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Hypothesis building from individual answers to a Demographic and Health Survey with an application to Côte d'Ivoire

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THE DISTRIBUTION OF AIDS OVER THE POPULATION IN AFRICA HYPOTHESIS BUILDING FROM INDIVIDUAL ANSWERS TO A DEMOGRAPHIC AND HEALTH SURVEY WITH AN APPLICATION TO CÔTE D'IVOIRE*

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RESUME

L'absence de connaissance des différentiels de risque concernant le SIDA rend très difficile l'analyse de l'impact économique de l'épidémie dans les pays en développement, au niveau macro comme au niveau micro-économique. Dans ce papier, nous estimons des hypothèses que nous pensons raisonnables sur les différentiels de risque de mortalité selon l'âge, le niveau d'éducation et d'autres caractéristiques individuelles à partir de l'Enquête Démographique et de Santé ivoirienne. Ces différentiels sont ensuite calibrés sur les projections démographiques des Nations Unies afin d'obtenir des tables de mortalité desagrégées. Un des principaux résultats de notre modèle est que les individus éduqués ont un risque plus fort de mourir du SIDA parce que ils tendent à avoir plus de partenaires sexuels. Cependant, cet effet est partiellement compensé par une utilisation plus fréquente des préservatifs relativement aux individus moins éduqués.

ABSTRACT

Lack of knowledge about risk differentials regarding AIDS seriously hampers the study of the economic impact of AIDS in developing countries, at both the macro- and micro-economic levels. In this paper, we derive, we think, reasonable assumptions on mortality risk differentials by age, education, and other micro-economic characteristics by exploiting variables from the Ivoirian DHS. Finally these differentials are calibrated on demographic projections of the United Nations to obtain disaggregated mortality tables. One main result of our model is that educated people have a higher risk of dying through AIDS, because they are more likely to have several sexual partners. This effect is however partly offset by a higher probability of condom use relative to less educated people.

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1 Introduction

Not much is known about the distribution of the AIDS epidemic in African countries. Prevalence rates of the HIV virus and mortality attributable to AIDS illness are only roughly estimated at the national/regional level. For each country and for the 1995-2050 period, UNAIDS produces estimates of AIDS-induced decrease in life expectancy for adults of both sexes.[1] Almost no information is available for such variables as localization, education or occupation, apart from qualitative, sometimes anecdotal, sources. Partial evidence suggests that urban, more educated people, and teachers or truck-drivers are indeed more exposed to the risk of AIDS.[2] Theoretically speaking, a number of factors like living standards, social status and spatial mobility may be invoked to explain contrasts in individual sexual behavior and within group intercourse leading to risks differentials. It remains that a precise quantification of such risks differentials is out of reach in the absence of representative surveys providing information on both individual characteristics and HIV/AIDS infection (or related opportunistic illnesses).[3]

Lack of such data seriously hampers the study of the economic impact of AIDS, at both the macro- and micro-economic levels.

Macro-economic studies of the impact of AIDS on growth and/or national welfare are forced to make rough assumptions concerning the distribution of the epidemics over the labor force. In their CGE study of the economic impact of AIDS in Cameroon, Kambou, Devarajan and Over (1994) consider a fall of 30 000 workers a year, they dispatch equally over three categories of labor, rural, urban unskilled and urban skilled, that is a 10 000 workers fall in each category, that is they make the assumption that the infection is far more perva-

[1] See United Nations (2001).

[2] See Miller and Rockwell (1988), Becker (1990), Ainsworth and Semali (1998), and also Gregson, Waddell and Chandiwana (2001) who provide a review of studies showing a positive relation between socioeconomic status and HIV infection in sub-Saharan Africa. Philipson and Posner (1995) try to rationalize a positive correlation between income and HIV infection, although they acknowledge it could be spurious.

[3] The most representative surveys available in developing countries are those based on tests in prenatal care centers. But, first not all women consult prenatal clinics, even if the proportion is in some developing countries relatively high, second not all women have the same probability to be pregnant, this is especially true for women infected by HIV, and third these data says nothing about infection among men.

sive among urban skilled workers. This shortage of skilled workers is of course, by far, the shock that has the strongest impact on the Cameroonian economy. Arndt and Lewis (2000) also use a CGE with sequential dynamics to estimate the medium term macro implications of AIDS in South Africa. They adopt ING Barings mortality rates estimates for unskilled, skilled and professional workers. These estimates are at odds with Kambou *et al.* assumption, as they show a decreasing profile of mortality with respect to education. Other studies do not consider any disaggregation in labor force, making the assumption of uniform rates of infection.[4] Micro-economic studies are, with a few exceptions, restricted to a listing of potential effects on households' welfare or enterprises efficiency or a based on unrepresentative case studies.[5] Macro-micro linkages are hardly explored, while they are probably the main issue at stake. Indeed, focusing on mortality, an uneven distribution of death events has potentially huge macro- and micro-consequences: labor force shortages leading not only to growth constraints but also to large relative wages changes, changes in the structure of households leading to reallocations of labor supply and school dropouts, appraisal of new categories of poor through unexpected transitions from the top to the bottom of the distribution of income, etc. The study of these phenomena calls for applied dynamic micro-simulation techniques, coupled with appropriate macro-economic closures, as we argue and exemplify in another paper with an application to Côte d'Ivoire. It requires also the building of reasonable assumptions on mortality risk differentials by age, education, and other micro-economic variables.

