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Are Africans Practicing Safer Sex?
Evidence from Demographic and Health Surveys for Eight Countries

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Abstract

We use repeated rounds of Demographic and Health Survey data from eight African countries to examine changes in and determinants of three HIV risk behaviors: age at first intercourse; number of current sexual partners, and use of condoms. As a prelude, we assess the within-country comparability of DHS surveys over time. We find some evidence of changes in sample composition, which is easily handled in a multivariate framework, and find evidence as well of changes in how people respond to questions about HIV behavior. Because of the latter, which likely represents an increase in social desirability bias over time, our estimates of risk reduction may be upper bounds on the true effects. Overall the picture is one of reductions in risk behaviors over recent 4-6 year intervals, especially with respect to condom use; in some cases the changes seem large given the short time periods involved. With some exceptions, however, the extent and pervasiveness of these changes seems inadequate in relation to the urgency of the public health crisis represented by AIDS. With respect to the determinants of behaviors, schooling and wealth have contradictory impacts on risk behavior: they both tend to increase the likelihood of using condoms while (for men) also increasing the demand for additional sexual partners.

1. Introduction

HIV/AIDS prevalence is higher in Africa than in any other region.[1] Yet despite increasing commitment on the part of the international community and many African governments, there remain few cases of documented success in turning back the epidemic. In recent years, attention and resources have increasingly been focused on providing anti-retroviral (ARV) drug therapies to the millions of infected people in Africa. However, ARV provision is not an HIV prevention policy, and while there may be positive externalities with respect to prevention, there may also be negative ones (Glick 2005). Nor is an AIDS vaccine likely to appear for years to come. Therefore HIV prevention through reductions in sexual risk behaviors remains the cornerstone of any strategy to combat HIV/AIDS in Africa.

Several earlier studies for Africa examined levels of such behaviors and the role of factors such as education and income in determining them (Filmer 1998; Blanc 2000; Glick, Randriamamonjy, and Sahn 2004). However, these studies have not addressed the question of whether, as a result of policy or simply a growing awareness of the devastation caused by the disease, populations in Africa are reducing levels of risky behaviors. There have been several country-level studies of this question—some using the Demographic and Health Survey data we use here—but systematic, multi-country analysis has been lacking. Clearly, knowledge of whether and where behavior change has occurred is essential for understanding the prospects for reversing Africa's AIDS epidemic and for assessing where prevention efforts need to be redoubled.

We take advantage of the availability of successive rounds of Demographic and Health Surveys (DHSs) from a number of African countries to examine recent changes in risk behaviors in Africa. For Benin, Burkina Faso, Ghana, Kenya, Mozambique, Nigeria, Uganda and Zambia, surveys are available from two points in time that include (with some exceptions) comparable questions on the following HIV-risk related behaviors: the age at first intercourse; whether the individual is sexually active and the number of his or her current sexual partners; and the use of condoms at last intercourse. The period between surveys is usually five years, plus or minus one year.

In addition to measuring changes over time in these behaviors, we model these behaviors as functions of factors such as education and wealth. These estimates are of interest for policy—they indicate, among other things, which groups (e.g., poor vs. wealthy) tend to engage in more and less risky behaviors. It is further of interest to assess whether the impacts of these factors on behavior are themselves changing, i.e., whether the parameters in these models are stable over time. This may tell us something about the nature and effectiveness of policies. For example, if messages designed to promote behavioral change have in effect been directed at the well educated (perhaps because they are disseminated largely through print media) or if the educated are better able to understand public campaigns designed to fight HIV, behavioral change is more likely to occur among them than among those with little schooling.

[1] According to UNAIDS (2005) data, adult prevalence in sub-Saharan Africa is 7.2 percent. 26 of the 40 million people worldwide living with HIV/AIDS are in Africa. The region with the next highest number of afflicted persons is South and South-East Asia, where prevalence is 0.7 percent.

A further—or in a sense, prior—aspect of this analysis is our examination of the validity of using repeated rounds of surveys like the DHS to measure trends in sexual behaviors. In principle, the analysis of repeated large, nationally representative surveys is the most appropriate way to understand behavior change in the population at large. However, it is important to be aware of potential pitfalls when using such data. We consider two problems that may lead to spurious estimates of changes in behaviors over time: changes in sampled populations and changes in reporting bias. The former can arise, for example, from a change in sampling frame such that one (or more) survey round is not fully representative. The second problem, which is more difficult to deal with, will occur if people interviewed in a later survey respond differently to sensitive questions about behavior than individuals in an earlier survey, perhaps because AIDS education and changing norms of behavior have made people less willing to disclose 'socially undesirable' risk behaviors. We test for both sorts of problems and propose (partial) solutions to them to be used in our analysis.

The remainder of this paper is organized as follows. The next section presents a brief conceptual discussion that frames the descriptive and econometric analysis to follow. The presentation also makes the point that policies that contribute to risk reduction by altering one behavior (e.g., unprotected sex) may be confounded by opposing effects on other behaviors (e.g., the number of partners). Section 3 describes the DHS data sets and the empirical specifications used to model each behavior. Section 4 addresses issues of data comparability over time and discussed how the analysis deals with these issues. Section 5 presents the evidence of changes in risk behaviors over time, and Section 6 presents estimates of the effects of key characteristics on these behaviors. The final section summarizes the results in an attempt to provide a broader perspective on the findings and to draw out implications for policy.

2. Conceptual Framework

The relations examined in this paper are complex. They involve both behavior itself and the formation of HIV knowledge that may change this behavior. Because of this, predictions about behavioral outcomes are difficult to make. However, it is important to understand the possible pathways to behavior change, as this will help in the interpretation of our empirical results and ultimately, in the derivation of policy implications. Simple modeling frameworks of the decision to engage in risk behaviors, based on considerations of preferences, information (about risk), costs, and life expectancy (see de Walque 2002; Kelly and Vencatachellum 2004), can help frame the discussion.[2]

Determinants of risk behaviors: education and wealth

[2] These simple models have important limitations. The decision to engage in risky behavior such as unprotected sex is complex and involves more than simply the direct utility and costs in terms of life expectancy of oneself or one's partners—among married couples, for example, the desire for children will mitigate against using condoms even when perceived infection risk is high. For some women, having additional partners may be a way to insure their own higher consumption levels. Given the prevalence of violence and coercion toward women in many African contexts, having sexual contact or having unprotected sex may not be a choice at all for many women. We return to some of these issues later in the paper.

Consider first the effect of schooling and wealth on risk behaviors, which is one focus of our empirical analysis. One reason to expect differences in behavior by level of education and wealth or income is that access to HIV information as well as the ability to comprehend this information may differ along these dimensions (Glick and Sahn 2007; de Walque 2004). We would expect wealthier individuals to have greater exposure to HIV information through visits to formal health care providers or through ownership of media such as TV or radio that are used to transmit prevention messages. This could lead to greater risk reductions by the wealthy, both through the provision of AIDS prevention knowledge and through an upward revision of the perceived risk of contracting HIV from unprotected sex. Even with no differential in information, an increase in the expected risk of transmission via unprotected sex should affect behavior among the wealthy the most. As Oster (2006) notes, it raises the cost of such activity more for the wealthy than the poor, since an early death due to AIDS implies greater foregone lifetime consumption and utility for those with higher incomes. The fact that the wealthy can usually expect to live longer further increases the costs associated with risky sex for them relative to the poor.

Like wealth, education also is likely to increase exposure to HIV prevention information. The educated are probably more likely to seek modern health care, hence to hear about prevention. They will also get messages through print media that are not accessed by the uneducated. Moreover, having an education may enhance an individual's ability to understand information about health in general and HIV in particular (Glick and Sahn 2007).

While these factors imply a lower demand for risky sex among the educated and better off, differences in preferences and prices may have the opposite effect. If having additional sexual partners ("sexual adventure" in de Walque's (2004) terms) is a normal good, we would expect the direct effect of wealth on this behavior to be positive. This is often put in less formal terms when referring to male behavior: those with money can 'afford' more partners (and in polygamous societies, men can afford to have more wives). Further, while as just noted the costs of risky sex in terms of foregone future utility may be higher for the wealthy, other aspects of the cost of additional sexual partners may be lower for the wealthy as well as the well-educated. In particular, the nature and density of social networks among these groups may make it relatively easy to meet new partners; partly this would reflect the association of wealth and schooling with urban residence (where the supply of potential partners is also greater) and partly not (e.g., higher status or more mobile occupations may bring individuals into contact with more potential partners).

The foregoing ignores possible gender differences in behavior, which may condition the effects of wealth and education. Wealth under their control may give women greater bargaining power in relationships, as would higher education since this implies greater actual or potential earnings, hence a stronger fallback position. This would help women avoid unwanted sexual relations, or to demand that a condom be used. One might then see a negative effect *cet. par*. of a woman's schooling on the number of partners, and a positive effect on the use of condoms. The same could be said of household wealth directly in the control of the woman, though unfortunately this information is not available in the DHS.

In sum, the effects of schooling and wealth on levels of risk behavior cannot be signed *a priori,* though previous evidence from Africa indicates a positive association of wealth and the number of partners (Filmer 1998; Carael 1995), as well as a positive association of wealth and AIDS mortality (Wojcicki 2005). Nevertheless, knowledge of the risk behavior/education and risk/wealth gradients that we estimate in this paper is of significant interest. They provide an indication of among which groups the needs for changes in behavior (and possibly, improvements in HIV knowledge) are greatest and hence where policy should be targeted.

Changes in risk behavior over time

Of perhaps greatest interest in this study is the assessment of whether and how risk behaviors (age at first sex, number of partners, and use of condoms) are changing in Africa in response to HIV/AIDS. Since levels of income and education should at most change only slightly over the relatively short time intervals we are considering, changes in behavior across surveys are likely to reflect growth in awareness of HIV prevention and risk -- the latter affecting estimates of the indirect costs of risky sex as just described -- as well as changes in the direct costs of risky sex. Expanding public efforts to promote HIV awareness and behavior adjustment should, depending on their intensity and effectiveness, lead to safer behavior overall. Greater individual exposure to evidence of AIDS related illness and mortality as the epidemic progresses may have the same effect.[3] Unfortunately, it is difficult in a study such as ours to distinguish these effects.

In addition, the direct cost of risky sex can change over time via changes in the market for sexual partners: overall reductions in the supply of potential partners, and specifically in partners willing to engage in unprotected sex, will increase the cost to an individual of finding such partners and reduce the optimal number of partners or level of unprotected sexual activity. Another price change that has clearly been taking place across Africa is the reduction in the cost of (or in barriers to accessing) condoms. A number of countries starting in the mid 90s effectively made condom promotion the centerpiece of their anti-AIDS campaigns, and significant shifts in the use of and attitudes toward condoms have been documented (Hearst and Chen 2004; Cleland and Ali 2006). One aspect of reductions in the cost of condoms is that they effectively reduce the cost (in terms of lost future utility) of additional sexual partners, since the risk of contracting or giving HIV infection to a new partner is lower when condoms are used. Therefore condom provision in theory can increase the demand for sexual partners, with ambiguous impacts on overall HIV risk. Indeed, there is suggestive evidence of such 'risk compensation' from longitudinal data from Rakai province, Uganda, where condom use increased from 1994 to 2003 while some other measures of risk behavior appeared to worsen, i.e., increase (Wawer et al. 2005). By the same logic, efforts to get people to limit the number of partners or casual sex can reduce the demand for condoms.

