms. If such a relationship is statistically significant, then failing to account for it may bias the results. Tables A24 and A25 present the results for HIV prevalence and concern and condom use respectively. HIV prevalence is insignificant for condom use and sexual activity; *PK* is significant for both while *Reject* is more important as a determinant of condom use than of sexual activity (A24). Although any change in concern (more or less), *PK* and *Reject* are significantly associated with using a condom, only less concern is

significantly associated with sexual activity (A25). The effect of other control variables is largely the same as in the main specifications. The Wald test rejects the null hypothesis of independence between the unobservables (*rho*=0). In both tables, the positive coefficient of *rho* suggests a positive relationship between unobservables affecting reported activity and those determining use of condoms. We therefore conclude that the approach that only focuses on those with reported activity could introduce bias. Given that the HIV/AIDS campaigns in the country used to (and still) emphasize the importance of abstaining from sexual activities through the slogan *ABC* (abstain, be faithful and use a condom), consideration of the sexually inactive is important.

As a further check we omit the sexually inactive and compare those with one partner to those with more than one partner using an indicator variable to proxy consistent condom use (frequency of use is not observed) given a value of 1 if the respondent reports condom use at both first and last sex, otherwise 0. Second stage results for both IV Probit and 2SLS are in Table A26. As in the probit, HIV prevalence (when instrumented) has an insignificant effect on condom use. Married and cohabiting are less likely to use a condom even if they report more than one partner, whereas *PK* and *Reject* increase likelihood of condom use (especially for multiple partners).

Having established that HIV prevalence has no effect on sexual behaviour (condom use or number of partners), but changes in concern do have effects, one question could be whether prevalence has any effect on perception. We test for this potential effect considering those who indicated an increased level of concern. Table A27 presents the probit marginal effects showing that HIV prevalence is positively associated with being more concerned. As information on the perceived risk was explicitly asked in relation to the existence of ART, this result suggests that HIV prevalence may indirectly affect sexual behaviour through altering perception, at least if the effect is to increase concern. Table A27 further shows that likelihood of being more concerned also increases with increasing levels of education and Christianity.

7 Discussion and Conclusions

This paper investigates whether sexual behaviour (indicators of sexual relations and use of condom) is responsive to HIV prevalence, knowledge about HIV and perceived risk of HIV infection due to the existence of a treatment programme (ART) with a pooled sample of almost 30000 respondents from three waves of the Botswana AIDS Impact Survey (BAIS) for 2004, 2008 and 2013. The existing literature is inconclusive on this matter and previous studies for Botswana do not account for the sexually inactive or endogeneity between sexual behaviour and HIV risk, gaps we address following established methods (Oster, 2012; Paula et al., 2014). Behaviour is measured by the number of partners and condom use; the HIV prevalence rate is the indicator for objective risk (assuming respondents are aware of the rate in their district) and perceived risk is represented by concern about the likelihood of being infected by HIV due to the antiretroviral therapy (ART) programme. Endogeneity is addressed through instrumental variables, with HIV prevalence rate instrumented by the distance from respondent`s area of residence to the district in Botswana with the highest prevalence rate, while perceived risk is instrumented by duration (in months) between ART rollout and the survey date. Two indicators are included to capture how knowledge about HIV affects behaviour – awareness of actions to reduce the risk of infection and being able to correctly reject myths about HIV.

The analysis shows that the HIV prevalence rate does not affect having multiple partners or, when endogeneity is accounted for, condom use. This could be because respondents are not aware of the local prevalence as although knowledge of HIV is generally associated with increased likelihood of multiple partners it is also associated with condom use. Knowledge of HIV does not deter the sexually active from having multiple partners but does increase the likelihood to use a condom. The way in which perceived risk changes over time affects risky behaviour. In Botswana, between 2004 and 2008 about a third of respondents became less concerned and about a quarter became more concerned whereas over 2008-2013 this pattern was reversed, with a third becoming more concerned but only 16 per cent became less concerned. A higher proportion of respondents reported multiple partners in 2008 and 2013 compared to the 2004 survey; although the proportion always using a condom declined the proportion using a condom at first sex increased. Compared to those who indicated no change in their level of concern about being infected with HIV due to ART, the less concerned are more likely to report more than one sexual relation, a pattern similar to Malawi (Paula et al., 2014), whereas being more concerned has no significant effect. Accounting for endogeneity, the less concerned are less likely to use condoms and more concerned are more likely to use condom (but only at first sex).

Males are more likely than females to report more than one partner and are also more likely to report using condoms. The likelihood for more than one partner increases with increasing level of education, consistent with De Walque (2009) for Ghana, Burkina Faso, Kenya, Cameroon and Tanzania; Bingenheimer (2010) for 15 SSA countries and Lucas and Wilson (2018) for 32 SSA countries find that education for males is associated with multiple partners. Although males and those with higher education levels are more likely to report having more than one partner, they are also more likely to use condoms. While the interaction between education and knowledge of HIV reduces the likelihood of condom use for those with secondary and higher education this may be offset as having secondary or higher education is associated with becoming more concerned. Levels of HIV knowledge are high in Botswana and are generally associated with safer behaviour (condom use).

There is lower use of condoms among married and cohabiting partners who report more than one sexual partner, indicating a degree of risk within relationships. The 2008 and 2013 surveys report higher HIV prevalence among cohabiting and married than among the never married, suggesting infection through unsafe sex although trust and faithfulness is relatively high, especially for the married. Considering only those who reported being married at the time of the survey, the most recent partner was not a spouse in only three per cent of cases (two per cent were boyfriend/girlfriend and 0.3 per cent were other relationship). Respondents engaging in sex with other relationship types are more likely to use a condom (but only at last sex), consistent with the literature surveyed by Guillon and Thuilliez (2015).

Overall, individuals are more responsive to perceived than objective risk indicators. The HIV prevalence rate has no effect on either number of partners or use of condom (prevalence is, however, associated with becoming more concerned). An important determinant of behaviour is how levels of concern with HIV change. An increase in perceived risk (more concern) encourages safer behaviour whereas those who perceive reduced risk are likely to exhibit unsafe behaviour. It is notable that despite relatively high HIV knowledge and some increased awareness of risks, a significant proportion of respondents believed risk was declining, perhaps because they expected ART to be effective reducing the incidence or severe effects of HIV, and they engaged in more risky behaviour.

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Appendix Tables

Table A1: Descriptive Statistics for Individual Surveys (2004, 2008, 2013)

Variable	2004		2008		2013	
	Mean	SD	Mean	SD	Mean	SD
Panel A. Demographics						
Male	0.450	0.497	0.445	0.497	0.453	0.498
Age in years	31.652	12.463	32.445	12.464	33.243	12.520
15-24 (1 if Age between 15 and 24)	0.357	0.479	0.321	0.467	0.294	0.456
25-34 (1 if Age between 25 and 34)	0.284	0.451	0.302	0.459	0.299	0.458
35-44 (1 if Age between 35 and 44)	0.179	0.383	0.184	0.387	0.202	0.401
45-54 (1 if Age between 45 and 54)	0.116	0.320	0.125	0.331	0.130	0.336
55-64 (1 if Age between 55 and 64)	0.064	0.245	0.068	0.252	0.076	0.265
Education Level						
No Education	0.136	0.342	0.118	0.322	0.087	0.281
Non-Formal	0.009	0.093	0.021	0.145	0.006	0.079
Primary	0.250	0.433	0.211	0.408	0.180	0.384
Secondary	0.466	0.499	0.493	0.500	0.524	0.499
Higher	0.140	0.347	0.156	0.363	0.203	0.402
Main Religion						
Christianity	0.808	0.394	0.703	0.457	0.862	0.345
Current Marital Status						
Married	0.187	0.390	0.171	0.377	0.189	0.391
Never Married	0.537	0.499	0.531	0.499	0.532	0.499
Cohabitation	0.225	0.418	0.251	0.433	0.244	0.429
Other Marital Status	0.051	0.220	0.047	0.212	0.036	0.185
Residence						
Rural	0.377	0.485	0.388	0.487	0.364	0.481
Panel B. Behaviour						
Ever had sexual intercourse (1=Yes)	0.830	0.376	0.855	0.352	0.861	0.346
Had sex in the past 12 months	0.669	0.471	0.688	0.463	0.829	0.376
No of sexual partners						
One Partner (1=Yes)	0.883	0.322	0.851	0.356	0.855	0.352
Two partners (1=Yes)	0.087	0.282	0.114	0.317	0.093	0.291
Three or more (1=Yes)	0.030	0.172	0.036	0.185	0.051	0.221
Relation to most recent sexual partner						
Husband/Wife	0.248	0.432	0.200	0.400	0.238	0.426
Cohabiting	0.281	0.450	0.328	0.469	0.289	0.453
Girlfriend/Boyfriend	0.449	0.497	0.450	0.498	0.442	0.497
Other relationship type	0.021	0.143	0.022	0.148	0.032	0.175
Behaviour with most recent sexual partner						
Always use condom (1=Yes)	0.872	0.334	0.609	0.488	0.591	0.492
Condom used at first sex with partner	0.619	0.486	0.766	0.423	0.823	0.382
Condom used at last sex with partner	0.600	0.490	0.699	0.459	0.692	0.462
Partner drunk at last sex	0.062	0.241	0.106	0.307	0.065	0.247
Perceived partner unfaithfulness	0.223	0.416	0.260	0.438	0.271	0.444
Panel C. Knowledge on HIV						
Ever heard of HIV (1=Yes)	0.956	0.204	0.973	0.161	0.979	0.142
HIV Prevention knowledge	1.741	0.538	1.773	0.505	1.844	0.419
Correctly rejects misconceptions	2.780	1.131	3.024	1.038	3.110	0.995
Concern change due to ART						
No change			0.419	0.493	0.502	0.500
Less concerned			0.320	0.467	0.162	0.368
More concerned			0.260	0.439	0.336	0.473
Observations	**12664**		**12035**		**7249**	

Note: Proportions for change in concern are only for 2004-08 and 2008-13 (17333 observations). Although questions were asked about the three most recent partners in the past 12 months, figures for relationship and behaviour refer to responses to questions regarding the first of these.