This technical paper deals with the latter issue, and presents a tentative analysis of a nationwide representative Demographic and Health Survey (DHS), providing for some clues on the distribution of mortality risks over some individual observables. Within such a survey, the only two available variables we may link directly to the risk of contracting AIDS are the number of sexual partners and the use of condoms within the two months preceding the survey. The first variable is available only for men and probably measured

[4] See Cuddington (1992), Cuddington and Hancok(1994) Cuddington, Hancok and Rogers (1994), MacFarlan and Sgherri (2001).

[5] See Philipson and Posner (1995) and Tibaijuka (1997), for example.

with biases, especially for married men. All other variables mainly reflect knowledge and attitudes about the AIDS illness. We use multiple correspondence analysis to get a preliminary overview of the patterns of individual attitudes towards AIDS. We then build up a standard model for the risk of being infected by HIV, depending on sexual activity, protection behavior and partners' selection. We estimate this model with available variables for different empirical specifications. Last, we derive from the estimated models and from United Nations' life expectancy projections a variety of mortality tables disaggregated by education levels.

In spite of its many methodological caveats, we believe that such an analysis provides for a better benchmarking than a "no-information" or "anecdotal" approach. The analysis is conducted on the Ivoirian DHS for the year 1994. The paper is organized as follows. We first present the data used and the AIDS variables under analysis (section 2.1-2.3). We then present the results of Multiple Correspondence Analysis on the population of men, spouses of heads and other women (section 2.4). We discuss the construction of hypothetical risk variables and analyze a variety of them by regression techniques (section 3). Finally, we derive mortality rate differentials for Côte d'Ivoire attributable to AIDS by calibrating the risk variables on demographic projections of the United Nations (section 4).

2 AIDS in Côte d'Ivoire and data sources

We use three different data sources: the Ivoirian Demographic and Health Survey (DHS) of 1994, United Nations' demographic projections for Côte d'Ivoire, and Ledermann model life tables. After a short description of some basic facts about the AIDS epidemic in Côte d'Ivoire, we present the DHS data, then examine the DHS variables describing attitudes and knowledge with regard to AIDS, and finally analyze them by a multiple correspondence analysis. The United Nations data and the used Ledermann life tables are presented in Section 4, when deriving the mortality tables.

2.1 The AIDS epidemic in Côte d'Ivoire

The first two AIDS cases in Côte d'Ivoire were declared at the end of 1985 (Garenne, Madison, Tarantola *et al.* 1995). Afterwards the epidemic spread very rapidly and today Côte d'Ivoire is one of the 15 hardest hit countries in the world. End-1999 UNAIDS estimated the adult prevalence rate at 10.8%[6], and the number of adults and children died in that year of AIDS at 72 000 (UNAIDS/WHO 2000).

The results of a representative survey (rural and urban areas without Abidjan) carried out in 1989, showed that even in that early stage of the epidemic it was already distributed over all regions in Côte d'Ivoire. However, the intensity was very different. In the South (near Abidjan) 8,3% of the adult population were infected, whereas in the North the adult prevalence rate of infection did not exceed 2,5% (Garenne *et al.* 1995). It seems that migration and mobility are very important factors regarding the Ivorian AIDS epidemic.

HIV prevalence among sex workers tested in Abidjan increased from 27% in 1986 to over 84% in 1992/93. In Odienne for instance, city in the North-West of Côte d'Ivoire and situated at one of the most important migration corridors, HIV prevalence among sex workers tested increased from 37% in 1987 to 53% in 1990 (UNAIDS/WHO 2000).

To our knowledge, the most recent mortality study for Côte d'Ivoire is that of Garenne and Zanou (2000), which is based on census data of 1998, administrative data and the registered causes of deaths in the hospitals in Abidjan. The authors state a less or more stagnation of the excess mortality due to AIDS in Abidjan since 1992, which would suggest a stabilization of the HIV prevalence rate in the population. However, the study suffers from the poor quality of the hospital registers. AIDS is only rarely declared and has therefore to be derived from other causes of death, as the tuberculosis, the meningitis and the toxoplasmosis, causes of death which increased in Côte d'Ivoire since the onset of the HIV/AIDS epidemic in 1985. These drawbacks justify some doubt concerning the hypothesis of a stabilization of the HIV

[6]This estimation includes all adults (15 to 49 years), with HIV infection, whether or not they have developed symptoms of AIDS, alive at the end of 1999.

prevalence rate in Abidjan.