[3] There may be confounding effects of greater awareness of HIV risk, however. People may become more likely to believe they have been infected, hence (unless they are altruistic and seek to avoid possibly infecting others) be less rather than more inclined to take precautions. Or, an upward revision in the perceived risk of HIV transmission per act would reduce expected future utility for any non-zero level of risk behavior, since it increases the risk of contracting HIV and dying prematurely. This would *cet. par.* reduce the cost of risky behavior.

Evolution of schooling and wealth gradients

The final focus of the empirical analysis will be on changes over time in the impacts of key determinants of behavior. The effects of schooling and wealth could change over time as a result of the targeting (intentional or not) of prevention campaigns. If HIV/AIDS information is disseminated primarily through media such as newspapers and television and through the formal health care system, it is more likely to reach the educated and better off, who have greater access to these sources of information. If schooling and wealth have negative impacts on risky behavior, this will make these impacts larger; if schooling and wealth tend to increase the level of risky behavior, this effect will be attenuated over time. Or, information may be targeted equally to the all groups in the population (strategies to reach the less educated might include, for example, outreach through community health workers). In this case wealth and schooling does not confer privileged access to information. However, if the educated are better able to process this information— meaning, if schooling and HIV related information are complementary inputs in the production of HIV knowledge—the positive effect of education on HIV risk knowledge again becomes stronger over time as the overall supply of this information increases. If schooling has negative impacts on risky behavior, this will make these impacts larger.

As noted, in addition to public policy, behavior may change as a result of exposure via family ties or social networks to evidence of the disease. This exposure may easily differ across the distributions of education and wealth. For example, at early stages of the epidemic, AIDS related mortality has tended to be concentrated among the relatively affluent and mobile. It might be expected in this case that behavior change would be more pronounced among these groups, increasing the gradient of risk behavior with respect to wealth. Although it is not possible to derive predictions of the direction (or existence) of changes in the effects of factors such as schooling or wealth on sexual risk behavior, knowledge about changes in the risk behavior/education and risk/wealth gradients can be used to guide or reorient prevention policies to insure that they reach all vulnerable segments of the population.

3. Data and Empirical Methods

3.1 Demographic and Health Survey Data

The Demographic and Health Surveys (DHS) are nationally representative surveys that have been carried out in more than 50 countries over the last two decades.[4] The DHS collects basic information on households and detailed information on women's reproductive histories, health, and the nutritional status of young children. In recent waves (DHS II and III) the surveys were expanded to include representative samples of men as well. Since the early 1990s, special modules have been added on sexual knowledge and behavior that include questions of relevance to understanding behaviors that affect the transmission of HIV/AIDS. An important further benefit of the DHS is that most aspects of the questionnaires are standardized both across countries and over time, though some differences exist. This allows us to use consistently

[4] The DHS is funded by USAID and implemented by Macro International, Inc. For details of the DHS, see Macro International, Inc. (2004)

defined outcomes and independent variables, facilitating comparisons across countries and over time.

We use 16 DHSs from eight countries for this study—two each from Benin, Burkina Faso, Ghana, Kenya, Mozambique, Nigeria, Uganda and Zambia. Our selection of countries was determined by our desire to have two recent survey rounds several years apart with HIV/AIDS questions presented in identical or very similar formats. This left eight countries, with the last surveys collected between 2001 and 2003 and four to six years separating earlier and later surveys. While these selection criteria precluded assembling a representative African country sample, our sample does feature basic regional representation as well as variation in HIV prevalence. We include the Southern African country of Zambia, with exceptionally high but falling prevalence (estimated to be 22% in 2001, the year of our last survey, and 16.5% in 2003). From East Africa, we include Uganda (estimated prevalence of 5% in 2001, the last survey year, down sharply from a decade before) and Kenya (7% in 2003). Several relatively low prevalence countries from West Africa are included: Benin (3.6% in 2001); Burkina Faso (4.2% in 2003) and Nigeria (5.4% in 2003).

Data quality for the DHS is considered to be generally high, and non-response, even for relatively sensitive questions, is typically not a major problem.[5] This does not mean these responses are accurate, or that other data issues are not significant. We discuss several of these in detail in Section 4.

3.2 Empirical approaches

As indicated, we focus on three behaviors: age at first intercourse, number of recent sexual partners (a series of outcomes encompassing abstinence and multiple partnerships), and use of condoms. We begin with an assessment of trends in these outcomes as well as a look at differences across country, gender, and rural-urban location. For considering trends, as noted above, comparability over time is an important issue, and we discuss this at length in the next section. Here, we briefly present the essentials of the multivariate analysis of the individual and household level determinants of these behaviors.

Age at first intercourse (AFI): A key objective of HIV prevention policy in many countries has been to persuade young adults to delay becoming sexually active. In looking at age at first intercourse, we focus therefore on young men and women age 15-19 in each survey, the group whose initiation into sexual activity would be most likely to have been influenced by recent policy or other social trends. To consider age at first intercourse among this group there is an obvious censoring problem, since many in this age range have not yet become sexually active: for these individuals we only know that age at first intercourse is at least as high as the current age. A standard approach to estimating age at first sex is to model the duration (years) to sexual debut using a hazard model. Hazard models are easily specified to handle the censoring problem. The commonly used proportional hazard form is:

$$h(t) = h_0(t)e^{\beta X} \qquad (1)$$

[5] Non-response does emerge as an issue in some of the recent DHSs that have included serotesting for HIV. See García -Calleja, Gouws, and Ghys (2006).

where the hazard rate h(t) is the probability of sexual activity at time (or age) t conditional on remaining a virgin until t and X is a vector of explanatory variables. $h_0(t)$ is the baseline hazard and can take a number of forms; we choose the Weibull in which it is specified parametrically to be a function of time: $h_0(t)= \lambda t^{\lambda-1}$. Allowing for this dependence is potentially important since we would expect the probability of having sex to be increasing in age for youth (i.e., $\lambda>1.0$). This was confirmed in the estimation for all subsamples of 15-19 years olds.

Sexually active status and number of partners: We use binary probit to estimate the probability of current (past 12 months) sexual activity and ordered probit to model the number of sexual partners in the last 12 months, distinguishing between none ('abstinence'), one, and more than one.

Use of condoms: Each of the surveys used for this analysis asks sexually active individuals if they used a condom during the last intercourse. It is important to distinguish the nature of the relationship with the individual with whom the condom was used. Prevention campaigns stress the need for people to use condoms with casual or non-steady partners to avoid HIV; among those in stable (and monogamous) partnerships, condoms are generally not deemed necessary unless one partner is HIV positive. Unfortunately, for only a few of our country samples does the DHS ask about the nature of the relationship with the person with whom the respondent last had intercourse, and in some of these cases the data appear to have consistency and non-response problems.

However, while we cannot generally distinguish individuals by the type of partner specifically for the most recent sexual intercourse, we can distinguish them by the nature of the partnerships they have. We distinguish the following: (1) in a stable union (married/cohabitating) and reporting having just one partner, i.e., monogamous; (2) in a stable union and having more than one partner (i.e., the spouse plus other partner(s)); and (3) not in a stable union, i.e., single. By definition, all partnerships in the third category are 'casual'. For this group of single people condom use would always be recommended. We would expect (and hope) that condom use in last sex is also non-trivial for those in category (2), since in some share of these cases the last intercourse will have been with a non-steady partner (and even if last intercourse was with the spouse, there is a greater need for protection given the presence of outside partnerships).[6]

For women, these divisions actually may come very close to capturing the relationship with the last sexual partner. This is because, at least to the extent that the data are reliable, very few married women report having other partners; therefore for married women, last intercourse would be with the spouse or cohabitating partner. A significant share of married men, on the other hand, report having had more than one partner in the last year. For this group of married men who report using a condom in their last encounter, we are not able to say if this was with the main partner or someone else.

[6] In the African context concurrent steady or long-term partnerships are common (Morris and Kretzschmar 1997). Therefore individuals who are married but report having two partners may be in two stable relationships. However, this does not reduce the advisability of using condoms in these non-monogamous situations.

The set of independent variables used when modeling number of partners and condom use is generally the same. Years of education and age are each entered in quadratic form in the model. With respect to a measure of household resources we employ an asset index created using factor analysis. This has been found to be a good proxy for household expenditures, which are lacking in the DHS (see Sahn and Stifel 2003 for details of the method). For the number of partners outcome, we include a dummy variable to capture whether the respondent is in a stable relationship with a spouse or cohabitating partner.

For the age at first intercourse hazard models, inclusion of education and household wealth are somewhat problematic. Causality can run from age at sexual initiation to schooling attainment rather than the reverse, if unintended pregnancy forces a girl to permanently leave school. Or, age at marriage (which is related age at first sex) may be jointly determined with completed schooling, if parents plan to marry off daughters at a certain age, hence after a certain duration of schooling. We minimize this problem by including a dummy variable indicating whether the individual has attained at least 3 years of schooling. Almost all children would have gotten this far by a realistic age of first sex, so reverse causality from AFI to this measure of education is ruled out. However, we are not able to control for unobservables that might affect both early sexual activity and this or any other measure of schooling.

Ambiguities also potentially arise in the case of wealth. The family income or wealth effect we should be estimating refers to the resources of the household in which the youth was or is being raised. The assets recorded in the survey, however, pertain to the households in which they currently reside. Some individuals (especially females) under 20 who are already married will no longer be living in the households in which they were raised: they may form their own household or move in with their spouse's family. If the new household is poorer, as it would be for most new families starting out, this will impart a spurious negative association of wealth and the probability of early sexual debut. However, few individuals under under 20, even married, have started their own households, as indicated by household headship status (for women 15-20, usually well below 5%; for men 15-20, usually under 10% except for Nigeria). Probably more of a concern is mismeasurement of wealth due to young married individuals—especially females—moving in with the families of their spouses. It is reasonable to suppose that assortative mating leads to a similarity in expectation of asset levels for original and receiving households. In this case the problem is mainly one of random measurement error, hence a downward bias in the estimates of the wealth effect. The estimated effects both of education as specified here and of wealth on AFI therefore require caution in interpretation.

4. Survey Comparability Over Time: Tests and Corrections[7]

When using repeated cross section survey rounds to measure changes in behaviors over time, researchers face three potential problems: (1) changes in samples; (2) changes in the questions posed; and (3) changes in how people respond to these questions, or, changes in reporting errors. Any of these can lead to misleading inferences about trends in behavior. With regard to (2), the designers of the DHS have generally been quite careful to keep formats consistent across years, though in various countries there have been some changes in HIV/AIDS

[7] We thank an anonymous referee for helpful comments on these issues.

related questions. For our analysis we chose to consider only countries for which successive surveys asked the questions in essentially identical ways (with a few exceptions as noted below). Therefore the second problem is minimized here.