Table A2: Differences in Characteristics by Sexual Activity

	No sex past year	Sex in the past year	Differences (No-Yes)
Male	0.424	0.455	-0.031***
Age	31.246	33.329	-2.083***
No education	0.154	0.107	0.047***
Primary	0.240	0.215	0.025***
Secondary	0.509	0.468	0.041***
Higher	0.083	0.197	-0.114***
Christianity	0.783	0.775	0.008
Married	0.066	0.236	-0.170***
Never Married	0.766	0.419	0.347***
Cohabitation	0.064	0.321	-0.257***
Other Marital Status	0.104	0.025	0.079***

Notes: Means and shares based on pooled sample, *** indicates difference is significant at the 1 per cent level.

Table A3: Cross Tabulation of HIV Knowledge and Education

Correct Prevention Knowledge	None	Primary	Secondary	Higher
0	343(10.31)	315(4.75)	464(3.03)	62(1.23)
1	689(20.72)	1018(15.35)	2156(14.07)	523(10.40)
2	2294(68.97)	5300(79.90)	12701(82.90)	4443(88.37)
Total	3326	6633	15321	5028
Pearson Chi2 (2)	562.991***	22.570***	71.409***	212.108***
Correctly reject misconceptions	**None**	**Primary**	**Secondary**	**Higher**
0	320 (9.66)	232 (3.50)	113 (0.74)	5 (0.10)
1	899 (27.14)	1083 (16.34)	705 (4.61)	100 (1.99)
2	1034 (31.22)	1980 (28.87)	2330 (15.23)	441 (8.76)
3	747 (22.55)	1900 (28.66)	5083 (33.22)	1324 (26.30)
4	312 (9.42)	1434 (21.63)	7071 (46.21)	3164 (62.85)
Total	3312	6629	15302	5034
Pearson χ^2 (4)	3400***	1700***	1800***	1700***

Notes: Based on pooled sample, number of respondents with percent shares in parentheses (%), *** indicates significant at the 1 per cent level.

Table A4: First stage Instrumenting for HIV Prevalence

Variables	IV Probit		TSLS	
	CUFS (1)	CULS (2)	CUFS (3)	CULS (4)
Male	0.178**	0.179**	0.178**	0.179**
	(0.081)	(0.082)	(0.081)	(0.082)
Age	0.037	0.037	0.037	0.037
	(0.032)	(0.032)	(0.032)	(0.032)
Age squared	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	-0.016	-0.034	-0.016	-0.034
	(0.319)	(0.319)	(0.319)	(0.319)
Secondary	0.600	0.593	0.600	0.593
	(0.651)	(0.654)	(0.651)	(0.654)
Higher	0.440	0.440	0.440	0.440
	(0.443)	(0.445)	(0.443)	(0.445)
Christianity	0.223	0.216	0.223	0.216
	(0.140)	(0.139)	(0.140)	(0.139)
Husband/Wife	0.152	0.150	0.152	0.150
	(0.125)	(0.127)	(0.126)	(0.127)
Cohabiting	0.331***	0.334***	0.331***	0.334***
	(0.114)	(0.114)	(0.114)	(0.115)
Other relationship type	0.346**	0.358**	0.346**	0.358**
	(0.173)	(0.171)	(0.173)	(0.171)
Perceived Unfaithfulness (Yes)	0.213***	0.217***	0.213***	0.217***
	(0.076)	(0.077)	(0.076)	(0.077)
Rural	-0.338	-0.342	-0.338	-0.342
	(0.399)	(0.398)	(0.399)	(0.398)
One Partner	-0.156**	-0.163**	-0.156**	-0.163**
	(0.072)	(0.072)	(0.072)	(0.072)
HIV PK	-0.181	-0.182	-0.181	-0.182
	(0.114)	(0.114)	(0.114)	(0.115)
Reject	0.047	0.046	0.047	0.046
	(0.089)	(0.090)	(0.089)	(0.090)
Primary*PK	-0.008	-0.002	-0.008	-0.002
	(0.147)	(0.147)	(0.147)	(0.147)
Secondary*PK	-0.039	-0.041	-0.039	-0.041
	(0.186)	(0.187)	(0.186)	(0.187)
Higher*PK	0.186	0.182	0.186	0.182
	(0.166)	(0.168)	(0.166)	(0.168)
Primary*Reject	0.136	0.138	0.136	0.138
	(0.084)	(0.084)	(0.084)	(0.084)
Secondary*Reject	-0.016	-0.013	-0.016	-0.013
	(0.109)	(0.110)	(0.109)	(0.110)
Higher*Reject	-0.145	-0.144	-0.145	-0.144
	(0.090)	(0.091)	(0.090)	(0.091)
Partner drunk at last sex	-	-0.086	-	-0.086
		(0.129)		(0.129)
Distance	-0.008***	-0.008***	-0.008***	-0.008***
	(0.002)	(0.002)	(0.002)	(0.002)
Observations	20493	20475	20493	20475

Notes: CUFS: Condom use at first sex, CULS: Condom use at last sex. Omitted categories: none for education; boyfriend/girlfriend for relation type. Standard errors clustered at district level in parentheses (significance indicated by ***, **, * for the 1, 5, 10 per cent level). Weak instrument rejected with F statistic of 13.3 above the threshold of 10 (Staiger and Stock, 1997). The null hypothesis that the HIV prevalence rate is exogenous is rejected: the Wald test for the IV Probit yields χ^2 (1) = 4.67 (with the P > χ^2 = 0.03) and the robust Durbin-Wu Hausman test for 2SLS yields F(1,25) = 3.082 significant at the 10 per cent level (Cameron and Trivedi, 2010).

Table A5: First Stage Instrumenting for Change in Concern

	CUFS		CULS	
Variables	Less Concern	More Concern	Less Concern	More Concern
Male	-0.015*	0.004	-0.015*	0.004
	(0.008)	(0.009)	(0.008)	(0.009)
Age	-0.000	0.004	-0.000	0.004
	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.021	0.094	0.021	0.098
	(0.069)	(0.064)	(0.069)	(0.064)
Secondary	0.053	0.159***	0.051	0.161***
	(0.061)	(0.056)	(0.061)	(0.056)
Higher	0.019	0.302***	0.021	0.307***
	(0.076)	(0.080)	(0.076)	(0.079)
Christianity	-0.028***	0.026***	-0.028***	0.026***
	(0.010)	(0.010)	(0.010)	(0.010)
Husband/Wife	0.007	-0.024*	0.008	-0.026*
	(0.012)	(0.013)	(0.012)	(0.013)
Cohabitation	0.035***	0.002	0.034***	0.002
	(0.010)	(0.011)	(0.010)	(0.011)
Other relationship type	0.009	-0.006	0.007	-0.006
	(0.026)	(0.027)	(0.026)	(0.027)
Perceived unfaithfulness (Yes)	0.008	0.023**	0.008	0.023**
	(0.010)	(0.010)	(0.010)	(0.010)
Rural	-0.028***	0.018*	-0.028***	0.018*
	(0.009)	(0.010)	(0.009)	(0.010)
One Partner	0.002	0.016	0.002	0.015
	(0.012)	(0.013)	(0.012)	(0.013)
HIV PK	-0.025	0.067***	-0.026	0.063***
	(0.027)	(0.023)	(0.027)	(0.023)
Correct Reject	0.037***	-0.002	0.038***	-0.001
	(0.013)	(0.013)	(0.013)	(0.013)
Primary*HIV PK	0.029	-0.040	0.030	-0.037
	(0.035)	(0.033)	(0.035)	(0.033)
Secondary*HIV PK	0.004	-0.029	0.006	-0.027
	(0.031)	(0.027)	(0.031)	(0.027)
Higher*HIV PK	0.007	-0.048	0.008	-0.046
	(0.035)	(0.035)	(0.035)	(0.035)
Primary* Reject	-0.031**	0.012	-0.031**	0.008
	(0.016)	(0.016)	(0.016)	(0.016)
Secondary*Reject	-0.030**	-0.002	-0.031**	-0.004
	(0.015)	(0.015)	(0.015)	(0.015)
Higher*Reject	-0.044***	-0.029	-0.045***	-0.032*
	(0.017)	(0.019)	(0.017)	(0.019)
Partner drunk at last sex	-	-	0.010	-0.001
			(0.015)	(0.015)
ARVMBS	-0.002***	0.001***	-0.002***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	11704	11704	11675	11675

Notes: CUFS: Condom use at first sex, CULS: Condom use at last sex. ARVMBS is months since roll out of ART. Omitted categories: none for education; boyfriend/girlfriend for relation type. Standard errors clustered at district level in parentheses (significance indicated by ***, **, * for the 1, 5, 10 per cent level).