2.2 Ivoirian Demographic and Health Survey (DHS) 1994

The Ivoirian DHS used for this study was carried out between June and November 1994 by the *Institut National de la Statistique* of Côte d'Ivoire with the technical assistance of the Demographic and Health Surveys Macro International Inc. (U.S.A.) (INS 1995). The weighted sample is representative on the national level. Each of the five sub-samples (Abidjan, Urban Forest, Rural Forest, Urban Savannah and Rural Savannah) is self-weightening.

This survey contains four types of questionnaires. One dedicated to households, one dedicated to women between 15 and 49 years old, one dedicated to men between 15 and 59 years old, and finally a community questionnaire collecting data about service facilities. The men questionnaire is a simplified version of the women questionnaire and was addressed only to a sub-sample of all men covered by the household questionnaire. The women and men questionnaires were filled out by 8 099 women and by 2 552 men respectively. These persons belong together to 5 935 households.

The household questionnaire provides information about the socio-demographic characteristics of the household members, but no information about incomes or expenditures. However, it contains some information on household assets and housing characteristics. The women questionnaire informs about reproductive behavior, contraception, pregnancy, vaccination and children's health, marriage, preferences regarding fertility, maternal mortality, height, and weight of mothers and their children. In addition, the survey aimed to evaluate the knowledge, attitudes and behavior with regard to AIDS. The corresponding section was integrated in the individual women and men questionnaire. It contains questions about the knowledge concerning the AIDS epidemic, about its transmission modes, and adequate strategies to avoid an infection with AIDS.

2.3 Variables describing attitudes and knowledge with regard to AIDS

This section offers a detailed statistical description of the variables concerning "attitudes and knowledge regarding the AIDS epidemic" in the Ivoirian DHS 1994.[7] The corresponding tables figure in appendix A. The analysis is carried out separately for men and women and is stratified by age, educational attainment, religion, and household size. This analysis will also guide the selection of variables used to construct the individual risk multipliers.

Table A1 shows that almost all people, that is more than 90%, have already heard of AIDS, even if women have so a little bit less often than men, notably in rural areas. People who do not know AIDS are rather old and less educated. It seems that moslems and those belonging to traditional religious groups are less informed than people belonging to the christian church. In line with information's public good character, men and women of larger households have more often heard of AIDS than others.

People who have already attended a conference on AIDS live more often in urban areas than in rural areas, which is surely not only a question of motivation, but also of supply. Furthermore the participation rate is higher among men than among women and is highly correlated with educational attainment as well as an affiliation to the christian church.

Sexual relations are the most often quoted origin of AIDS (see table A2). More than 90% of the men and 78% of the women mentioned this cause, without much difference between urban and rural areas. In contrast, the risk of getting AIDS by using unsterilized needles for medical injections is less known, particularly in rural areas. 60% of urban men and 36% of urban women mentioned this as origin of AIDS. In rural areas the respective ratios were only 47% and 28%. Knowledge of possible transmission channels increases with educational attainment, particularly for women, with household size, and decreases with age. That eating from the same same plate than a with AIDS infected person might transmit AIDS was mentioned especially in urban areas and surprisingly by well educated people.

[7] For a statistical description of the answers to the DHS AIDS module for several other countries see, for instance, Filmer (1998) and Gersowitz (2001).

It is interesting to see, that people in rural areas and in the "other cities" are more conscious than people in Abidjan that occasional sexual intercourse is a risky behavior regarding AIDS (table A3). 54% of the men in rural areas mentioned this as an important transmission channel and only 44% in Abidjan. The respective ratios for women are 58% and 43%. However, this could also signify that people in Abidjan know better how to protect against AIDS, and thus find occasional intercourse not so risky. The proportion of people judging occasional intercourse as risky, first increases and then decreases with age, increases with educational attainment and is higher among christians than among moslems. The proportion of people having no idea about sexual transmission channels is higher in urban areas than in rural areas, but remains in general very low (under 5%). Less than one fifth of the population consider the fact that they might even get infected by sexual intercourse with their partner. Women evaluate this risk not higher as men. The proportion which mentioned this danger follows an inverted "U" with age (with exception for men in rural areas), and increases with educational attainment.

The fact that a mother can pass the AIDS virus to her baby is known by 70% of the men and women without any important gender gap (table A4). About 16% of the men and 12% of the women consider this type of transmission as impossible, and the remaining people do not know. Knowledge and no answers decrease with age. Knowledge increases with education and household size and is more widespread among christians than among moslems.