The first problem occurs when the samples drawn in two surveys differ in ways that are related to behaviors. For example, means levels of education and wealth may differ beyond what would be due to simple sampling errors or to the evolution of these characteristics over a short period. This is not supposed to occur in nationally representative samples—it obviously means that one or both samples are not representative—but can happen if, for example, the sampling frame for the survey changes, say because the national census has been updated and used for the later survey. It is straightforward to determine from the data if sample composition has changed, by comparing the sample means of individual or household characteristics in the two data sets. Most useful here are characteristics that should not be changing at all over time, such as the mean years of education of a cohort of adults (individuals born in the same year or say, 5-year period) that is beyond school age. Mean heights, ethnicity, and religion of individuals in the cohort would other good measures. If the sampled populations are the same in two surveys, these means should be statistically equivalent.[8]

Where changes in sampling are apparent, one can control for them by stratifying the data on key characteristics such as education and location and examining changes in behavior within these strata, as in Zaba et al. (2004). A more flexible approach, which we take here, is to estimate a regression (or probit, or hazard model as appropriate) for the behavior including as regressors indicators for survey round and controls for a broader range of characteristics, i.e.,

$$Y_i = \alpha_1 Survey_i + \alpha_2 X_i + e_i \qquad (2)$$

where Y_i is the behavior reported by individual *i*, $Survey_i$ indicates the round of the survey and X_i is a vector of individual, household, and regional controls. Provided that this is the only data problem and that the included covariates are adequate to account for the relevant differences in the samples, the coefficient on survey year captures the change in behavior between surveys controlling for between-sample differences in other factors that affect behavior.

It should be pointed out that not all of the between-survey differences in the control variables included in *X* need be spurious, even for surveys spaced only several years apart. For example, average household wealth may have increased in the interval, and this could have led to actual changes in behavior in the population. With these factors held constant, the regression estimate of the survey effect (the 'trend') does not capture this source of change. Nevertheless, the estimated effect is still informative, as it shows how behavior has changed over time for individuals with a given set of characteristics, thus capturing policy effects or the effects of the epidemic on behavior controlling for the effects, say, of economic growth.[9]

[8] Less useful for this purpose are characteristics such as wealth, which we indeed expect to change for a cohort over time, and age at first marriage and first intercourse, which in reality is fixed over time, but because of possible changes in reporting bias may be reported with (differential) bias over time.

[9] The alternative is to leave out as controls all factors that could legitimately change over time. However, with respect to characteristics as basic as wealth, this would mean we run the risk of controlling for too

The other problem we are concerned with, changes in reporting error, is more problematic: how can one determine if changes in self-reported activity represent true changes or merely a shift in how people answer questions about HIV-related behavior? One approach (Gersovitz 2005; Zaba et al. 2004) is to examine responses to one standard question about HIV risk-related behavior that should always be the same in expectation across surveys for people in a given birth cohort: the age at which they first had sex, or alternately, if they had sex before marriage. That is, the mean age at first sex as reported by individuals age (say) 25-34 in a given year should be the same statistically as that reported by individuals age 30-39 in a survey conducted five years later. Inconsistencies in within-cohort responses signal a problem in the data; in particular, if mean age at first sex for the same cohort is higher in later surveys, this may be a sign that 'social desirability bias' is increasing—people are becoming less willing to admit to engaging in high risk behaviors, even those occurring in the past.[10] If this is affecting responses to age at first sex questions, it may bias responses about other risk behaviors as well, in the same direction.

Note that changes in sample composition could also lead to differences in within-cohort responses between surveys, so where there is evidence of this, the within-cohort comparisons should stratify on key characteristics or use a regression framework with controls for these and other factors. The model would take the general form:

$$AFI_i = \alpha_1 Survey_i + \alpha_2 Cohort_i + \alpha_3 X_i + v_i \qquad (2)$$

where AFI_i is reported age at first intercourse and $Cohort_i$ is a vector of indicator variables for 5-year birth cohort. With controls for survey sample characteristics X_i, an estimate of α_1 statistically different from zero signals a change in reporting error; a positive sign suggests that social desirability bias may be increasing.[11] We conduct these checks on cohorts that were 25 or older in the first survey. This is to avoid conflation of general changes in reporting bias, which we are trying to detect, with a specific age bias effect among youth. Including young people would mean that in the first survey we are using self-reports from youth about more or less current high-risk behavior; for this reason the tendency to underreport (or possibly even, over

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little, i.e., our survey year effect could pick up behavior changes through survey differences in wealth that are in fact spurious, i.e., due to sampling. The advantage of the more inclusive approach is that it lends itself to a less ambiguous and still useful interpretation.

[10] Other interpretations, such as age bias and differential mortality of high and low risk individuals, may also explain observed differences, but as discussed below these seem less likely.

[11] For these cohort consistency regressions we include in X_i only those factors that should be strictly fixed over time for adults in the sample such as education, religion, and ethnicity. It is necessary, in particular, to leave out wealth. Even in stagnant economies, wealth is expected to change over time for a given cohort as they progress through the life cycle. To control for wealth therefore in essence means we would not be comparing responses of the same (type of) individuals within the cohort over time.

report) in this survey is likely to be different than in a second survey some five years later, after these individuals have entered adulthood.[12]

It should be pointed out that evidence of changing social desirability bias in responses to age at first sex questions—which as discussed below we find in the DHS data—does not necessarily mean that individuals are also becoming more prone to underreport current levels of risk related behavior such as the number of sexual partners. It may be, for example, that people are adjusting their behavior in response to HIV risk and public education campaigns and feel the need to adjust responses about past risky behavior to be more in line with their current behavior and social norms. Still, a tendency within cohorts to adjust upward age at first intercourse responses should at the least raise concerns about possible biases in other responses.

Unlike in the case of changes in sample composition, there is no simple or reliable correction to be applied where within-cohort discrepancies are found. One could decide to use consider only countries or sub-national samples (e.g., rural women) for which no within-cohort discrepancies are found. For a multi-country analysis that attempts to say something about overall trends in the region, however, this may lead to serious selectivity bias, because actual changes in behavior are plausibly correlated with changes in reporting bias. Countries or subsamples where social desirability bias is increasing the most—where people are becoming more reluctant to reveal high risk behavior—may be those with greater AIDS awareness and more aggressive public HIV campaigns, which would also tend to lead to lower actual levels of risk behavior. Therefore, we report all country/gender/location results, while taking care to caution where these tests suggest that the data may be a concern.

Finally, we should note that while our main concern with misreporting has been with changes in bias over time, there are more general issues of misreporting that have been widely discussed in the literature (Curtis and Sutherland 2004; Gersovitz et al. 1998). For example, it has long been hypothesized that women tend to underreport the number of sexual partners, perhaps out of fear of disclosing behavior for which they could be stigmatized. Indeed, men's and women's responses to this question in representative surveys have been found to be incompatible (Gersovitz et al. 1998), and de Walque (2006) uses several African DHS with serodata to infer that married women with more than one partner are less likely than men to disclose this behavior. With respect to understanding the impacts of covariates on levels of behavior, bias could occur if the degree of misreporting was associated with the levels of the regressors, e.g., if the educated were more aware of methods of AIDS prevention and as a result were more inclined to understate levels of risk behavior.

Evidence on intertemporal comparability of the DHS

Following the discussion above, Appendix Table 1 presents cross-survey mean comparisons of several 'fixed' population characteristics. We focus here on the cohort age 25-35

[12] Asking teenagers about loss of virginity is particularly problematic; as Zaba et al. (2004) note, many, especially boys, might be inclined to falsely report that they have already had sex. Once they have reached an age where essentially everyone is sexually experienced, they might be more inclined to answer truthfully about sexual debut. For older cohorts as in our analysis, these age-related issues are presumably much less important.

in the first survey year (hence age 30-40 in the second survey, give or take a year); results were similar using older cohorts, e.g., 30-40 and 35-45. With respect to schooling variables, almost all individuals would have completed their education by age 25, so grade attainment is essentially fixed for this cohort even in the first survey. However, to confirm the findings we also consider an indicator of having completed primary school.

Based on these comparisons, we would conclude that sample differences may be an issue in some cases. Both primary completion and years of schooling differ within cohorts over time for rural areas of Burkina Faso, Ghana, and Nigeria. Significant disparities in education are often seen for one sex and not the other, though in these cases the point estimates change in the same direction for men and women. Mean heights of women for the cohort also differ across surveys for rural Kenya as well as urban Ghana, though caution is necessary here because heights are missing for a non-trivial share of women, and this share is larger in the second year. The table also indicates sporadic differences in composition of the samples along ethnic and religious lines.

The table also compares means for this cohort for age at first intercourse and having had intercourse by age 18.[13] There are statistically significant differences across survey years in these indicators for numerous subsamples—in fact for a majority of cases for rural men and women, though only for slightly less than half of cases for urban samples. Other than for Nigeria, in all cases of differences the directions are consistent with increasing social desirability bias over time, since they indicate an increase in reported age at first intercourse. However, these simple mean comparisons do not adjust for changes in sample, which as just seen seem to have occurred in some cases. Therefore, along the lines of model (2) above, we estimated two regressions: probits for reporting age at first before age 18, and OLS regressions for age at first sex, both estimated on the same 25-35 (in year 1) cohort and including controls for fixed cohort characteristics such as education, religion, and ethnic grouping. We repeated the estimations for the older cohort that was 30-39 in the first survey year.[14] The implications are quite similar for either outcome and for either cohort, so in Table 1 we present only the probit results for the 25-35 group.

The multivariate results essentially confirm the conclusions from the simple means comparisons: there is an apparent tendency for individuals born in a given period to report a later age at sexual debut when interviewed in more recent surveys. The results confirm similar analyses by Zaba et al. (2004) and Gersovitz (2005) on DHS surveys from Africa that partially overlap with our own samples. Zaba et. al. find a number of cases of inconsistent within-cohort responses, but because they examine a young cohort (age 15-24) and also do not at the same time control for possible sample differences, the differences likely conflate changes in social

[13] The binary indicator for sex by age 18 insures that the comparisons will not be affected by the possibility of some individuals in the 25-35 age group not having had sex by the time of the first survey, but in fact the share reporting not having had sex is in almost all cases miniscule.

[14] Note there is an upper age limit for the cohort consistency analysis because the age range for the male and female samples in the DHS is 15-49. Had we chosen the cohort age, say, 35-44 in year 1, the oldest part of the cohort would disappear from the second survey because they would in some cases be as old as 50 in year 2.

desirability bias, changes in sampling, and age effects, i.e., changes in reporting bias as young people enter adulthood. In his four-country sample, Gersovitz (2005) while not attempting to control for sample changes, finds for men a pattern of within-cohort inconsistencies similar to what we report here: a tendency for (adult) individuals to report higher AFI in later surveys.[15]

These results obviously raise difficulties in interpreting trends derived from self-reported behaviors in successive DHSs. Apparent biases observed for reported age of first intercourse may well occur in other self-reported behaviors discussed in this paper, though as discussed above, this cannot be inferred for certain (nor can it be directly checked). However, where within-cohort inconsistencies in reported AFI suggest that social desirability bias has been increasing, it is probably reasonable to say that reported changes in other HIV related behaviors represent an upper bound on the true changes.