Table A6: Ordered Probit Marginal Effects, Sexual Partners for Males

Variables	0 Partner	1 partner	>1 partner
Age	-0.053***	0.019***	0.033***
	(0.002)	(0.001)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.060**	0.022**	0.038**
	(0.025)	(0.009)	(0.016)
Secondary	-0.117***	0.043***	0.074***
	(0.030)	(0.011)	(0.019)
Higher	-0.120***	0.044***	0.076***
	(0.038)	(0.014)	(0.024)
Christianity	0.023***	-0.009***	-0.015***
	(0.007)	(0.002)	(0.004)
Cohabitation	-0.042***	0.015***	0.026***
	(0.009)	(0.004)	(0.006)
Never married	0.074***	-0.027***	-0.047***
	(0.015)	(0.005)	(0.009)
Other Marital status	0.150***	-0.055***	-0.095***
	(0.025)	(0.009)	(0.016)
HIV Rate	0.001	-0.000	-0.000
	(0.002)	(0.001)	(0.001)
Rural	0.010	-0.004	-0.006
	(0.013)	(0.005)	(0.008)
HIV Prevention Knowledge	-0.050***	0.018***	0.032***
	(0.012)	(0.004)	(0.008)
Correct Reject	-0.010	0.004	0.007
	(0.008)	(0.003)	(0.005)
Primary*HIV PK	0.016	-0.006	-0.010
	(0.017)	(0.006)	(0.011)
Secondary*HIV PK	0.003	-0.001	-0.002
	(0.015)	(0.005)	(0.009)
Higher*HIV PK	-0.005	0.002	0.003
	(0.018)	(0.007)	(0.011)
Primary* Reject	0.007	-0.002	-0.004
	(0.009)	(0.003)	(0.006)
Secondary*Reject	0.010	-0.004	-0.006
	(0.010)	(0.004)	(0.006)
Higher*Reject	0.003	-0.001	-0.002
	(0.010)	(0.004)	(0.006)
Wave 3 (2008)	-0.014	0.005	0.009
	(0.009)	(0.004)	(0.006)
Wave 4 (2013)	-0.086***	0.032***	0.054***
	(0.012)	(0.005)	(0.007)
District FE	Yes	Yes	Yes
Observations	13188	13188	13188

Notes: Reports marginal effects at means. Omitted categories: none for education; married for relationship status. Standard errors clustered at district level in parentheses (significance indicated by ***, **, * for the 1, 5, 10 per cent level).

Table A7: Ordered Probit Marginal Effects, Sexual Partners for Females

Variables	0 Partner	1 partner	>1 partner
Age	-0.054***	0.040***	0.013***
	(0.002)	(0.002)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.080*	0.060*	0.020*
	(0.043)	(0.033)	(0.011)
Secondary	-0.032	0.024	0.008
	(0.035)	(0.027)	(0.009)
Higher	-0.063	0.048	0.016
	(0.052)	(0.039)	(0.013)
Christianity	0.067***	-0.050***	-0.017***
	(0.010)	(0.007)	(0.002)
Cohabitation	-0.006	0.004	0.001
	(0.010)	(0.007)	(0.002)
Never married	0.212***	-0.160***	-0.053***
	(0.013)	(0.010)	(0.003)
Other Marital status	0.354***	-0.266***	-0.088***
	(0.022)	(0.017)	(0.005)
HIV Rate	0.000	-0.000	-0.000
	(0.002)	(0.001)	(0.000)
Rural	0.012	-0.009	-0.003
	(0.009)	(0.007)	(0.002)
HIV Prevention Knowledge	-0.022	0.017	0.006
	(0.019)	(0.015)	(0.005)
Correct Reject	-0.011	0.008	0.003
	(0.009)	(0.007)	(0.002)
Primary*HIV PK	0.006	-0.004	-0.001
	(0.023)	(0.017)	(0.006)
Secondary*HIV PK	-0.033	0.025	0.008
	(0.021)	(0.016)	(0.005)
Higher*HIV PK	-0.005	0.004	0.001
	(0.027)	(0.020)	(0.007)
Primary* Reject	0.017	-0.013	-0.004
	(0.011)	(0.008)	(0.003)
Secondary*Reject	0.013	-0.010	-0.003
	(0.011)	(0.008)	(0.003)
Higher*Reject	-0.003	0.002	0.001
	(0.011)	(0.008)	(0.003)
Wave 3 (2008)	-0.022**	0.017**	0.006**
	(0.010)	(0.007)	(0.002)
Wave 4 (2013)	-0.070***	0.053***	0.017***
	(0.011)	(0.009)	(0.003)
District FE	Yes	Yes	Yes
Observations	16413	16413	16413

Notes: As for Table A6.

Table A8: Ordered Probit Marginal Effects, Sexual Partners in Rural Sample

Variables	0 Partner	1 partner	>1 partner
Male	-0.083***	0.056***	0.027***
	(0.007)	(0.005)	(0.003)
Age	-0.046***	0.031***	0.015***
	(0.002)	(0.002)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.049*	0.033*	0.016*
	(0.026)	(0.018)	(0.009)
Secondary	-0.141***	0.094***	0.046***
	(0.027)	(0.019)	(0.009)
Higher	-0.185**	0.124**	0.061*
	(0.094)	(0.062)	(0.032)
Christianity	0.036***	-0.024***	-0.012***
	(0.007)	(0.005)	(0.002)
Cohabitation	0.006	-0.004	-0.002
	(0.007)	(0.005)	(0.002)
Never married	0.236***	-0.159***	-0.078***
	(0.011)	(0.009)	(0.004)
Other Marital status	0.363***	-0.224***	-0.120***
	(0.022)	(0.017)	(0.007)
HIV Rate	0.001	-0.001	-0.000
	(0.002)	(0.002)	(0.001)
HIV Prevention Knowledge	-0.039**	0.026**	0.013**
	(0.016)	(0.011)	(0.015)
Correct Reject	-0.015**	0.010**	0.005**
	(0.007)	(0.005)	(0.002)
Primary*HIV PK	0.011	-0.007	-0.004
	(0.016)	(0.011)	(0.005)
Secondary*HIV PK	-0.002	0.001	0.001
	(0.017)	(0.011)	(0.005)
Higher*HIV PK	-0.029	0.020	0.010
	(0.041)	(0.027)	(0.013)
Primary* Reject	0.008	-0.005	-0.003
	(0.008)	(0.005)	(0.003)
Secondary*Reject	0.024**	-0.016**	-0.008**
	(0.011)	(0.008)	(0.004)
Higher*Reject	0.030	-0.020	-0.010
	(0.024)	(0.016)	(0.008)
Wave 3 (2008)	-0.005	0.004	0.002
	(0.009)	(0.006)	(0.003)
Wave 4 (2013)	-0.059***	0.040***	0.020***
	(0.011)	(0.008)	(0.004)
District FE	Yes	Yes	Yes
Observations	11009	11009	11009

Notes: As for Table A6.

Table A9: Ordered Probit Marginal Effects, Sexual Partners in Urban Sample

Variables	0 Partner	1 partner	>1 partner
Male	-0.077***	0.040***	0.037***
	(0.005)	(0.003)	(0.003)
Age	-0.057***	0.030***	0.028***
	(0.002)	(0.001)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.099**	0.051**	0.048**
	(0.047)	(0.024)	(0.022)
Secondary	-0.067*	0.035*	0.032*
	(0.039)	(0.020)	(0.019)
Higher	-0.079	0.041	0.038
	(0.049)	(0.025)	(0.023)
Christianity	0.047***	-0.024***	-0.022***
	(0.006)	(0.003)	(0.003)
Cohabitation	-0.030***	0.016***	0.014***
	(0.009)	(0.005)	(0.004)
Never married	0.118***	-0.061***	-0.057***
	(0.012)	(0.006)	(0.007)
Other Marital status	0.253***	-0.131***	-0.122***
	(0.024)	(0.013)	(0.012)
HIV Rate	-0.001	0.001	0.001
	(0.002)	(0.001)	(0.001)
HIV Prevention Knowledge	-0.037*	0.019*	0.018*
	(0.020)	(0.010)	(0.010)
Correct Reject	-0.014	0.007	0.007
	(0.009)	(0.005)	(0.004)
Primary*HIV PK	0.008	-0.004	-0.004
	(0.020)	(0.010)	(0.010)
Secondary*HIV PK	-0.014	0.007	0.007
	(0.024)	(0.013)	(0.012)
Higher*HIV PK	-0.002	0.001	0.001
	(0.025)	(0.013)	(0.012)
Primary* Reject	0.024**	-0.012**	-0.011**
	(0.010)	(0.005)	(0.005)
Secondary*Reject	0.011	-0.006	-0.005
	(0.011)	(0.006)	(0.005)
Higher*Reject	-0.000	0.000	0.000
	(0.011)	(0.006)	(0.005)
Wave 3 (2008)	-0.024***	0.013***	0.012***
	(0.009)	(0.005)	(0.004)
Wave 4 (2013)	-0.091***	0.047***	0.044***
	(0.010)	(0.005)	(0.005)
District FE	Yes	Yes	Yes
Observations	18592	18592	18592

Notes: As for Table A6.

Table A10: Ordered Probit Marginal Effects of Concern on Sexual Partners, Males

Variables	0 Partner	1 partner	>1 partner
Age	-0.043***	0.007***	0.037***
	(0.002)	(0.001)	(0.002)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.004	0.001	0.003
	(0.054)	(0.008)	(0.046)
Secondary	-0.023	0.004	0.019
	(0.050)	(0.008)	(0.043)
Higher	-0.052	0.008	0.044
	(0.065)	(0.010)	(0.045)
Christianity	0.014*	-0.002	-0.012
	(0.009)	(0.001)	(0.007)
Cohabitation	-0.038***	0.006***	0.032***
	(0.010)	(0.002)	(0.008)
Never married	0.035***	-0.005**	-0.029***
	(0.011)	(0.002)	(0.009)
Other Marital status	0.079***	-0.012***	-0.067***
	(0.028)	(0.005)	(0.024)
Less concerned	-0.016*	0.003	0.014*
	(0.010)	(0.002)	(0.008)
More concerned	-0.002	0.000	0.002
	(0.009)	(0.001)	(0.008)
Rural	0.024**	-0.004**	-0.020**
	(0.011)	(0.012)	(0.009)
HIV Prevention Knowledge	-0.026	0.004	0.022
	(0.020)	(0.003)	(0.017)
Correct Reject	0.003	-0.000	-0.003
	(0.010)	(0.001)	(0.008)
Primary*HIV PK	-0.018	0.003	0.015
	(0.027)	(0.004)	(0.023)
Secondary*HIV PK	-0.028	0.004	0.024
	(0.024)	(0.004)	(0.020)
Higher*HIV PK	-0.014	0.002	0.011
	(0.028)	(0.004)	(0.024)
Primary* Reject	0.008	-0.001	-0.006
	(0.012)	(0.002)	(0.010)
Secondary*Reject	-0.002	0.000	0.002
	(0.012)	(0.002)	(0.010)
Higher*Reject	-0.009	0.001	0.008
	(0.014)	(0.002)	(0.012)
Wave 4 (2013)	-0.066***	0.010***	0.056***
	(0.009)	(0.002)	(0.007)
District FE	Yes	Yes	Yes
Observations	7116	7116	7116

Notes: As for Table A6 except omitted categories is boyfriend/girlfriend for relationship type.