5. Trends and Patterns in Behavior

Age at first intercourse

Table 2 presents evidence of changes in sexual activity of 15 to 19 year olds from earlier to later survey in each sample. The figures on the right hand side for each sex are calculated from hazard model results and indicate the probability of having sex before age 18. Note that this differs from the simple share of 15-19 year olds reporting having had sex (or having had sex before age 18) in two ways. First, as discussed in Section 3, they are based on regression results that condition on key sample characteristics to eliminate possible effects of sample differences across surveys. Second, the hazard estimates control for censoring of individuals who have not had sex, so they provide a more accurate depiction of sexual activity among this age group than the simple shares reporting having had sex.[16] Table 2 also shows the probability of intercourse before age 15 for the same samples of 15-19 year olds. For this earlier cutoff age there is no censoring issue so we are able to use simple probits for sex before 15, again with controls for sample composition.

There are not many statistically significant changes in either of these indicators between surveys. There appear to have been reductions in early sexual activity in Uganda and Zambia for both girls and boys, cutting across rural and urban divisions, and for girls and boys in rural

[15] Rather than change in social desirability bias, higher AIDS-related mortality among high risk individuals could lead to a spurious upward trend in AFI, since earlier AFI (hence higher risk) individuals within the cohort are more likely to die between survey periods. However, Gersovitz (2005) shows that this is unlikely to affect the estimates in his samples, and his argument is applicable to the present surveys as well. Internal (e.g., rural to urban) migration over time within a cohort also may be selective on AFI or other risk behaviors. Repeating the analysis at the national level, which should by and large take care of this problem given national representivity, did not change the thrust of the findings.

[16] The simple descriptive share of 15-19 year olds reporting sex by age 17 would clearly underestimate the true share, since many in this group have not reached age 17. One could avoid or reduce the censoring problem by examining recalls of early sexual behavior of an older group, but that would take the focus away from current or very recent behavior among young people.

Burkina Faso. For girls in Uganda the probabilities are as much as 10% lower in 2000 than 1995. These reductions suggest a continuation of a prior trend seen in the Uganda DHS for 1989-1995 (see Stoneburner and Low-beer 2004).

On the other hand, in Mozambique in rural areas age at first sex seems to have fallen, and several other subsamples show similar increases in early sexual debut. Further, for most subsamples where there are reductions in self-reported early sexual activity there was also statistically significant evidence of a change in response to AFI questions among adult cohorts (see Table 1). The possibility of increasing social desirability bias among older cohorts raises concern as to whether changes reported by young people in the same areas are accurate.[17] This issue aside, it is notable that for the first intercourse by age 15 indicator the overall evidence of reductions is somewhat stronger than for intercourse by 18. One might conclude that to the extent they are occurring, reductions in early sexual activity are largest among younger adolescents.

The table also indicates that age of sexual debut varies widely across countries, reflecting cultural differences (and possibly, recent policy). For example, the likelihood of AFI under 15 is high in the Southern African countries of Mozambique and Zambia—ranging from 19% to over 30%—while it is mostly below 10% in the West African countries of Ghana, Burkina Faso and Nigeria. For girls, there is a consistent pattern of later sexual debut in urban relative to rural areas. Since for many girls, sexual initiation begins at marriage, part of the rural-urban difference may reflect longer average time in school in urban areas, which is associated with later marriage. Especially in rural areas, AFI for girls is typically lower than for boys, often substantially so. In many African societies, relationships of young women with more established older men are common, and this may provide opportunities for earlier sexual activity for girls.

Abstinence

Next we consider trends in the probabilities of adult women and men (age 15-49) being sexually active, defined as reporting having had sexual intercourse within the last year. This indicator, of course, is simply the inverse of the abstinence outcome. In the majority of cases in Table 3 where a significant change is observed, the change is negative. For women, statistically significant reductions are observed in rural or urban areas of five of eight countries; reductions are seen for men in three countries. Increases are seen in two countries for women and one for men.

The changes that are observed are not usually very large: Kenya stands out as having substantial reductions (from 1998 to 2003) of between 5 and 10 percent in the probability of being sexually active, by and large cutting across both gender and rural and urban divisions. Against the overall trend in reductions for women stands in particular Nigeria, where the

[17] In several cases, such as for young women in rural Uganda and rural Zambia, the potential bias in percentage point terms seen in Table 1 is smaller than the percentage point reduction in the probability of sex before 18 among young people, which might be taken to show a net reduction. In other cases the opposite is found. Admittedly, the validity of such direct comparisons of information for an older cohort and from adolescents is tenuous.

probability a woman reports being sexually active rose in rural and urban areas by 5 and 6 percentage points, respectively in four years (1999 to 2003). Also notable, especially in light of evidence of earlier reductions in risk behaviors (Stoneburner and Low-beer 2004), is the increase for urban women in Uganda, for whom the probability of reporting recent sexual activity rose 4.5% between 1995 and 2000. It should be recalled that these probabilities control for changes in basic characteristics of samples. As with the AFI estimates above, however, they do not control for changes in response bias, and in most of the cases where reductions in this indicator of sexual activity are observed we also saw within cohort changes (that is to say, increases) in reported age at first sex.

There are some differences between men and women in the (level) probabilities of being sexually active, but the differences are not large. This indicator, however, is a blunt measure of HIV-relevant sexual behavior: most adults, after all, are in partnerships and hence will be sexually active. The greater variation instead is in number of partners among sexually active adults.

Number of current partners

Table 4 shows the probabilities of having had more than one partner in the last 12 months for women and men. For men, as discussed in Section 3.2, we further distinguish those with just two partners and those with three or more partners. The differences between men and women in the probabilities of reporting more than one partner are striking. For example, in urban Zambia in 2000 the men's probability is 28 percent while for women it is less than 3 percent. These gaps are typical: the figure is almost always below 5 percent for women and usually at least 15 percent, and often far higher, for men. As discussed above, a tendency by women to underreport the number of partners would mean the gap is smaller than it appears.

Data issues, including our desire to include only surveys using the same (12 month) reference period, limit our sample with comparable data over time to Benin, Burkina Faso, Kenya, and Zambia.[18] Even for the included countries, a slight change in question format must be noted. Each of the earlier surveys for these countries asked (married) respondents whether they had had intercourse with their spouses in the previous year, and then if they had had intercourse with anyone else, and how many others. The later surveys begin by asking simply how many individuals the respondent had sex with in the past year. Strictly speaking these questions each should elicit the total number of partners, but it may be possible that individuals react differently to them; if so, our expectation is that the later method is more likely to elicit truthful responses about non-spousal partners, implying a downward bias in the estimated magnitude of any actual reduction over time in multiple partnerships.

For three of these four countries—Benin, Kenya, and Zambia—there are strongly significant reductions in the probability of multiple partnerships that are generally seen for both men and women and in urban and rural areas. The Zambia results are consistent with data from a separate population based survey showing declines in risk behaviors in the late 1990s (Fylkesnes et al. 2001). For the fourth country, Burkina Faso, we observe reductions in reported

[18] For Ghana, Mozambique, Nigeria, and Ghana, we only show results from the second survey in Table 4.

multiple partners among rural women but, somewhat implausibly, increases among men at the same time.

Additional regressions results (not shown) considered changes in the number of partners separately for those in stable unions and those who are single. For men, reductions tended to occur for both single men and those in unions. In contrast, where changes for women overall occurred they mostly reflect reductions in multiple partnerships for single women. This is not surprising since for married women the shares reporting multiple partners was so low to begin with—roughly one percent on average.

By and large, therefore, the limited sample of countries at our disposal suggests a general if not universal tendency toward reductions in the likelihood both of being sexual active and of having additional partners if active. It also noteworthy that for the highest risk behavior--having more than two partners (last two columns)—the evidence of reductions among men is more consistent, with no cases of statistically significant increases in this indicator. Further, for most cases where partner reduction took place, the reductions were quite large in proportional terms. Whether these reported changes (assuming they represent true changes in behavior) are large enough to impact the spread of the epidemic is another question, which we consider this question briefly in the concluding section.

Condom use

Tables 5 and 6 presents the probabilities for women and men of reporting condom use in last intercourse, based on probits controlling for respondent characteristics and distinguishing by partnership status. As noted in section 3.2, because the share of married women reporting having more than one partner is very small, it is not possible to analyze this group separately. Thus we show only women in a stable union and having one sexual partner and women not in a union (the totals columns, however, do include all women in the rural or urban samples). For men we are able to distinguish those in a stable union and having one partner, in a union and having multiple partners, and not in a union.

Considering some basic patterns in the data first, as might be expected, individuals in urban areas are more likely to use condoms than those in rural areas, by a wide margin. Also as expected, condom use at last sex is much more likely among single men and women than among their married counterparts. A third clear pattern is that reported condom use is greater for men than women, whether we look at overall rural or urban samples for a country or compare subsamples based on partnership status. In many cases the share for men is more than double that for women. This could reflect underreporting by women, or the fact that men have more partners, some of whom are commercial sex workers or other women not likely to be captured in the DHS; in other words, symmetry of male and female responses regarding condoms is not necessarily expected. Still, one would have expected closer shares for men and women in stable unions who report being monogamous. It is possible that some of these men underreport the number of partners, and the use of condoms at last sex may have been with a partner other than their spouse.

Among men in unions, those reporting having more than one sexual partner report greater condom use than those saying they have just one partner (compare columns 1 and 3 and 2 and 4 of Table 6), though this is still usually well below the reports of single men. Of course, in many cases married or cohabitating men with outside partners may use condoms with these partners but not with their spouses, reducing the likelihood of reporting condom use at last sex even though condoms are being used effectively to prevent infection in high-risk encounters. Since the questionnaires generally do not identify the last partner, this cannot be determined from the data.

With respect to changes over time, Tables 5 and 6 present a picture of widespread increases in condom use for both women and men. Probabilities of use at last sex rose for both sexes in at least one subpopulation in each country with the exception of Nigeria where no changes are seen. Increases in condom use were more consistent and larger for single men and women than for those in unions, though the latter also points to an upward trend. The largest changes in proportional terms were in Mozambique, where for single men and women the probabilities more than doubled in both urban and rural areas between 1997 and 2003 (through from a very low base). Even the smaller increases in other countries represent large changes in behavior over a four to six year period. Kenya presents something of a mixed picture, since while reported condom use rose for single women in both rural and urban areas, it generally fell among men and women in stable unions.

Overall, the trends in Tables 5 and 6 suggest that condom promotion efforts throughout much of Africa, which began in many countries in the mid-1990s, have had significant positive impacts on use (See Hearst and Chen 2004; Myer et al. 2001). More than the other kinds of behavior change examined in this paper, this can be clearly linked to policy, since it reflects not just changes in attitudes and risk perceptions (which affect the demand for condoms) but also increased provision (supply); before governments and donors stepped in, access to condoms in Africa was often very limited. Some of the more striking findings seem to be explicable in terms of the condom policies in specific contexts. The very large increase in Mozambique from 1997 to 2003 corresponds to the timing of an effective social marketing campaign of subsidized branded condoms *(*Agha, Karlyn and Meekers 2001), which began on large scale in 1995. Increases in Burkina Faso were less dramatic in proportional terms but the overall levels of use, especially in urban areas, are extraordinarily high for Africa: even in the first survey (1999), over 80% of single urban men reported using a condom in their last sexual encounter. These figures are all the more noteworthy because Burkina Faso is not a very high prevalence country. However, Burkina Faso stands out for an early commitment to condom education and distribution through its PROMACO program, which began in 1991 (Yoda e. al. 1992) and the effects of which undoubtedly are reflected in the DHS data for both years.