Table A11: Ordered Probit Marginal Effects of Concern on Sexual Partners, Females

Variables	0 Partner	1 partner	>1 partner
Age	-0.048***	0.033***	0.015***
	(0.002)	(0.002)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.015	0.010	0.005
	(0.059)	(0.041)	(0.019)
Secondary	-0.028	0.019	0.009
	(0.055)	(0.038)	(0.017)
Higher	-0.046	0.031	0.014
	(0.085)	(0.058)	(0.027)
Christianity	0.059***	-0.040***	-0.018***
	(0.012)	(0.008)	(0.004)
Cohabitation	-0.014	0.010	0.004
	(0.010)	(0.007)	(0.003)
Never married	0.173***	-0.118***	-0.054***
	(0.011)	(0.009)	(0.003)
Other Marital status	0.288***	-0.198***	-0.091***
	(0.022)	(0.017)	(0.007)
Less concerned	-0.012	0.008	0.004
	(0.010)	(0.007)	(0.003)
More concerned	-0.006	0.004	0.002
	(0.010)	(0.007)	(0.003)
Rural	0.010	-0.007	-0.003
	(0.011)	(0.008)	(0.003)
HIV Prevention Knowledge	-0.023	0.015	0.007
	(0.023)	(0.015)	(0.007)
Correct Reject	0.001	-0.001	-0.000
	(0.012)	(0.008)	(0.004)
Primary*HIV PK	-0.011	0.007	0.003
	(0.030)	(0.021)	(0.010)
Secondary*HIV PK	-0.030	0.021	0.009
	(0.026)	(0.018)	(0.008)
Higher*HIV PK	0.002	-0.002	-0.001
	(0.037)	(0.026)	(0.012)
Primary* Reject	0.005	-0.004	-0.002
	(0.015)	(0.010)	(0.005)
Secondary*Reject	0.010	-0.007	-0.003
	(0.014)	(0.010)	(0.004)
Higher*Reject	-0.015	0.010	0.005
	(0.019)	(0.013)	(0.006)
Wave 4 (2013)	-0.046***	0.031***	0.014***
	(0.009)	(0.006)	(0.003)
District FE	Yes	Yes	Yes
Observations	9140	9140	9140

Notes: As for Table A10.

Table A12: Ordered Probit Marginal Effects, Concern and Sexual Partners, Rural

Variables	0 Partner	1 partner	>1 partner
Male	-0.090***	0.053***	0.037***
	(0.010)	(0.006)	(0.005)
Age	-0.040***	0.024***	0.017***
	(0.003)	(0.002)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	0.030	-0.018	-0.013
	(0.056)	(0.033)	(0.023)
Secondary	-0.048	0.028	0.020
	(0.056)	(0.033)	(0.023)
Higher	-0.161	0.094	0.066
	(0.123)	(0.072)	(0.051)
Christianity	0.027**	-0.016**	-0.011**
	(0.012)	(0.007)	(0.005)
Cohabitation	0.010	-0.006	-0.004
	(0.013)	(0.008)	(0.005)
Never married	0.197***	-0.115***	-0.081***
	(0.015)	(0.010)	(0.006)
Other Marital status	0.304***	-0.179***	-0.126***
	(0.029)	(0.019)	(0.012)
Less concerned	0.000	-0.000	-0.000
	(0.012)	(0.007)	(0.005)
More concerned	-0.018	0.011	0.007
	(0.012)	(0.007)	(0.005)
HIV Prevention Knowledge	-0.025	0.014	0.010
	(0.019)	(0.011)	(0.008)
Correct Reject	0.007	-0.004	-0.003
	(0.010)	(0.006)	(0.004)
Primary*HIV PK	-0.025	0.015	0.011
	(0.028)	(0.016)	(0.012)
Secondary*HIV PK	-0.029	0.017	0.012
	(0.026)	(0.015)	(0.011)
Higher*HIV PK	-0.012	0.007	0.005
	(0.047)	(0.027)	(0.019)
Primary* Reject	0.001	-0.000	-0.000
	(0.013)	(0.008)	(0.006)
Secondary*Reject	0.007	-0.004	-0.003
	(0.014)	(0.008)	(0.006)
Higher*Reject	0.009	-0.005	-0.004
	(0.027)	(0.016)	(0.011)
Wave 4 (2013)	-0.041***	0.024***	0.017***
	(0.011)	(0.007)	(0.005)
District FE	Yes	Yes	Yes
Observations	5869	5869	5869

Notes: As for Table A6 except additional omitted category is no change in concern for concern level.

Table A13: Ordered Probit Marginal Effects, Concern and Sexual Partners, Urban

Variables	0 Partner	1 partner	>1 partner
Male	-0.089***	0.033***	0.056***
	(0.007)	(0.003)	(0.005)
Age	-0.048***	0.018***	0.031***
	(0.002)	(0.001)	(0.001)
Age squared	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)
Primary	-0.065	0.024	0.041
	(0.066)	(0.024)	(0.042)
Secondary	-0.055	0.020	0.035
	(0.061)	(0.022)	(0.038)
Higher	-0.055	0.020	0.035
	(0.071)	(0.026)	(0.045)
Christianity	0.035**	-0.013**	-0.022**
	(0.009)	(0.003)	(0.006)
Cohabitation	-0.030***	0.011***	0.019***
	(0.008)	(0.003)	(0.005)
Never married	0.080***	-0.029***	-0.051***
	(0.009)	(0.004)	(0.005)
Other Marital status	0.179***	-0.066***	-0.113***
	(0.020)	(0.009)	(0.012)
Less concerned	-0.021***	0.008***	0.013***
	(0.008)	(0.003)	(0.005)
More concerned	0.003	-0.001	-0.002
	(0.008)	(0.003)	(0.005)
HIV Prevention Knowledge	-0.024	0.009	0.015
	(0.028)	(0.010)	(0.018)
Correct Reject	-0.016	0.006	0.010
	(0.012)	(0.004)	(0.008)
Primary*HIV PK	-0.011	0.004	0.007
	(0.034)	(0.012)	(0.021)
Secondary*HIV PK	-0.027	0.010	0.017
	(0.030)	(0.011)	(0.019)
Higher*HIV PK	-0.010	0.004	0.006
	(0.034)	(0.012)	(0.021)
Primary* Reject	0.025	-0.009*	-0.016*
	(0.014)	(0.005)	(0.009)
Secondary*Reject	0.017	-0.006	-0.011
	(0.013)	(0.005)	(0.008)
Higher*Reject	0.001	-0.000	-0.001
	(0.015)	(0.006)	(0.010)
Wave 4 (2013)	-0.068***	0.025***	0.043***
	(0.008)	(0.003)	(0.005)
District FE	Yes	Yes	Yes
Observations	10387	10387	10387

Notes: As for Table A12.

Table A14: Probit Marginal Effects of HIV Prevalence on Condom Use by Gender

	Males		**Females**	
Variables	CUFS	CULS	CUFS	CULS
	(1)	(2)	(3)	(4)
Age	-0.016***	-0.014***	-0.017***	0.007**
	(0.003)	(0.003)	(0.002)	(0.003)
Age squared	0.000**	0.000***	0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.045	0.052	0.144***	0.103*
	(0.039)	(0.061)	(0.054)	(0.060)
Secondary	0.204***	0.383***	0.248***	0.335***
	(0.053)	(0.064)	(0.055)	(0.064)
Higher	0.347***	0.267***	0.316***	0.442***
	(0.076)	(0.089)	(0.064)	(0.073)
Christianity	0.007	0.008	0.019*	0.018
	(0.010)	(0.009)	(0.011)	(0.017)
Husband/Wife	-0.208***	-0.255***	-0.237***	-0.270***
	(0.009)	(0.014)	(0.008)	(0.020)
Cohabiting	-0.078***	-0.130***	-0.091***	-0.117***
	(0.008)	(0.012)	(0.011)	(0.010)
Other relationship type	0.037	0.099***	-0.018	0.027
	(0.026)	(0.027)	(0.031)	(0.043)
HIV Rate	0.004*	0.006***	0.004*	0.000
	(0.002)	(0.002)	(0.002)	(0.003)
Perceived Unfaithfulness (Yes)	-0.017	0.056***	-0.011*	0.031***
	(0.011)	(0.012)	(0.006)	(0.005)
Rural	-0.051***	-0.055***	-0.047***	-0.059***
	(0.005)	(0.012)	(0.008)	(0.008)
One Partner	0.027***	0.010	-0.015	-0.044***
	(0.008)	(0.008)	(0.017)	(0.017)
HIV Prevention Knowledge	0.025	0.056***	0.063***	0.077***
	(0.021)	(0.017)	(0.022)	(0.029)
Correct Reject	0.019**	0.025	0.027***	0.029**
	(0.008)	(0.016)	(0.010)	(0.014)
Primary*HIV PK	0.033	0.029	-0.034	-0.010
	(0.021)	(0.026)	(0.026)	(0.034)
Secondary*HIV PK	-0.016	-0.089***	-0.029	-0.076**
	(0.027)	(0.018)	(0.030)	(0.032)
Higher*HIV PK	-0.026	-0.040	-0.053**	-0.055
	(0.038)	(0.036)	(0.027)	(0.042)
Primary* Reject	-0.017*	-0.008	-0.011	-0.006
	(0.010)	(0.015)	(0.012)	(0.020)
Secondary*Reject	-0.012	-0.029*	-0.017	-0.015
	(0.008)	(0.016)	(0.013)	(0.017)
Higher*Reject	-0.041***	-0.022	-0.008	-0.048***
	(0.010)	(0.019)	(0.017)	(0.019)
Partner drunk at last sex	-	-0.093***	-	-0.092***
		(0.012)		(0.019)
Wave 3 (2008)	0.093***	0.070***	0.094***	0.060***
	(0.008)	(0.013)	(0.007)	(0.010)
Wave 4 (2013)	0.172***	0.054***	0.173***	0.072***
	(0.011)	(0.014)	(0.013)	(0.015)
District FE	Yes	Yes	Yes	Yes
Observations	9273	9265	11220	11210
Loglikelihood	-3641.604	-4679.703	-4663.476	-6325.804

Notes: As for Table A5.

Table A15: Probit Marginal Effects for Prevalence and Condom Use, Urban and Rural

	Urban		Rural	
Variables	CUFS	CULS	CUFS	CULS
	(1)	(2)	(3)	(4)
Male	0.050***	0.063***	0.055***	0.076***
	(0.009)	(0.006)	(0.009)	(0.012)
Age	-0.015***	-0.001	-0.020***	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)
Age squared	0.000*	-0.000	0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.008	0.016	0.112**	0.101**
	(0.062)	(0.059)	(0.046)	(0.040)
Secondary	0.088	0.237***	0.275***	0.363***
	(0.061)	(0.052)	(0.068)	(0.066)
Higher	0.167**	0.195***	0.511***	0.459***
	(0.072)	(0.067)	(0.078)	(0.128)
Christianity	0.015	0.007	0.002	0.011
	(0.009)	(0.011)	(0.013)	(0.019)
Husband/Wife	-0.213***	-0.279***	-0.242***	-0.225***
	(0.006)	(0.015)	(0.016)	(0.022)
Cohabiting	-0.071***	-0.114***	-0.109***	-0.142***
	(0.006)	(0.013)	(0.014)	(0.011)
Other relationship type	0.029	0.091***	0.004	0.087*
	(0.026)	(0.028)	(0.032)	(0.049)
HIV Rate	0.006**	0.004*	0.002	0.001
	(0.003)	(0.002)	(0.002)	(0.003)
Perceived Unfaithfulness (Yes)	-0.011**	0.043***	-0.015	0.038***
	(0.005)	(0.006)	(0.010)	(0.010)
One Partner	0.021*	-0.009	0.003	-0.018
	(0.011)	(0.011)	(0.011)	(0.014)
HIV Prevention Knowledge	-0.016	0.009	0.074***	0.088***
	(0.025)	(0.022)	(0.018)	(0.018)
Correct Reject	0.014*	0.028*	0.027***	0.025*
	(0.008)	(0.015)	(0.008)	(0.013)
Primary*HIV PK	0.042*	0.067**	-0.014	-0.011
	(0.024)	(0.030)	(0.027)	(0.023)
Secondary*HIV PK	0.034	-0.021	-0.033	-0.097***
	(0.027)	(0.025)	(0.035)	(0.024)
Higher*HIV PK	0.025	-0.002	-0.095**	-0.008
	(0.035)	(0.037)	(0.047)	(0.042)
Primary* Reject	-0.011	-0.019	-0.010	0.004
	(0.011)	(0.016)	(0.010)	(0.013)
Secondary*Reject	-0.007	-0.027*	-0.015	-0.008
	(0.008)	(0.017)	(0.012)	(0.016)
Higher*Reject	-0.016	-0.025	-0.027*	-0.062***
	(0.011)	(0.019)	(0.015)	(0.022)
Partner drunk at last sex	-	-0.109***	-	-0.066***
		(0.010)		(0.018)
Wave 3 (2008)	0.092***	0.067***	0.101***	0.067***
	(0.007)	(0.011)	(0.011)	(0.016)
Wave 4 (2013)	0.174***	0.059***	0.172***	0.083***
	(0.014)	(0.011)	(0.015)	(0.017)
District FE	Yes	Yes	Yes	Yes
Observations	13243	13243	7234	7225
Loglikelihood	-5086.791	-6861.441	-3225.832	-4146.436

Notes: As for Table A5.

Table A16: Probit Marginal Effects of Concern on Condom Use by Gender

	Males		Females	
Variables	CUFS	CULS	CUFS	CULS
Age	-0.010***	-0.011***	-0.010***	0.010***
	(0.003)	(0.004)	(0.003)	(0.004)
Age squared	0.000	0.000**	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.143**	0.058	0.114	0.126
	(0.063)	(0.088)	(0.071)	(0.101)
Secondary	0.247***	0.370***	0.188***	0.453***
	(0.063)	(0.083)	(0.064)	(0.089)
Higher	0.303***	0.263**	0.257***	0.488***
	(0.081)	(0.102)	(0.098)	(0.119)
Christianity	0.012	0.017	0.028**	0.033**
	(0.010)	(0.013)	(0.012)	(0.015)
Husband/Wife	-0.182***	-0.262***	-0.218***	-0.277***
	(0.014)	(0.017)	(0.012)	(0.015)
Cohabitation	-0.074***	-0.113***	-0.081***	-0.108***
	(0.012)	(0.014)	(0.011)	(0.013)
Other relationship type	0.022	0.142***	-0.008	0.072
	(0.030)	(0.038)	(0.053)	(0.057)
Less Concerned	0.017	0.022	0.019*	0.011
	(0.012)	(0.014)	(0.011)	(0.014)
More Concerned	0.020*	0.028**	0.019*	0.045***
	(0.011)	(0.013)	(0.010)	(0.013)
Perceived Unfaithfulness	-0.012	0.057***	-0.017	0.025**
	(0.013)	(0.016)	(0.010)	(0.013)
Rural	-0.055***	-0.066***	-0.047***	-0.066***
	(0.013)	(0.016)	(0.012)	(0.015)
One Partner	0.014	0.007	-0.018	-0.062***
	(0.013)	(0.015)	(0.018)	(0.021)
HIV Prevention Knowledge	0.044*	0.030	0.028	0.116***
	(0.024)	(0.033)	(0.026)	(0.038)
Correct Reject	0.022*	0.027*	0.025**	0.035*
	(0.012)	(0.016)	(0.013)	(0.018)
Primary*HIV PK	-0.020	0.014	-0.018	-0.034
	(0.031)	(0.044)	(0.035)	(0.049)
Secondary*HIV PK	-0.041	-0.089**	-0.008	-0.142***
	(0.030)	(0.040)	(0.030)	(0.042)
Higher*HIV PK	-0.051	-0.047	-0.032	-0.101*
	(0.036)	(0.045)	(0.042)	(0.053)
Primary* Reject	-0.024	-0.006	-0.008	-0.009
	(0.015)	(0.019)	(0.015)	(0.022)
Secondary*Reject	-0.022	-0.035**	-0.012	-0.031*
	(0.014)	(0.018)	(0.015)	(0.021)
Higher*Reject	-0.031*	-0.029	-0.007	-0.058**
	(0.018)	(0.022)	(0.020)	(0.026)
Partner drunk at last sex	-	-0.103***	-	-0.086***
		(0.019)		(0.020)
Wave 4 (2013)	0.062***	0.021*	0.073***	-0.001
	(0.011)	(0.013)	(0.010)	(0.012)
District FE	Yes	Yes	Yes	Yes
Observations	5245	5232	6459	6443
Loglikelihood	-1903.769	-2566.311	-2532.648	-3591.979
Prob>chi2	0.000	0.000	0.000	0.000

Notes: As for Table A12.

Table A17: Probit Marginal Effects for Concern and Condom Use, Urban and Rural

	Urban		Rural	
Variables	CUFS	CULS	CUFS	CULS
Male	0.047***	0.060***	0.049***	0.065***
	(0.008)	(0.010)	(0.013)	(0.015)
Age	-0.008***	0.001	-0.015***	-0.000
	(0.003)	(0.003)	(0.004)	(0.004)
Age squared	0.000	-0.000	0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.063	0.181	0.142**	-0.006
	(0.080)	(0.114)	(0.068)	(0.089)
Secondary	0.119	0.394***	0.224***	0.361***
	(0.074)	(0.105)	(0.070)	(0.085)
Higher	0.149*	0.321***	0.329***	0.425***
	(0.087)	(0.116)	(0.124)	(0.148)
Christianity	0.017*	0.013	0.017	0.037**
	(0.010)	(0.012)	(0.014)	(0.017)
Husband/Wife	-0.190***	-0.278***	-0.227***	-0.243***
	(0.010)	(0.013)	(0.017)	(0.022)
Cohabitation	-0.067***	-0.096***	-0.101***	-0.139***
	(0.010)	(0.012)	(0.014)	(0.017)
Other relationship type	-0.003	0.137***	0.037	0.133***
	(0.033)	(0.041)	(0.045)	(0.052)
Less Concerned	0.015	0.002	0.026*	0.043**
	(0.010)	(0.012)	(0.015)	(0.018)
More Concerned	0.019**	0.033***	0.020	0.044**
	(0.009)	(0.011)	(0.014)	(0.017)
Perceived Unfaithfulness (Yes)	-0.012	0.041***	-0.023	0.029*
	(0.009)	(0.012)	(0.014)	(0.017)
One Partner	0.008	-0.016	-0.001	-0.029
	(0.012)	(0.014)	(0.021)	(0.024)
Partner drunk at last sex	-	-0.100***	-	-0.087***
		(0.017)		(0.024)
HIV Prevention Knowledge	-0.011	0.068	0.066***	0.071**
	(0.033)	(0.047)	(0.025)	(0.032)
Correct Reject	0.011	0.035*	0.031**	0.027*
	(0.014)	(0.020)	(0.012)	(0.016)
Primary*HIV PK	0.009	-0.035	-0.027	0.024
	(0.039)	(0.055)	(0.034)	(0.044)
Secondary*HIV PK	0.007	-0.109**	-0.019	-0.100**
	(0.035)	(0.050)	(0.033)	(0.041)
Higher*HIV PK	0.000	-0.081	-0.033	-0.014
	(0.040)	(0.054)	(0.053)	(0.062)
Primary* Reject	-0.012	-0.033	-0.013	0.015
	(0.016)	(0.023)	(0.016)	(0.021)
Secondary*Reject	-0.008	-0.044**	-0.016	-0.019
	(0.015)	(0.022)	(0.016)	(0.020)
Higher*Reject	-0.009	-0.038	-0.016	-0.066**
	(0.017)	(0.024)	(0.030)	(0.034)
Wave 4 (2013)	0.067***	0.019*	0.070***	-0.009
	(0.009)	(0.011)	(0.013)	(0.016)
District FE	Yes	Yes	Yes	Yes
Observations	7703	7694	3985	3973
Loglikelihood	-2700.014	-3862.921	-1740.923	-2297.908
Prob > $\chi 2$	0.000	0.000	0.000	0.000

Notes: As for Table A12.