In rural Burkina Faso, while condom use among men has increased, so has the likelihood of having more than one sexual partner, as was seen in Table 4. In Uganda increases in condom use among urban women seem to have occurred alongside a rising overall share of women who are sexually active, at least in rural areas (see Table 3). Unfortunately, we are not able to consider changes in the number of partners in Uganda because of a change in reference period from 6 months in the 1995 DHS to 12 months in 2000. Still, the patterns we do observe are noteworthy and consistent with other evidence. Condoms began to be promoted more heavily in

Uganda in the early to mid 1990s using social marketing campaigns. Analysis of longitudinal data from Rakai province for the period 1994-2003 suggests that a portion of the fall in HIV prevalence during the period was due to behavior change (most was due to rising AIDS mortality; see Wawer et. al. 2005). Unlike in previous years, however, behavior adjustment took the form of increases in condom use; some other self-reported risk behaviors actually increased over the period. The 1995-2001 DHS data we show here on the probability of being sexually active thus are qualitatively in accord with this pattern.

The patterns of change in Burkina Faso and Uganda raise the possibility of a disinhibition or 'risk compensation' effect of condom use: individuals adopted one form of protective behavior and compensated by being less careful in other dimensions, possibly leading to an increase in net HIV risk. This has been suggested as well by experimental evidence from Uganda (Kajubi et al. 2005). It illustrates the need, noted above, to consider different dimensions of behavior when evaluating whether overall risk behavior is changing and assessing the effectiveness of prevention policy. At the same time, it should be pointed out that in other cases (Benin and Zambia), there is no evidence of risk compensation, as partner reduction occurred in step with greater condom use. In Kenya, partner reduction took place alongside increasing condom use among single women and apparent *reductions* in condom use among married or cohabitating men and women. If the extent of multiple partnerships was indeed falling among married individuals, however, the latter result could reflect a reduced need for condoms.

6. Determinants of HIV Risk Behaviors

Estimates of the determinants of behavioral outcomes are conducted on the same subsamples featured in the analysis of changes. With regard to presentation, given the number of estimations it would be very cumbersome to show all our regression results. Instead we focus on the results for schooling and wealth, calculating marginal effects (the change in the probability of a outcome from a unit change in the independent variable) and t-statistics for these covariates. We also report statistical tests of whether these marginal effects have changed from one survey year to the next.

Determinants of the number of sexual partners

Table 7 shows for women and men results from ordered probit models for the number of sexual partners in the last 12 months. We present marginal effects for the probability of having zero partners and having multiple (two or more) partners. Given the structure of the ordered probit model, these effects will always be inversely related: any variable that has a positive effect on the number of partners will increase the probability of having two partners (relative to one or none) and reduce the probability of having no partners (relative to one or more than one). However, the effects are not mirror images, that is, the absolute values of the magnitudes can differ, because these depend as well on the threshold parameters estimated by the ordered probit.

For women (first two columns), education does not have consistently significant impacts on the number of partners, and those effects that are found are not overwhelmingly in one direction or the other. Effects of household wealth are shown in the next two columns. Since the asset index does not have an interpretable scale, rather than the marginal effects themselves we show the difference in the outcome when the index equals the median for the top wealth quartile and when it equals the median for the bottom quartile (as before, all other covariates are set at the means of the relevant sample). Household wealth has significant impacts in a number of urban female samples, where it is consistently associated with a reduced probability of having more than one partner (and a higher probability of being abstinent).

For men, in contrast, greater wealth is more likely to increase the number of partners (last two columns). The same is true for education. As noted in Section 2, education and wealth conceptually have ambiguous effects on the number of partners: they may increase access to or understanding of HIV knowledge as well as implicit costs of risky sex, reducing the willingness to engage in high risk behavior, but they may also have positive impacts on the demand for, and possibly also the supply of, sexual partners (or in some cases, wives). For men, we would surmise that the latter effects often outweigh the former. That we are more likely instead to see negative wealth effects for women may indicate that greater wealth does not confer upon women easier access (or desire for) additional sexual partners in the way it does for men. Perhaps for women, therefore, the negative HIV knowledge effects of wealth on the demand for partners dominate.[19] The table also shows that there are relatively few changes over time in the effects of assets or education. Interestingly, those that are found occur almost exclusively in the effects of assets on the number of partners for women, but with no obvious pattern in terms of direction.

Determinants of condom use

Marginal effects from probit models of condom use at last sex for women and men are shown in Table 8. As expected based on the discussion in Section 2, education has consistently positive impacts on the probability of condom use for both women and men. Note that in addition to operating through greater access to or understanding of condoms, schooling may also increase the demand for condoms if it also increases the number of partners, especially casual partners.[20] Indeed, in either rural or urban areas (or both) in Benin, Burkina Faso, Ghana, Mozambique, and Nigeria, schooling is associated both with a higher probability of condom use and a greater number of sexual partners.

The magnitudes of the schooling effects are generally small, especially for women. The largest impacts for women are in urban Mozambique and Uganda, where an additional year of school increases the probability of condom use by 1.6 percentage points. Part of the explanation

[19] As discussed in Section 2, alternative explanations are that wealthier women can more easily refuse unwanted sexual relations, or that they have less need of the consumption or income benefits of having more partners.

[20] The probit model includes an indicator of whether the individual is married or cohabitating, but not the number of partners, which clearly would be endogenous to condom demand.

for these small effects is that mean sample probabilities of condom use, by which the probit marginal effects are scaled, are themselves very low.

There are somewhat fewer significant effects of wealth on the use of condoms (cols. 3 and 4), but consistent with the discussion in Section 2, these are uniformly positive. Further, these impacts are generally becoming larger over time, with potentially important implications for policy. This trend may indicate that condom messages have been more successful at reaching the well-off, or perhaps that improvement in access to condoms has grown disproportionately for the well-off. On the other hand, it is possible that with improved overall access, condom use has risen most among the wealthy simply because they are more likely to have multiple partners, hence to need condoms.

As expected based on the analysis in the preceding section, being married or cohabitating is negatively associated with condom use. This effect is generally becoming more negative over time, which is consistent with our earlier results showing that increases in condom use have been largest among those not in unions.

Determinants of age at first intercourse

We noted in Section 3.2 that the interpretation of education and wealth effects in age at first sex models are somewhat problematic given the possibility that observed values of these covariates are jointly determined with the outcome. Still, these hazard model estimates are of some interest and merit a brief discussion (results available from the authors). For most country subsamples of girls age 15-19, delay in sexual initiation is associated both with having had some education (as discussed in Section 3.2 we use a dummy for having had 3 or more years of schooling) and with household wealth. For boys, in contrast, no more than a few significant impacts of either education or wealth are found. The education effects for girls likely reflect in part the association of having some primary schooling and the ultimate duration of schooling, which in turn may delay age at marriage and sexual debut.[21] This delaying effect of schooling on marriage probably operates more strongly for girls than boys given that in many African contexts males are more likely in any case to be beyond school age when they marry. Or, girls may be simply be more likely than boys to wait until marriage before becoming sexually active, again implying larger negative impacts of schooling for girls. Similarly for wealth: the larger negative effects on age at first sex for girls would occur if greater household wealth tends to delay marriage more for girls, or if the delay in marriage is the same but girls tend more than boys to delay sex until marriage.

This is of potential significance for policy. If lower wealth and lower (or no) schooling lead to earlier sexual activity among girls, prevention programs need to focus especially strongly on girls in poor households and on those not attending school (itself a function of poverty). The most common programs of HIV education for youth in Africa are school-based, hence are poorly

[21] As noted earlier, the use of the three years of schooling indicator, as opposed to completed schooling, avoids biases due to reverse causality from early sexual debut to schooling duration (via unexpected pregnancy for example). But it does not avoid possible biases due to preferences or other unobservables that affect both whether a child is schooled at least three years and the age at first intercourse or marriage.

targeted to this vulnerable group. Unfortunately, the ambiguities in the DHS data noted earlier preclude drawing firm conclusions from the estimates.

7. Conclusions

Assessing the evidence for behavior change

To put the findings in perspective, we note that there are three basic questions that must be addressed: are there trends toward reductions in self-reported risk behaviors; if so, do these trends represent true changes in behavior; and finally, are they significant enough in an epidemiological sense—that is to say, large enough—to have meaningful impacts on HIV/AIDS incidence and prevalence?

To address the first question comprehensively, Tables 9 and 10 present the findings from Section 5 in summary form for women and men, showing the direction of change (when statistically significant) for each indicator. To clarify the presentation, we have redefined several of the indicators so that the desired change from a prevention standpoint is always an increase, e.g., the probability a sexually active individual has more than one partner is replaced with the probability of having only one partner. The picture overall is one of generally favorable movement over the relatively brief periods between surveys, at least with regard to direction. These qualitatively favorable changes occur in most behaviors, with the exception of early sexual behavior (delayed intercourse in the tables) where the findings are mixed. The most consistent improvement has been in the use of condoms among men and women who are not in stable partnerships. Because comparable data were available for only five countries on changes in the number of sexual partners, it is harder to draw broad conclusions, but in three of these countries there were large reductions in this indicator, cutting across gender and rural-urban divisions.

Still, it should be stressed that the picture is not one of across the board reduction in HIV risk behaviors. It is obvious from Tables 9 and 10 that cases of indicators showing no movement (represented by zeros) are as common as those moving in the direction of reduced risk. In some cases changes have apparently been in the direction of increasing risk. The country with the most consistently favorable changes in behavior is very high-prevalence Zambia: for women in Zambia, the indicators improved across the board. In Nigeria, on the other hand, where the epidemic has yet to come into full force and where HIV knowledge appears particularly weak (see Glick and Sahn 2007), almost no behavior indicators have moved in a favorable direction while the likelihood of being sexually active seems to have risen for both young women and older adult women. Although this simple comparison might suggest that behavior change is greatest where AIDS has inflicted the heaviest damage, is it notable that improvements have occurred in countries where HIV prevalence is relatively low, such as Benin and Ghana (and Burkina Faso for condom use, noted above). This suggests the importance of public policy and perhaps cultural attitudes as influences on the pace of change in behavior, in addition simply to the extent of HIV risk.[22]

[22] In a careful analysis using IV methods to control for the endogeneity of HIV prevalence, Oster (2006) finds little or no effect of HIV risk as measured by prevalence on risk behaviors in a multi-country

The second question—the accuracy of these changes inferred from self-reports of sexual behavior—is hard to judge. The results presented above control for possible changes in sample composition, and it is likely that these controls are adequate. On the other hand, in many of our country/region/sex subsamples, there is evidence that over time adult men and women have been changing their responses to questions about the age of sexual debut. As we have noted, the within cohort inconsistencies in responses to age at first sex do not necessarily mean that responses to questions about current sexual behavior are also subject to increasing bias (increasing underreporting), but at the very least they raise serious concerns that apparent movements toward less risky current behavior are overstated. In these contexts, it is necessary to assume that estimates of reductions in risk represent upper bounds of the true changes.