Table A18: IV Probit Results for Prevalence and Condom use by Gender

Variables	Males		Females	
	CUFS (1)	CULS (2)	CUFS (3)	CULS (4)
HIV Rate	-0.008	0.005	-0.012	0.014
	(0.015)	(0.010)	(0.010)	(0.011)
Age	-0.059***	-0.041***	-0.070***	0.023***
	(0.011)	(0.008)	(0.010)	(0.009)
Age squared	0.000**	0.000***	0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.208	0.184	0.510**	0.294
	(0.146)	(0.215)	(0.217)	(0.181)
Secondary	1.059***	1.362***	1.111***	1.050***
	(0.219)	(0.227)	(0.218)	(0.200)
Higher	1.655***	0.969***	1.472***	1.419***
	(0.309)	(0.305)	(0.241)	(0.219)
Christianity	0.024	-0.001	0.074*	0.038
	(0.045)	(0.033)	(0.039)	(0.051)
Husband/Wife	-0.939***	-0.901***	-0.999***	-0.850***
	(0.041)	(0.059)	(0.041)	(0.068)
Cohabiting	-0.338***	-0.447***	-0.346***	-0.354***
	(0.037)	(0.045)	(0.038)	(0.035)
Other relationship type	0.225*	0.366***	-0.039	0.102
	(0.118)	(0.092)	(0.120)	(0.129)
Perceived Unfaithfulness (Yes)	-0.030	0.212***	-0.026	0.096***
	(0.045)	(0.042)	(0.027)	(0.019)
Rural	-0.203***	-0.203***	-0.183***	0.169***
	(0.038)	(0.038)	(0.028)	(0.029)
One Partner	0.096**	0.031	-0.072	-0.139***
	(0.039)	(0.026)	(0.071)	(0.049)
HIV PK	0.150*	0.208***	0.272***	0.251***
	(0.086)	(0.061)	(0.086)	(0.084)
Correct Reject	0.106***	0.094*	0.159***	0.100**
	(0.033)	(0.054)	(0.041)	(0.044)
Primary*HIV PK	0.152*	0.103	-0.095	-0.023
	(0.083)	(0.090)	(0.101)	(0.104)
Secondary*HIV PK	-0.089	-0.315***	-0.099	-0.235**
	(0.112)	(0.067)	(0.117)	(0.095)
Higher*HIV PK	-0.141	-0.152	-0.219**	-0.183
	(0.161)	(0.119)	(0.099)	(0.126)
Primary* Reject	-0.065	-0.026	-0.047	-0.015
	(0.043)	(0.053)	(0.050)	(0.062)
Secondary*Reject	-0.052	-0.096*	-0.076	-0.043
	(0.037)	(0.055)	(0.056)	(0.053)
Higher*Reject	-0.175***	-0.076	-0.048	-0.148**
	(0.044)	(0.066)	(0.068)	(0.060)
Partner drunk at last sex	-	-0.336***	-	-0.239***
		(0.043)		(0.066)
Observations	9273	9265	11220	11210
Exogeneity test Males	5.53	0.0187		
Exogeneity test Females	2.55	0.100		

Notes: As for Table A6. Exogeneity test reports $\chi 2$ (first column) and p-value.

Table A19: IV Probit for Prevalence and Condom Use, Urban and Rural

	Urban		Rural	
Variables	CUFS	CULS	CUFS	CULS
	(1)	(2)	(3)	(4)
HIV Rate	-0.005	0.017**	-0.029	-0.008
	(0.008)	(0.007)	(0.019)	(0.014)
Male	0.221***	0.208***	0.229***	0.241***
	(0.044)	(0.018)	(0.032)	(0.034)
Age	-0.061***	0.001	-0.070***	-0.007
	(0.012)	(0.011)	(0.011)	(0.010)
Age squared	0.000*	-0.000	0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.012	-0.075	0.369**	0.280**
	(0.266)	(0.200)	(0.150)	(0.118)
Secondary	0.524**	0.816***	1.170***	1.118***
	(0.269)	(0.164)	(0.238)	(0.223)
Higher	0.930***	0.684***	2.102***	1.487***
	(0.295)	(0.221)	(0.303)	(0.390)
Christianity	0.075*	0.007	-0.015	0.012
	(0.042)	(0.037)	(0.050)	(0.054)
Husband/Wife	-0.966***	-0.955***	-0.965***	-0.704***
	(0.037)	(0.061)	(0.062)	(0.069)
Cohabiting	-0.307***	-0.385***	-0.387***	-0.421***
	(0.031)	(0.049)	(0.053)	(0.036)
Other relationship type	0.171	0.304***	0.086	0.316**
	(0.115)	(0.091)	(0.116)	(0.143)
Perceived Unfaithfulness (Yes)	-0.023	0.155***	-0.024	0.125***
	(0.024)	(0.020)	(0.038)	(0.034)
One Partner	0.053	-0.041	0.013	-0.048
	(0.048)	(0.033)	(0.049)	(0.040)
HIV PK	-0.055	0.034	0.305***	0.283***
	(0.109)	(0.074)	(0.065)	(0.055)
Correct Reject	0.120***	0.119**	0.131***	0.085**
	(0.036)	(0.051)	(0.027)	(0.041)
Primary*HIV PK	0.222**	0.243**	-0.020	-0.029
	(0.107)	(0.107)	(0.089)	(0.067)
Secondary*HIV PK	0.161	-0.066	-0.124	-0.284***
	(0.120)	(0.084)	(0.126)	(0.077)
Higher*HIV PK	0.113	-0.004	-0.407**	-0.058
	(0.149)	(0.123)	(0.175)	(0.135)
Primary* Reject	-0.069	-0.071	-0.021	0.026
	(0.048)	(0.055)	(0.038)	(0.039)
Secondary*Reject	-0.052	-0.094*	-0.052	-0.018
	(0.036)	(0.055)	(0.046)	(0.048)
Higher*Reject	-0.102**	-0.087	-0.092	-0.184***
	(0.046)	(0.064)	(0.058)	(0.066)
Partner drunk at last sex	-	-0.353***	-	-0.180***
		(0.035)		(0.055)
Observations	13259	13242	7234	7234
Exogeneity test Rural	4.45	0.0349		
Exogeneity test Urban	2.42	0.100		

Notes: As for Table A19.

Table A20: TSLS for the Impact of Concern on Condom Use, Males

Variables	CUFS	CUFS	CULS	CULS
Less Concerned	-0.385***	-	0.036	-
	(0.114)		(0.127)	
More Concerned	-	1.413*	-	-0.128
		(0.835)		(0.465)
Age	0.003	-0.007	-0.006	-0.005
	(0.004)	(0.009)	(0.004)	(0.005)
Age squared	-0.000***	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.326***	0.018	0.105	0.134
	(0.109)	(0.212)	(0.112)	(0.144)
Secondary	0.473***	0.072	0.407***	0.443***
	(0.091)	(0.255)	(0.094)	(0.155)
Higher	0.543***	-0.028	0.337***	0.390*
	(0.108)	(0.363)	(0.118)	(0.216)
Christianity	0.003	-0.013	0.011	0.012
	(0.013)	(0.030)	(0.014)	(0.017)
Husband/Wife	-0.233***	-0.184***	-0.317***	-0.322***
	(0.020)	(0.046)	(0.020)	(0.027)
Cohabitation	-0.059***	-0.058**	-0.114***	-0.114***
	(0.013)	(0.027)	(0.015)	(0.015)
Other relationship type	0.027	0.019	0.085***	0.086***
	(0.021)	(0.047)	(0.018)	(0.019)
Perceived unfaithfulness (Yes)	-0.003	-0.042	0.050***	0.053***
	(0.012)	(0.033)	(0.013)	(0.017)
Rural	-0.057***	-0.068***	-0.078***	-0.076***
	(0.012)	(0.023)	(0.013)	(0.014)
One Partner	0.013	-0.014	0.010	0.013
	(0.012)	(0.030)	(0.013)	(0.016)
HIV PK	0.092**	-0.059	0.046	0.057
	(0.042)	(0.099)	(0.043)	(0.060)
Correct Reject	0.043*	0.014	0.031	0.034
	(0.022)	(0.034)	(0.021)	(0.023)
Primary*HIV PK	-0.064	0.059	0.002	-0.009
	(0.054)	(0.099)	(0.055)	(0.065)
Secondary*HIV PK	-0.108**	-0.024	-0.093**	-0.100**
	(0.045)	(0.077)	(0.046)	(0.049)
Higher*HIV PK	-0.117**	0.009	-0.064	-0.075
	(0.052)	(0.106)	(0.053)	(0.064)
Primary* Reject	-0.044*	-0.034	-0.005	-0.006
	(0.026)	(0.039)	(0.025)	(0.025)
Secondary*Reject	-0.037	0.002	-0.037*	-0.041
	(0.023)	(0.040)	(0.022)	(0.026)
Higher*Reject	-0.061**	0.013	-0.035	-0.043
	(0.026)	(0.054)	(0.026)	(0.034)
Partner drunk at last sex	-	-	-0.102***	-0.102***
			(0.020)	(0.021)
Observations	5245	5245	5232	5232
Exogeneity test (χ2, P value)	14.233	0.0002		
Instrument strength (F, P value)	62.360	0.0000		

Notes: As for Table A12.

Table A21: TSLS for the Impact of Concern on Condom Use, Females

Variables	CUFS	CUFS	CULS	CULS
Less Concerned	-0.455***	-	-0.066	-
	(0.095)		(0.105)	
More Concerned	-	1.011***	-	0.148
		(0.308)		(0.235)
Age	0.002	-0.000	0.012***	0.011***
	(0.004)	(0.005)	(0.004)	(0.004)
Age squared	-0.000***	-0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.154	0.186	0.131	0.136
	(0.107)	(0.138)	(0.101)	(0.100)
Secondary	0.389***	0.317***	0.499***	0.488***
	(0.087)	(0.112)	(0.081)	(0.084)
Higher	0.410***	0.199	0.531***	0.499***
	(0.110)	(0.178)	(0.112)	(0.129)
Christianity	0.021	-0.006	0.031*	0.027
	(0.015)	(0.024)	(0.016)	(0.019)
Husband/Wife	-0.258***	-0.247***	-0.308***	-0.306***
	(0.017)	(0.023)	(0.017)	(0.018)
Cohabitation	-0.050***	-0.078***	-0.104***	-0.108***
	(0.012)	(0.017)	(0.014)	(0.013)
Other relationship type	0.004	0.051	0.061	0.068
	(0.044)	(0.067)	(0.042)	(0.043)
Perceived unfaithfulness	-0.009	-0.035*	0.025***	0.021
	(0.011)	(0.018)	(0.012)	(0.013)
Rural	-0.052***	-0.056***	-0.062***	-0.063***
	(0.012)	(0.017)	(0.012)	(0.013)
One Partner	0.000	-0.016	-0.048***	-0.050***
	(0.016)	(0.024)	(0.017)	(0.017)
HIV PK	0.021	0.001	0.118***	0.115***
	(0.041)	(0.052)	(0.037)	(0.038)
Correct Reject	0.068***	0.063**	0.041**	0.040**
	(0.022)	(0.027)	(0.021)	(0.021)
Primary*HIV PK	0.025	-0.015	-0.024	-0.030
	(0.055)	(0.070)	(0.051)	(0.050)
Secondary*HIV PK	-0.005	-0.016	-0.144***	-0.145***
	(0.044)	(0.055)	(0.040)	(0.040)
Higher*HIV PK	-0.027	-0.034	-0.112**	-0.113**
	(0.050)	(0.069)	(0.051)	(0.051)
Primary* Reject	-0.036	-0.041	-0.012	-0.013
	(0.026)	(0.034)	(0.025)	(0.025)
Secondary*Reject	-0.057**	-0.055*	-0.040*	-0.040*
	(0.023)	(0.029)	(0.023)	(0.023)
Higher*Reject	-0.052*	-0.009	-0.063**	-0.057**
	(0.027)	(0.037)	(0.027)	(0.027)
Partner drunk at last sex	-	-	-0.085***	-0.086***
			(0.021)	(0.021)
Observations	6459	6459	6443	6443
Exogeneity test (χ2, P value)	29.358	0.0000		
Instrument Strength (F, P value)	105.312	0.0000		

Notes: As for Table A12.

Table A22: TSLS results for Concern and Condom Use, Rural

Variables	CUFS	CUFS	CULS	CULS
Less Concerned	-0.372**	-	-0.278*	-
	(0.145)		(0.164)	
More Concerned	-	0.630***	-	0.473
		(0.280)		(0.291)
Male	0.054***	0.053***	0.065***	0.064***
	(0.014)	(0.016)	(0.015)	(0.016)
Age	-0.008*	-0.010**	0.001	-0.001
	(0.004)	(0.005)	(0.004)	(0.005)
Age squared	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.255***	0.182*	0.039	-0.016
	(0.095)	(0.102)	(0.098)	(0.098)
Secondary	0.420***	0.261**	0.415***	0.294***
	(0.080)	(0.104)	(0.084)	(0.106)
Higher	0.566***	0.252	0.496***	0.257
	(0.128)	(0.202)	(0.136)	(0.197)
Christianity	0.012	0.002	0.025	0.017
	(0.017)	(0.021)	(0.019)	(0.022)
Husband/Wife	-0.272***	-0.266***	-0.260***	-0.256***
	(0.024)	(0.027)	(0.025)	(0.027)
Cohabitation	-0.086***	-0.097***	-0.134***	-0.142***
	(0.016)	(0.018)	(0.019)	(0.019)
Other relationship type	0.045	0.056	0.104***	0.113***
	(0.037)	(0.041)	(0.035)	(0.037)
Perceived unfaithfulness (Yes)	-0.026*	-0.043**	0.023	0.013
	(0.015)	(0.021)	(0.017)	(0.022)
One Partner	0.019	0.009	-0.011	-0.018
	(0.020)	(0.022)	(0.022)	(0.023)
Partner drunk at last sex	-	-	-0.086***	-0.088***
			(0.026)	(0.027)
HIV PK	0.090***	0.054	0.076**	0.050
	(0.032)	(0.040)	(0.033)	(0.040)
Correct Reject	0.064***	0.043**	0.045**	0.029
	(0.020)	(0.019)	(0.021)	(0.019)
Primary*HIV PK	-0.032	-0.019	0.021	0.031
	(0.046)	(0.052)	(0.048)	(0.050)
Secondary*HIV PK	-0.060	-0.017	-0.110***	-0.078*
	(0.038)	(0.046)	(0.040)	(0.046)
Higher*HIV PK	-0.088	-0.023	-0.040	0.008
	(0.056)	(0.073)	(0.060)	(0.073)
Primary* Reject	-0.041*	-0.035	0.003	0.007
	(0.025)	(0.026)	(0.026)	(0.025)
Secondary*Reject	-0.044**	-0.031	-0.029	-0.019
	(0.021)	(0.022)	(0.023)	(0.023)
Higher*Reject	-0.061*	-0.021	-0.083**	-0.051
	(0.034)	(0.040)	(0.035)	(0.036)
Observations	3985	3985	3981	3981
Exogeneity test (χ2, P value)	8.047	0.0046		
Instrument strength (F, P value)	49.384	0.000		

Notes: As for Table A12.

Table A23: TSLS Impact of Concern on Condom Use, Urban

Variables	CUFS	CUFS	CULS	CULS
Less Concerned	-0.459***	-	0.096	-
	(0.085)		(0.094)	
More Concerned	-	1.534**	-	-0.320
		(0.599)		(0.338)
Male	0.034***	0.038**	0.060***	0.059***
	(0.010)	(0.019)	(0.010)	(0.011)
Age	0.005	-0.000	0.004	0.005
	(0.003)	(0.007)	(0.003)	(0.004)
Age squared	-0.000***	-0.000*	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.013	-0.060	0.241*	0.254*
	(0.146)	(0.225)	(0.138)	(0.142)
Secondary	0.121	-0.060	0.443***	0.458***
	(0.132)	(0.199)	(0.121)	(0.123)
Higher	0.132	-0.107	0.405***	0.458***
	(0.142)	(0.261)	(0.136)	(0.157)
Christianity	0.009	-0.008	0.010	0.013
	(0.012)	(0.026)	(0.012)	(0.015)
Husband/Wife	-0.238***	-0.201***	-0.333***	-0.342***
	(0.015)	(0.033)	(0.015)	(0.019)
Cohabitation	-0.036***	-0.060***	-0.094***	-0.089***
	(0.011)	(0.022)	(0.012)	(0.013)
Other relationship type	0.005	0.007	0.073***	0.076***
	(0.023)	(0.056)	(0.019)	(0.022)
Perceived unfaithfulness (Yes)	0.002	-0.031	0.034***	0.040***
	(0.010)	(0.023)	(0.011)	(0.012)
One Partner	0.006	-0.025	-0.009	-0.003
	(0.011)	(0.028)	(0.012)	(0.015)
HIV PK	-0.057	-0.112	0.084	0.093
	(0.066)	(0.093)	(0.056)	(0.059)
Correct Reject	0.014	0.031	0.040	0.038
	(0.028)	(0.043)	(0.025)	(0.025)
Primary*HIV PK	0.067	0.091	-0.048	-0.051
	(0.074)	(0.106)	(0.067)	(0.069)
Secondary*HIV PK	0.046	0.025	-0.119**	-0.113**
	(0.067)	(0.080)	(0.058)	(0.058)
Higher*HIV PK	0.037	0.050	-0.102	0.103
	(0.070)	(0.100)	(0.063)	(0.063)
Primary* Reject	-0.010	-0.026	-0.040	-0.039
	(0.031)	(0.049)	(0.028)	(0.028)
Secondary*Reject	-0.011	-0.020	-0.048*	-0.048*
	(0.028)	(0.045)	(0.026)	(0.026)
Higher*Reject	-0.016	0.019	-0.045*	-0.055*
	(0.030)	(0.051)	(0.028)	(0.030)
Partner drunk at last sex	-	-	-0.099***	-0.099***
			(0.018)	(0.020)
Observations	7719	7719	7694	7694
Exogeneity test (χ2, P value)	38.617	0.000		
Instrument Strength (F, P value)	114.112	0.000		

Notes: As for Table A12.