Finally, are the apparent changes in behavior of a magnitude that could impact the epidemic? Some of the changes we observe are 'large' in the sense that they represent significant shifts in personal behavior over a short period in traditional societies. The unweighted country average change (including all countries in the sample) in the probability of condom use among urban single adults is 12 percentage points for men and 11 percentage points for women, over an average period of five years. Given unweighted average initial probabilities of about 24 and 47 percent, this is a significant proportional increase. Changes among rural single women and men are comparable in proportional terms. Cleland and Ali (2006), considering DHS evidence for increasing condom use among young people in 18 African countries, find comparable changes on an annual basis and note that this growth is on par with the rate of adoption of modern contraception in Africa in the last several decades. With respect to the number of recent sexual partners, for three of five countries with appropriate data (Benin, Kenya, and Zambia), proportional reductions approaching 50% in the probability of reporting more than one partner are observed. If these are accurate, they surely represent major shifts in sexual behavior given the time frames involved.

Of course, that does mean that the changes are large enough to have a significant public health impact. Epidemiological modeling could in principal answer this question, but such a model would need to be able to incorporate a range of behaviors, including age at first sex, number of partners, and condom use, not to mention plausible assumptions about sexual networks. We can perhaps gain some perspective by comparing these behavior changes to what has occurred in other contexts where the evidence shows reductions in HIV prevalence and incidence. As noted earlier, in Uganda from 1989 to 1995, during a period when HIV prevalence began to fall sharply, the share of men reporting sex with casual partners fell from 34% to 14% for men, a proportional decline of 60%. The association of this change in reported behavior (as well as more modest declines in the share of young people having sex), on the one hand, and falling HIV prevalence, on the other, does not prove causality. However, epidemiological modeling of the course of the epidemic in Uganda and elsewhere suggests that observed declines in prevalence in Uganda in the 1990s cannot be explained without behavior change (Hallet et al. 2006). In periods of approximately similar duration in our study, the proportional declines in the probability of having multiple partners in Benin, Kenya, and Zambia were of a similar order of magnitude as that which occurred earlier in Uganda. On the

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African sample. It is possible that variations in policy response, not considered in her analysis, would explain some of the variation in behavior.

other hand, initial levels of this behavior were not as high in these countries as in Uganda at the start of the 1990s.

We may infer that, if measured accurately, the behavior change observed in Benin, Kenya, and Zambia along this dimension may have been strong enough to have had an effect on the course of the epidemic. Indeed, in Kenya and Zambia, the two countries out of this group with medium or high prevalence—hence bearing somewhat more resemblance to Uganda in the early 1990s—there have been recent declines in prevalence and incidence (Chelgut et al. 2006; Fylkesnes et al. 2001). As always, assessing the precise role of behavior change is difficult in the context of other sources of falling prevalence, but in the case of Kenya (in urban areas), simulations of Hallet et al. (2006) suggest that, as with Uganda in the 1990s, the declines were due in part to changes in behavior.

Condoms were not a major component of behavior change in the early 90s in Uganda (Green et al. 2002) but have figured prominently in other success stories, notably that of Thailand and more recently, Cambodia (UNAIDS 2000,UNAIDS 2006). Comparisons with our African samples are somewhat tenuous, both because of differences in the nature of sexual networks and in the stage of the epidemic. In these Asian settings transmission was still occurring primarily through specific high-risk populations, notably commercial sex workers and the military, and condom promotion was focused on these groups. Still, condom use in the general population appears very high. Among men in Cambodia, rates of condom use with non-steady partners is 80% in rural areas and almost 90% in urban areas; among single youth 15-24 who are sexually active (a much smaller share than in Africa), rates appear to be slightly higher (ORC/Macro 2006). In most of the African countries in our sample, HIV risk is substantially higher than in Cambodia, but with the exceptions of urban Burkina Faso and Uganda, condom use remains much lower despite the recent gains, especially in rural areas.

Due to concerns that consistent condom use is not attainable on a scale required by the generalized epidemics characterizing many African countries[23], many observers argue that condom promotion in the absence of successful promotion of other risk behavior reduction has not and will not be sufficient to turn back the epidemic (Hearst and Chen 2004, Green et al. 2006). The possibility that increased condom use will be offset by increases in other risk behaviors, which we may be observing in Uganda and Burkina Faso, heightens these concerns, though it bears repeating that this pattern was not observed elsewhere.

However, there is clearly an important role for condoms in prevention in high prevalence environments, in which half or more of new infections occur within stable couples in which one partner is HIV positive. Unless abstinence is a viable alternative, condoms are necessary for such serodiscordant partners. In this regard the findings are discouraging, because the likelihood of condom use within marriage remains very low. As was seen in Table 5, among women in stable unions, the probability of condom use at last sex is usually well under 5%, and increases have been less consistent than for single women. Even these low numbers presumably reflect in part pregnancy prevention motivations, not risk avoidance. Given high HIV prevalence in most

[23] UNAIDS defines a generalized epidemic as one in which adult HIV prevalence among the general adult population is at least 1% and transmission is mostly heterosexual and a concentrated epidemic as one in which HIV is concentrated in groups with behaviors that expose them to a high risk of HIV infection.

of these countries, we can infer that many more married women (and men) are at risk of infection from their partners than are taking precautions to avoid infection. This is made more likely by the low share of adults in Africa who have been tested for HIV (see Glick and Sahn 2007), meaning that most couples do not know if one or both partners are HIV positive. Even those who know or suspect that their relationship is serodiscordant may be unwilling or unable to use condoms. Women may lack the power to negotiate safe sex practices with their spouses (Van der Straten et. al. 1995; Ulin 1992). In other cases, the desire to have children may overwhelm fears of infection.

In sum, we find overall that behaviors are changing in African countries in response to the HIV epidemic and likely, in response policies developed to deal with the epidemic. In some cases the changes seem large given the short time periods involved, though we are obligated to consider them as upper bounds of the true changes. Even ignoring that issue, however, the improvements are not universal. And in many cases where the changes have been substantial, such as in the use of condoms both by single men and women and those in unions, they have yet to reach levels that would be appropriate in light of the urgency of the public health crisis represented by AIDS.[24]

With regard to econometric modeling, theoretical considerations lead to relatively few predictions regarding the effects of individual or household characteristics on these behaviors, but do provide a framework for interpreting the empirical results. Wealth and especially education often have important, but sometimes contradictory, impacts on risk behavior, depending on gender and the behavior considered. Among men but not women, one tendency we have observed is for education and to a lesser extent, wealth, to lead to higher risk by increasing the demand for additional sexual partners. At the same time (and possibly for this reason), for both men and women education is very strongly associated with the probability of using condoms, which reduces risk. Both education and wealth are also often associated with delayed sexual activity among girls but not boys, probably reflecting positive effects of these factors on girls' schooling duration and age at marriage.

Finally, we examined the stability over time of the relationships of these outcomes to their determinants. There were relatively few statistically significant changes in the effects of education or wealth on risk behaviors across survey rounds. One exception is that the association of wealth and condom use appears to have become stronger over time, suggesting differential impacts by wealth of policies of condom promotion or provision. With respect to other outcomes, public safe sex or AIDS awareness campaigns have not generally become any more (or less) effective over time at reaching the poor or uneducated or at least, at changing their behaviors.

[24] While too recent a phenomenon to be reflected in the data we use, the growing provision of anti-retroviral (ARV) drug therapies to those with HIV/AIDS may have important behavioral implications. It is not clear whether these will be favorable (for example, by increasing testing and reducing stigma) or unfavorable (by encouraging more risky behavior because a treatment is available if one becomes infected). See Glick (2005) for discussion.

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TABLE 1

SURVEY CONSISTENCY IN RESPONSES ABOUT EARLY SEXUAL ACTIVITY: EFFECT OF SURVEY YEAR ON PROBABILITY OF REPORTING AGE AT FIRST INTERCOURSE<=17, 25-34 FIRST YEAR COHORTS

	BENIN		BURKINA FASO		GHANA		KENYA		MOZAMBIQUE		NIGERIA		UGANDA		ZAMBIA	
	Rural	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*
Women																
Survey Effect	-0.003	0.025	-0.057	-0.011	-0.019	-0.034	-0.121	-0.134	-0.044	-0.071	0.069	0.089	-0.035	-0.004	-0.042	-0.001
	(0.12)	(0.85)	(3.07) ***	(0.29)	(0.78)	(1.13)	(6.27) ***	(3.72) ***	(2.07) **	(2.37) **	(2.72) ***	(2.55) **	(1.96) **	(0.13)	(2.37) **	(0.05)
Men																
Survey Effect	-0.222	0.004	-0.122	-0.067	-0.161	0.021	-0.094	-0.197	0.025	-0.015	-0.083	-0.157	-0.154	-0.166	-0.225	-0.152
	(0.50)	(0.08)	(3.85) ***	(1.40)	(4.16) ***	(0.49)	(2.81) ***	(3.80) ***	(0.50)	(0.19)	(1.98) **	(2.62) ***	(3.41) ***	(2.77) ***	(5.57) ***	(2.81) ***

Notes:

T-statistics in parentheses.

Based on probit for reported age at first intercourse <=17, estimated on pooled (both survey) samples of individuals age 25-34 in year of first survey. Estimates show effect of second survey year relative to first year in model with controls for schooling, religion, ethnicity, and province.

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are adjusted for clustering.

TABLE 2

MALES AND FEMALES AGED 15-19: PROBABILITY OF REPORTED FIRST INTERCOURSE BEFORE AGE 15 AND 18

		Females						**Males**					
		Age at First Intercourse <15[a]			Age at First Intercourse <18[b]			Age at First Intercourse <15[a]			Age at First Intercourse <18[b]		
Country/years		Year 1	Year 2	Difference	Year 1	Year 2	Difference	Year 1	Year 2	Difference	Year 1	Year 2	Difference
Benin	Rural	0.151	0.177	0.026	0.379	0.410	0.031	_	0.276	_	_	0.460	_
(1996, 2001)	Urban	0.080	0.135	0.054 **	0.289	0.368	0.079 ***	_	0.161	_	_	0.354	_
Burkina Faso	Rural	0.128	0.080	-0.048 ***	0.359	0.349	-0.010	0.052	0.021	-0.031 ***	0.192	0.134	-0.058 **
(1998/99, 2003)	Urban	0.055	0.043	-0.012	0.198	0.212	0.014	0.089	0.116	0.027	0.220	0.300	0.080 *
Ghana	Rural	0.061	0.078	0.018	0.271	0.324	0.053 **	0.027	0.038	0.011	0.117	0.119	0.001
(1998, 2003)	Urban	0.066	0.042	-0.024 *	0.152	0.174	0.022	0.022	0.021	-0.002	0.062	0.085	0.023
Kenya	Rural	0.139	0.132	-0.007	0.328	0.306	-0.022	0.317	0.320	0.003	0.465	0.472	0.007
(1998, 2003)	Urban	0.112	0.105	-0.007	0.305	0.265	-0.040	0.258	0.231	-0.028	0.303	0.255	-0.048
Mozambique	Rural	0.320	0.320	0.000	0.595	0.669	0.074 ***	0.141	0.329	0.188 ***	0.436	0.576	0.140 **
(1997, 2003)	Urban	0.186	0.196	0.010	0.509	0.551	0.042	0.323	0.313	-0.010	0.721	0.637	-0.083
Nigeria	Rural	0.180	0.208	0.028	0.364	0.402	0.038	0.083	0.061	-0.022	0.195	0.164	-0.031
(1999, 2003)	Urban	0.073	0.085	0.013	0.189	0.249	0.060 **	0.055	0.074	0.019	0.184	0.164	-0.020
Uganda	Rural	0.218	0.129	-0.090 ***	0.480	0.375	-0.106 ***	0.183	0.124	-0.059 *	0.341	0.293	-0.048
(1995, 2001)	Urban	0.224	0.132	-0.092 ***	0.414	0.388	-0.026	0.157	0.130	-0.028	0.460	0.366	-0.094
Zambia	Rural	0.230	0.190	-0.040 **	0.517	0.455	-0.062 ***	0.368	0.234	-0.134 ***	0.575	0.443	-0.132 ***
(1996, 2001/02)	Urban	0.173	0.132	-0.040 *	0.392	0.367	-0.025	0.397	0.323	-0.074	0.579	0.561	-0.017

Notes:

[a] Based on probit for intercourse before age 15. Shows effect of second survey year relative to first year in model with controls for having 3 or more years of schooling, wealth, province, religion, and ethnicity where available.