Table A24: Heckman Sample Selection for HIV Prevalence and Condom Use

Dependent Variables:	Condom use at first sex		Condom use at last sex	
Controls	Coefficient	CSE	Coefficient	CSE
HIV Rate	0.001	0.001	0.002	0.002
Male	0.060***	0.006	0.072***	0.006
Age	0.008**	0.003	0.016***	0.003
Age squared	-0.000***	0.000	-0.000***	0.000
Primary	0.157***	0.051	0.102***	0.039
Secondary	0.392***	0.061	0.411***	0.051
Higher	0.477***	0.069	0.405***	0.063
Husband/Wife	-0.208***	0.010	-0.239***	0.016
Cohabiting	-0.022**	0.010	-0.074***	0.009
Other relation status	0.017	0.014	0.063***	0.018
Perceived unfaithfulness (Yes)	-0.013**	0.005	0.038***	0.004
Rural	-0.049***	0.006	-0.064***	0.010
One Partner	0.012*	0.007	-0.012	0.008
PK	0.072***	0.023	0.081***	0.017
Reject	0.038***	0.008	0.034***	0.012
Primary*PK	-0.003	0.025	0.014	0.023
Secondary*PK	-0.042	0.028	-0.080***	0.019
Higher*PK	-0.057*	0.030	-0.055*	0.029
Primary* Reject	-0.024**	0.011	-0.012	0.012
Secondary* Reject	-0.031***	0.008	-0.028**	0.013
Higher* Reject	-0.034***	0.011	-0.035**	0.015
Partner drunk at last sex	-	-	-0.094***	0.007
Wave 3 (2008)	0.097***	0.007	0.061***	0.010
Wave 4 (2013)	0.203***	0.010	0.081***	0.010
Selection Dependent variable:		Report of being sexually active		
HIV Rate	-0.003	0.006	-0.001	0.007
Male	0.108***	0.019	0.094***	0.019
Age	0.229***	0.007	0.226***	0.006
Age squared	-0.003***	0.000	-0.003***	0.000
Primary	0.176*	0.102	0.179*	0.100
Secondary	0.351***	0.092	0.352***	0.087
Higher	0.109	0.168	0.082	0.162
Christianity	-0.143***	0.019	-0.153***	0.020
Cohabitation	-0.128***	0.036	-0.107***	0.036
Never married	-1.295***	0.045	-1.268***	0.043
Other Marital status	-1.615***	0.082	-1.588***	0.081
Rural	-0.031	0.034	-0.031	0.034
PK	0.125***	0.046	0.135***	0.044
Reject	0.054*	0.029	0.051*	0.028
Primary*PK	0.014	0.051	0.007	0.047
Secondary*PK	0.025	0.055	0.020	0.054
Higher*PK	0.071	0.072	0.062	0.071
Primary*Reject	-0.047	0.035	-0.044	0.036
Secondary* Reject	-0.046	0.034	-0.041	0.033
Higher* Reject	-0.047	0.044	0.061	0.042
Wave 3 (2008)	-0.076***	0.024	-0.088***	0.025
Wave 4 (2013)	0.343***	0.037	0.323***	0.037
/athrho	0.491***	0.043	0.391***	0.044
/lnsigma	-0.974***	0.009	-0.830***	0.007
rho	0.455	0.034	0.372	0.038
Observations	28855		28837	
Selected	20489		20471	
Non selected	8366		8366	
Wald test $\chi 2$ (P value)	131.44(0.000)		70.52(0.000)	

Notes: Omitted categories: none for education; boyfriend/girlfriend for relation type. Standard errors clustered at district level in parentheses (significance indicated by ***, **, * for the 1, 5, 10 per cent level).

Table A25: Heckman Sample Selection for Concern and Condom Use

Dependent Variables:	Condom use at first sex		Condom use at last sex	
Controls	Coefficient	CSE	Coefficient	CSE
Less concerned	0.022**	0.009	0.019*	0.011
More concerned	0.019**	0.008	0.037***	0.009
Male	0.052***	0.007	0.064***	0.007
Age	0.013**	0.004	0.016***	0.004
Age squared	-0.000***	0.000	-0.000***	0.000
Primary	0.247***	0.062	0.132**	0.059
Secondary	0.400***	0.064	0.459***	0.066
Higher	0.466***	0.082	0.438***	0.078
Husband/Wife	-0.209***	0.013	-0.268***	0.017
Cohabiting	-0.034***	0.008	-0.075***	0.009
Other relation status	0.014	0.014	0.086***	0.018
Perceived unfaithfulness (Yes)	-0.015*	0.008	0.033***	0.010
Rural	-0.054***	0.007	-0.073***	0.011
One Partner	0.005	0.006	-0.018*	0.009
PK	0.075**	0.031	0.090***	0.030
Reject	0.039***	0.013	0.036**	0.014
Primary*PK	-0.037	0.033	-0.010	0.036
Secondary*PK	-0.057*	0.032	-0.114***	0.035
Higher*PK	-0.080**	0.036	-0.093**	0.041
Primary* Reject	-0.029*	0.017	-0.012	0.016
Secondary* Reject	-0.032***	0.012	-0.039**	0.015
Higher* Reject	-0.032**	0.015	-0.042**	0.017
Partner drunk	-	-	-0.096***	0.009
Wave 4 (2013)	0.093***	0.007	0.009	0.008
Selection Dependent variable:		Report of being sexually active		
Less concerned	0.074**	0.034	0.071**	0.034
More concerned	0.034	0.033	0.032	0.035
Male	0.124***	0.026	0.115***	0.026
Age	0.233***	0.009	0.230***	0.009
Age squared	-0.003***	0.000	-0.003***	0.000
Primary	0.095	0.204	0.091	0.201
Secondary	0.181	0.162	0.179	0.158
Higher	-0.035	0.232	-0.067	0.229
Christianity	-0.141***	0.022	-0.149***	0.023
Cohabitation	-0.138**	0.058	-0.097*	0.054
Never married	-1.206***	0.059	-1.165***	0.053
Other Marital status	-1.507***	0.088	-1.446***	0.084
Rural	-0.057	0.042	-0.058	0.042
PK	0.097	0.062	0.103*	0.060
Reject	0.012	0.036	0.009	0.036
Primary*PK	0.054	0.086	0.046	0.084
Secondary*PK	0.080	0.084	0.079	0.082
Higher*PK	0.056	0.111	0.047	0.108
Primary* Reject	-0.034	0.047	-0.027	0.048
Secondary* Reject	-0.024	0.043	-0.020	0.042
Higher* Reject	0.102**	0.046	0.115**	0.046
Wave 4 (2013)	0.430***	0.031	0.430***	0.031
/athrho	0.355***	0.039	0.326***	0.044
/lnsigma	-1.033***	0.011	-0.847***	0.011
rho	0.341	0.034	0.315	0.039
Observations	15650		15621	
Selected	11700		11671	
Non selected	3950		3950	
Wald test $\chi 2$ (P value)	83.76(0.000)		55.99(0.000)	

Notes: As for Table A24.

Table A26: IV Results for Condom use: One vs More Than One Partner

	One Partner		More than One partner	
Variables	IV Probit	2SLS	IV Probit	2SLS
	(1)	(2)	(3)	(4)
HIV Rate	-0.001	-0.001	0.009	0.005
	(0.010)	(0.003)	(0.014)	(0.004)
Male	0.268***	0.201***	0.133**	0.084**
	(0.025)	(0.008)	(0.055)	(0.015)
Age	-0.037***	-0.033***	-0.073***	-0.048***
	(0.007)	(0.002)	(0.021)	(0.005)
Age squared	0.000*	0.000***	0.001**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Primary	0.182	0.097	1.025***	0.686***
	(0.153)	(0.039)	(0.392)	(0.102)
Secondary	0.990***	0.756***	2.750***	2.058***
	(0.183)	(0.051)	(0.418)	(0.094)
Higher	1.171***	0.881***	2.704***	2.072***
	(0.228)	(0.066)	(0.507)	(0.103)
Christianity	0.035	0.025	-0.064	-0.045
	(0.030)	(0.009)	(0.073)	(0.018)
Husband/Wife	-1.032***	-0.889***	-1.347***	-1.170***
	(0.042)	(0.014)	(0.100)	(0.029)
Cohabiting	-0.424***	-0.361***	-0.600***	-0.489***
	(0.024)	(0.007)	(0.066)	(0.022)
Other relationship type	0.181*	0.111*	0.456***	0.233***
	(0.105)	(0.027)	(0.130)	(0.020)
Rural	-0.206***	-0.160***	-0.120**	-0.085**
	(0.025)	(0.007)	(0.052)	(0.013)
Perceived Unfaithfulness (Yes)	0.047**	0.036***	0.060	0.041
	(0.021)	(0.006)	(0.053)	(0.014)
HIV Prevention Knowledge	0.168**	0.100**	0.413**	0.314**
	(0.070)	(0.018)	(0.165)	(0.045)
Correct Reject	0.072**	0.051**	0.482***	0.359***
	(0.031)	(0.009)	(0.118)	(0.031)
Primary*HIV PK	0.072	0.078	-0.019	0.039
	(0.077)	(0.020)	(0.208)	(0.060)
Secondary*HIV PK	-0.148*	-0.068	-0.625***	-0.445***
	(0.087)	(0.024)	(0.203)	(0.052)
Higher*HIV PK	-0.173	-0.103	-0.401	-0.309**
	(0.108)	(0.031)	(0.256)	(0.061)
Primary* Reject	-0.014	-0.007	-0.358***	-0.264***
	(0.034)	(0.010)	(0.127)	(0.035)
Secondary*Reject	-0.035	-0.023	-0.454***	-0.339***
	(0.033)	(0.010)	(0.128)	(0.034)
Higher*Reject	-0.050	-0.033	-0.489***	-0.370***
	(0.045)	(0.014)	(0.165)	(0.040)
Observations	17634	17634	2854	2854

Notes: As for Table A24; TSLS results have been rescaled by 2.5 (Amemiya, 1981).

Table A27: Probit Marginal Effects for Increased Level of Concern

Variables	Marginal Effect (1)	Standard errors (2)
HIV Rate	0.004***	0.001
Male	0.001	0.009
Age	0.004	0.003
Age squared	-0.000	0.000
Primary	0.120	0.082
Secondary	0.183**	0.073
Higher	0.322***	0.090
Christianity	0.027**	0.011
Husband/Wife	-0.022*	0.013
Cohabiting	0.003	0.010
Other relationship type	-0.012	0.027
Rural	-0.023**	0.010
Perceived Unfaithfulness (Yes)	0.020**	0.010
HIV Prevention Knowledge	0.082**	0.033
Correct Reject	-0.002	0.015
Primary*HIV PK	-0.053	0.041
Secondary*HIV PK	-0.041	0.036
Higher*HIV PK	-0.062	0.042
Primary* Reject	0.012	0.017
Secondary*Reject	-0.002	0.016
Higher*Reject	-0.006	0.019
ARVMBS	0.001***	0.000
Observations	11731	
Loglikelihood	-7152.027	

Notes: As for Table A26.