[b] Based on Weibull hazard model for timing of first intercourse. Shows effect of second survey year relative to first year in model with same controls as previous model.

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are adjusted for clustering.

TABLE 3

WOMEN AND MEN 15-49: PROBABILITY OF REPORTING BEING SEXUALLY ACTIVE

	BENIN		BURKINA FASO		GHANA		KENYA		MOZAMBIQUE		NIGERIA		UGANDA		ZAMBIA	
	Rural	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*
Women																
Year 1	0.772	0.749	0.687	0.710	0.784	0.670	0.792	0.788	0.840	0.823	0.773	0.727	0.812	0.701	0.795	0.739
Year 2	0.759	0.759	0.656	0.693	0.752	0.651	0.750	0.699	0.783	0.840	0.820	0.782	0.821	0.746	0.805	0.709
Difference	-0.013	0.011	-0.032 **	-0.017	-0.032 **	-0.018	-0.043 ***	-0.090 ***	-0.057 ***	0.017	0.047 ***	0.055 ***	0.008	0.045 **	0.010	-0.029 **
Men																
Year 1	0.852	0.868	0.677	0.751	0.710	0.588	0.861	0.886	0.881	0.863	0.712	0.721	0.790	0.800	0.872	0.861
Year 2	0.873	0.862	0.622	0.749	0.713	0.650	0.753	0.855	0.905	0.909	0.754	0.644	0.801	0.804	0.859	0.839
Difference	0.022	-0.006	-0.055 **	-0.002	0.003	0.062 **	-0.107 ***	-0.031	0.024	0.045	0.042	-0.077 **	0.012	0.004	-0.013	-0.022

Notes:
Based on probit for reporting sexual intercourse in the last 12 months. Shows effect of second survey year relative to first year in model with controls for years of schooling, wealth, province, religion, and ethnicity.
* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are adjusted for clustering.

TABLE 4

SEXUALLY ACTIVE WOMEN AND MEN 15-49: PROBABILITY OF HAVING MORE THAN 1 RECENT SEXUAL PARTNER

	Women 15-49		**Men 15-49**			
	Probability of 2 or More Partners		Probability of 2 or More Partners		Probability of 3 or More Partners	
	Rural	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*
Benin						
1996	0.010	0.028	0.348	0.464	0.179	0.222
2001	0.005	0.016	0.221	0.324	0.049	0.116
Difference	-0.005 **	-0.013 **	-0.127 **	-0.139 ***	-0.131 ***	-0.106 ***
Burkina Faso						
1999	0.008	0.025	0.145	0.292	0.066	0.127
2003	0.004	0.024	0.197	0.279	0.023	0.064
Difference	-0.004 *	-0.001	0.053 ***	-0.013	-0.042 ***	-0.063 ***
Ghana						
2003	0.014	0.014	0.126	0.163	0.014	0.012
Kenya						
1998	0.027	0.048	0.284	0.288	0.124	0.122
2003	0.017	0.027	0.137	0.180	0.021	0.029
Difference	-0.010 ***	-0.021 ***	-0.147 ***	-0.108 ***	-0.103 ***	-0.093 ***
Mozambique						
2003	0.037	0.074	0.256	0.405	0.044	0.111
Nigeria						
2003	0.007	0.012	0.215	0.213	0.057	0.057
Uganda						
2000	0.016	0.028	0.235	0.254	0.038	0.044
Zambia						
1996	0.033	0.046	0.315	0.318	0.151	0.146
2000	0.017	0.029	0.255	0.278	0.050	0.065
Difference	-0.017 ***	-0.016 **	-0.060 **	-0.041	-0.102 ***	-0.081 ***

Notes:

Based on probit for reporting sexual intercourse with more than one partner the last 12 months. Shows effect of second survey year relative to first year in model with controls for years of schooling, wealth, province, religion, and ethnicity. For Ghana, Mozambique, Nigeria, and Uganda changes in question format made comparisons across years unreliable. For these cases, only results for the latest survey are shown.

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are adjusted for clustering.

TABLE 5

SEXUALLY ACTIVE WOMEN 15-49: PROBABILITY OF USING A CONDOM AT LAST INTERCOURSE, BY PARTNERSHIP STATUS

	In a Union		Not in a Union		All	
	Rural	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*
Benin						
1996	0.006	0.007	0.032	0.094	0.007	0.019
2001	0.007	0.009	0.039	0.164	0.009	0.034
Difference	0.0013	0.0022	0.0062	0.0698 **	0.0019	0.0143 **
Burkina Faso						
1999	0.012	0.059	0.269	0.559	0.016	0.129
2003	0.017	0.083	0.234	0.691	0.021	0.202
Difference	0.0050 *	0.0243 *	-0.0350	0.1325 ***	0.0053	0.0730 ***
Ghana						
1998	0.024	0.044	0.068	0.142	0.028	0.055
2003	0.019	0.047	0.163	0.314	0.037	0.091
Difference	-0.0050	0.0029	0.0953 ***	0.1721 ***	0.0097 *	0.0355 ***
Kenya						
1998	0.021	0.039	0.107	0.212	0.034	0.093
2003	0.011	0.030	0.158	0.276	0.029	0.095
Difference	-0.0100 ***	-0.0092	0.0503 **	0.0638 *	-0.0043	0.0011
Mozambique						
1997	0.001	0.016	0.001	0.043	0.001	0.020
2003	0.003	0.017	0.017	0.280	0.006	0.083
Difference	0.0022 ***	0.0017	0.0168 ***	0.2372 ***	0.0049 ***	0.0626 ***
Nigeria						
1999	0.010	0.035	0.167	0.185	0.020	0.048
2003	0.007	0.024	0.124	0.239	0.014	0.050
Difference	-0.0024	-0.0114	-0.0434	0.0548	-0.0055	0.0026
Uganda						
1995	0.006	0.051	0.090	0.437	0.009	0.112
2000	0.010	0.054	0.203	0.491	0.024	0.156
Difference	0.0037 *	0.0029	0.1131 ***	0.0541	0.0153 ***	0.0440 ***
Zambia						
1996	0.029	0.061	0.099	0.268	0.038	0.106
2000	0.050	0.079	0.169	0.386	0.068	0.141
Difference	0.0211 ***	0.0187 *	0.0700 ***	0.1178 ***	0.0301 ***	0.0352 ***

Notes:

Based on probit for reporting condom use at last intercourse. Shows effect of second survey year relative to first year in model with controls for years of schooling, wealth, province, religion, and ethnicity.

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are adjusted for clustering.

TABLE 6

SEXUALLY ACTIVE MEN 15-49: PROBABILITY OF USING A CONDOM AT LAST INTERCOURSE, BY PARTNERSHIP STATUS

	1 PARTNER, IN A UNION		2+ PARTNERS, IN A UNION		NOT IN A UNION		ALL	
	Rural	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*
Benin								
1996	0.023	0.018	0.075	0.159	0.102	0.290	0.049	0.139
2001	0.045	0.031	0.095	0.097	0.223	0.381	0.088	0.153
Difference	0.0217 *	0.0134	0.0205	-0.0622	0.1210 ***	0.0904	0.0386 ***	0.0136
Burkina Faso								
1999	0.056	0.138	0.194	0.378	0.394	0.836	0.121	0.511
2003	0.087	0.219	0.192	0.178	0.484	0.924	0.174	0.567
Difference	0.0308 *	0.0810 **	-0.0026	-0.2003 *	0.0902	0.0879 ***	0.0529 ***	0.0559
Ghana								
1998	–	–	–	–	0.255	0.344	0.099	0.216
2003	–	–	–	–	0.394	0.515	0.119	0.243
Difference	–	–	–	–	0.1390 ***	0.1714 **	0.0204	0.0267
Kenya								
1998	0.045	0.050	0.136	0.248	0.385	0.475	0.157	0.211
2003	0.020	0.040	0.005	0.106	0.402	0.571	0.113	0.193
Difference	-0.0248 ***	-0.0098	-0.1309 ***	-0.1416 **	0.0171	0.0954	-0.0442 ***	-0.0182
Mozambique								
1997	–	–	–	–	0.010	0.121	0.015	0.054
2003	–	–	–	–	0.140	0.365	0.023	0.151
Difference	–	–	–	–	0.1299 ***	0.2435 ***	0.0081	0.0974 ***
Nigeria								
1999	–	–	–	–	0.346	0.468	0.069	0.200
2003	–	–	–	–	0.358	0.547	0.085	0.238
Difference	–	–	–	–	0.0112	0.0789	0.0159	0.0381
Uganda								
1995	0.012	0.063	0.014	0.101	0.336	0.748	0.044	0.235
2000	0.021	0.078	0.023	0.095	0.423	0.807	0.064	0.304
Difference	0.0094	0.0144	0.0094	-0.0066	0.0874	0.0590	0.0197 *	0.0688 *
Zambia								
1996	0.044	0.212	0.082	0.261	0.263	0.485	0.108	0.263
2000	0.069	0.276	0.075	0.221	0.321	0.499	0.133	0.271
Difference	0.0254	0.0638	-0.0070	-0.0399	0.0584	0.0142	0.0250	0.0077

Notes:

Based on probit for reporting condom use at last intercourse. Shows effect of second survey year relative to first year in model with controls for years of schooling, wealth, province, religion, and ethnicity.

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are adjusted for clustering.

TABLE 7

EFFECTS OF SCHOOLING AND WEALTH ON THE NUMBER OF PARTNERS: MARGINAL EFFECTS FROM ORDERED PROBIT MODELS

	Women 15-49						Men 15-49					
	Year of Schooling[a]		Assets[b]				Years of Schooling[a]		Assets[b]			
	Zero Partners	>1 Partner	Zero Partners		>1 Partner		Zero Partners	>1 Partner	Zero Partners		>1 Partner	
Benin												
Rural	0.003	0.000	-0.003		0.000		0.000	0.000	0.000		0.000	
Urban	-0.005 *	0.000 *	0.030		-0.003		-0.006 **	0.006 **	-0.076 **	inc	0.084 **	
Burkina Faso												
Rural	-0.003	0.000	0.000		0.000		-0.012 ***	0.005 ***	-0.001 *		0.000 *	
Urban	-0.001	0.000	0.069 *	inc	-0.006 *		-0.002	0.002	-0.031 **		0.025 **	
Ghana												
Rural	-0.002	0.000	0.010		0.000		-0.005 *	0.001 *	-0.015		0.004	
Urban	0.003	0.000	0.156 ***		-0.008 ***		-0.002	0.001	-0.031		0.010	
Kenya												
Rural	0.004	0.000	0.037 ***		-0.002 ***		0.005	-0.002	-0.037 **		0.015 **	
Urban	0.005	0.000	0.132 ***	dec	-0.011 ***	dec	0.002	-0.001	0.028		-0.020	
Mozambique												
Rural	-0.003	0.001	-0.008 **		0.002 **		-0.008 ***	0.012 ***	-0.011 **		0.017 **	
Urban	-0.006 ***	0.003 ***	0.023		-0.010		-0.007	0.012	-0.029		0.053	
Nigeria												
Rural	0.007 ***	-0.001 ***	-0.009		0.001		-0.010 **	0.005 **	0.085		-0.042	
Urban	0.004 **	0.000 **	0.003		0.000		-0.009 *	0.004 *	0.013		-0.005	
Uganda												
Rural	0.009 ***	-0.001 ***	0.001		0.000		-0.002	0.001	0.001		-0.001	
Urban	0.002	0.000	0.058 *	inc	-0.006 *	inc	0.003	-0.002	0.095 **		-0.068 **	
Zambia												
Rural	0.007 ***	-0.001 ***	0.004		0.000		0.001	-0.001	0.005		-0.005	
Urban	0.016 ***	-0.002 ***	0.087 ***		-0.010 ***	inc	0.010 **	-0.010 ***	0.084 *		-0.085 *	

Notes:

[a] Shows the effect of an additional year of schooling on the probability of having no partners and of having more than one partner in the past year.

[b] Shows the probability of having 0 (>1) partners, evaluated at the median value of the asset index for the richest quartile, minus the probability of having 0 (or >1) partners evaluated at the median asset index for the poorest quartile.

Shows results for most recent survey (Year 2) for each sample. Standard errors calculated using the delta method.

'inc' to the right of a value indicates that the Year 2 marginal effect was larger in absolute value than the Year 1 marginal effect; 'dec' indicates that the marginal effect was smaller in abs. value in Year 2 than Year 1. For Ghana and Nigeria, data are only available in Year 2 so marginal effects cannot be compared over time.

TABLE 8

DETERMINANTS OF CONDOM USE IN LAST INTERCOURSE, WOMEN AND MEN, AGE 15-49

	Years of Schooling[a]				Assets[b]				In Stable Union[a]			
	Women		Men		Women		Men		Women		Men	
Benin												
Rural	0.000		0.005 ***		0.001		0.019 **		-0.023 ***	inc	-0.084 ***	
Urban	0.005 ***		0.013 ***		0.016 *	inc	0.024		-0.076 ***		-0.238 ***	
Burkina Faso												
Rural	0.004 ***		0.015 ***		0.000		-0.001		-0.118 ***	dec	-0.308 ***	
Urban	0.010 ***		0.006		0.074 ***	inc	-0.026 *	dec	-0.501 ***	inc	-0.589 ***	
Ghana												
Rural	0.003 ***		0.007 ***		0.009		0.033 ***	inc	-0.103 ***	inc	-0.222 ***	
Urban	0.007 ***		0.013 ***		0.050 **	inc	0.029		-0.199 ***	inc	-0.251 ***	
Kenya												
Rural	0.002 ***		0.002		0.007 **		0.003		-0.088 ***		-0.295 ***	
Urban	0.005 ***		0.010 **		0.059 ***	inc	0.085		-0.283 ***	inc	-0.517 ***	inc
Mozambique												
Rural	0.002 ***		0.009 ***		0.000		0.003 *		-0.022 ***	inc	-0.113 ***	inc
Urban	0.016 ***	inc	0.034 ***		0.059 ***	inc	0.126 ***	inc	-0.173 ***	inc	-0.256 ***	
Nigeria												
Rural	0.001 ***		0.007 ***		0.004		0.053 **	inc	-0.046 ***	dec	-0.279 ***	
Urban	0.004 ***		0.014 ***		0.024 **		0.122 *		-0.137 ***		-0.358 ***	
Uganda												
Rural	0.004 ***	inc	0.005 ***		0.000 *		0.003		-0.153 ***	inc	-0.306 ***	inc
Urban	0.016 ***		0.015 *		0.033 *	inc	0.187 **	inc	-0.417 ***	inc	-0.680 ***	
Zambia												
Rural	0.007 ***		0.009 ***		0.000		0.014		-0.096 ***	inc	-0.208 ***	
Urban	0.010 ***		0.013		-0.001	dec	-0.023	dec	-0.282 ***	inc	-0.386 ***	

Notes

[a] Shows marginal effects (for year of schooling) or changes in probability (for in union) from probits for reporting condom use in last intercourse

[b] Shows the probability of using condom evaluated at the median value of the asset index for the richest quartile minus the probability of using condom evaluated at the median for the poorest quartile.

'inc' to the right of a value indicates that the Year 2 marginal effect was larger in absolulte value than the Year 1 marginal effect; 'dec' indicates that the marginal effect was smaller in abs. value in Year 2 than Year 1.

Shows results for most recent survey (Year 2) for each sample. Standard errors calculated using the delta method.

TABLE 9

SUMMARY OF INTERTEMPORAL CHANGES IN RISK BEHAVIORS, FEMALES

	Delay in Sexual Debut[a]	Abstinent	Only One Partner (If Sexually Active)[b]	Condom Use: In Union, 1 Partner	Condom Use: Not in Union
Benin (1999, 2001)					
Rural	0	0	Increase	0	0
Urban	Decrease	0	Increase	0	Increase
Burkina Faso (1999, 2003)					
Rural	0	Increase	Increase	Increase	0
Urban	0	0	0	Increase	Increase
Ghana (1998, 2003)					
Rural	Decrease	Increase	n.a.	0	Increase
Urban	0	0	n.a.	0	Increase
Kenya (1998, 2003)					
Rural	0	Increase	Increase	Decrease	0
Urban	0	Increase	Increase	0	0
Mozambique (1997, 2003)					
Rural	Decrease	Increase	n.a.	Increase	Increase
Urban	0	0	n.a.	0	Increase
Nigeria (1999, 2003)					
Rural	0	Decrease	n.a.	0	0
Urban	Decrease	Decrease	n.a.	0	0
Uganda (1995, 2000)					
Rural	Increase	0	n.a	Increase	Increase
Urban	0	Decrease	n.a.	0	Increase
Zambia (1996, 2000)					
Rural	Increase	0	Increase	Increase	Increase
Urban	0	Increase	Increase	Increase	Increase
All Countries/ Regions	2 inc/ 4 dec/10 nc	6 inc/ 3 dec/7 nc	7 inc/ 0 dec/1 nc	6 inc/ 1 dec/8 nc	10 inc/ 0 dec/6 nc

Notes: for each indicator, ' increase' indicates a statistically significant (at 10% or better) change in the direction of reduced risk; 'decrease' indicates increasing risk. '0' or 'nc' indicates no statistically significant change; 'n.a.' indicates data not available for the comparison.

[a] Based on estimated probabilities of age at first intercourse <18 for individuals 15-19 in Table 2.

[b] Probability a sexually active adult has only one partner, from Table 4.

TABLE 10

SUMMARY OF INTERTEMPORAL CHANGES IN RISK BEHAVIORS, MALES

	Delay in Sexual Debut[a]	Abstinent	Only One Partner (If Sexually Active)[b]	Condom Use: In Union, 1 Partner	Condom Use: Not in Union
Benin (1999, 2001)					
Rural	n.a.	0	Increase	Increase	Increase
Urban	n.a.	0	Increase	0	0
Burkina Faso (1999, 2003)					
Rural	Increase	Increase	Decrease	Increase	0
Urban	Decrease	0	0	Increase	Increase
Ghana (1998, 2003)					
Rural	0	0	n.a	n.a	Increase
Urban	0	Decrease	n.a.	n.a.	Increase
Kenya (1998, 2003)					
Rural					
Urban	0	Increase	Increase	Decrease	0
	0	0	Increase	0	0
Mozambique (1997, 2003)					
Rural	Decrease	0	n.a	n.a	Increase
Urban	0	0	n.a.	n.a.	Increase
Nigeria (1999, 2003)					
Rural	0	0	n.a	n.a	0
Urban	0	Increase	n.a.	n.a.	0
Uganda (1995, 2000)					
Rural	0	0	n.a	0	0
Urban	0	0	n.a.	0	0
Zambia (1996, 2000)					
Rural	Increase	0	Increase	0	0
Urban	0	0	0	0	0
All Countries/ Regions	2 inc/ 2 dec/10 nc	2 inc/2 dec/ 12 nc	5 inc/1 dec/ 2 nc	2 inc/1 dec/ 6 nc	6 inc/ 0 dec/10 nc

Note: for each indicator, ' increase' indicates a statistically significant (at 10% or better) change in the direction of reduced risk; 'decrease' indicates increasing risk. '0' or 'nc' indicates no statistically significant change; 'n.a.' indicates data not available for the comparison.

[a] Based on estimated probabilities of age at first intercourse <18 for individuals 15-19 in Table 2.

[b] Probability a sexually active adult has only one partner, from Table 4.

APPENDIX TABLE A1

25-34 FIRST YEAR COHORT: SURVEY TO SURVEY MEAN COMPARISONS OF SELECTED CHARACTERISTICS

	WOMEN								MEN							
	Benin	**Burkina Faso**	**Ghana**	**Kenya**	**Mozambique**	**Nigeria**	**Uganda**	**Zambia**	**Benin**	**Burkina Faso**	**Ghana**	**Kenya**	**Mozambique**	**Nigeria**	**Uganda**	**Zambia**
Rural																
Education (years)			X	X	X	X				X	X					
Primary education			X			X				X	X					
Height				X												
Age at first intercourse<=18		X		X		X				X	X	X		X	X	X
Age of first intercourse		X		X		X	X	X		X	X	X		X	X	X
1 province																
2+ province																
1 religion											X					
2+ religion					X			X								
1 ethnic group																
2+ ethnic group																
Urban																
Education (years)															X	
Primary education																
Height			X													
Age at first intercourse<=18				X		X						X		X	X	X
Age of first intercourse			X	X		X					X	X		X	X	X
1 province																
2+ province																
1 religion					X											
2+ religion													X			X
1 ethnic group																
2+ ethnic group																

Notes:

Compares mean reported values in earlier and later surveys for the cohort of women or men age 25-34 in the first survey for each country

'X' indicates the difference in means between survey years is significant at 5% level

Height variable is available only for women

‘1’ province, religion, or ethnic group means the share in the category is significantly different in earlier and later surveys (for categories accounting for at least 20% of sample); '2+' means the shares differ for 2 or more categories