Only 51% of the men and 33% of the women in Abidjan are aware of the fact that an infected person can seem healthy. Knowledge about this decreases with age, increases with educational attainment and is, likewise, more widespread among christians than among moslems.

That AIDS is a fatal illness is better known by women than by men (90% vs. 80%) and by rural people than by urban residents (table A5). Knowledge about this decreases with age, decreases with educational attainment in urban areas, but increases with educational attainment in rural areas. Perhaps urban people, who have probably heard more often of antiretroviral therapies, think that these therapies can cure infected people.

One of five persons know or knew somebody who has or had AIDS. This proportion is similar for men and women, increases with age and strongly with educational attainment (table A5). The proportion is also much higher for christians than for moslems.

Having only one partner is more often considered as an efficient strategy to avoid AIDS in urban areas than in rural areas (table A6). Furthermore it is favored more by men, by the young, by the well educated, and by christians relative to the others.

Avoiding prostitutes and stopping sexual intercourse are in the same way considered as good strategies. The first was mentioned by approximately 60% of the men and 35% of the women and the second by approximately 60% of both sex'. However, in urban areas avoiding prostitutes is more often mentioned than in rural areas. It is also more often quoted by the young, the well educated and christians. Stopping intercourse is more often mentioned in rural areas, more by older people, more by the well educated and by adherents of traditional religions relative to others.

The large majority of the people know where getting an AIDS test (table A7). Knowledge decreases with age for men, and depends not very much on age for women. As expected, it increases with educational attainment and decreases strongly with household size.

The questionnaire contains not many information regarding sexual behavior. One question concerns the existence of sexual contacts during the two months prior to the survey. A second question concerns the use of condoms, and a third one, which is missing in the women data set, concerns the number of sexual partners during the two months preceding the survey.

Between 50% and 60% of the people declared to have had sexual contact during the two moths prior to the survey. Activity follows an inverted "U" with age, increases strongly with educational attainment, for men as well as for women, and finally catholics seem more active than moslems and protestants. Almost 30% of the men and 10% of the women, having had sexual intercourse during the two months prior to the survey, used condoms. Condom use decreases with age, increases with educational attainment, and is

more widespread among christians and people without religion than among moslems.

The number of sexual partners during the two months preceding the survey is highest for the intermediate age groups (table A8). In rural areas sexual activity seems in general higher and earlier. The proportion of people without sexual activity is lower among the well educated men. In contrast, they have more often than the less educated people two or more sexual partners. The proportion of people having declared to have sexual contact only with their spouse or at least with only one partner is highest among the less and the best educated men. May be surprising, the number of sexual partners varies not very much over religion. It is clear, that the number of sexual partners declared may strongly be affected by measurement error, notably for married men. Thus table A8 should be interpreted with caution.[8]

2.4 Descriptive analysis of the pattern of individual attitudes towards AIDS

In this section we present the results of two Multiple Correspondence Analysis implemented on two sub-samples of the DHS: men aged between 15 and 59 years, and women between 15 and 49 years. In each analysis, the individuals are described by the vector of their answers to the 'attitude' variables detailed in the preceding subsection.

The Multiple Correspondence Analysis (MCA) is the most suitable multivariate data descriptive analysis method for our purposes, since it deals directly with logical variables without making linearity assumptions. MCA extracts 'information' (inertia) from a multivariate categorical data, providing for an ordered set of orthogonal variables ('axis'), the first axis being the best univariate summary of the cloud of answers in terms of inertia maximization.[9] The bidimensionnal map obtained by the crossing of the first and second axis thus gives an overview of the main contrasting patterns of answers given by individuals of the samples under analysis.

[8] However, normally the interviews in the DHS are undertaken separately for men and women. Each man is interviewed by one man and each woman by one woman. Several field researchers told us that in average people living in rural Côte d'Ivoire talk more easily about sexual behavior and AIDS than people living in Abidjan.

[9] See Benzécri (1973), and Volle (1981).

Let us look first at the map giving the patterns of answers of men (see figure A1 in appendix B). Unsurprisingly, the first axis opposes a global ignorance of the AIDS illness to a well-informed sensitivity to the AIDS problem. On the one hand we find men who do not even know how one gets AIDS, whether AIDS can be cured, whether an infected person may seem healthy, whether a mother may transmit AIDS to a child and where a test can be done. On the other hand, we find men who attended a conference, knowing that an infected person may seem healthy, or that one may get AIDS by a sexual intercourse even with one's partner/spouse. Furthermore, the well-informed men know more often somebody who is infected, and have had more often more than one partner in the last two months.

The second axis puts at one end men who favor more often stopping sexual intercourse and/or avoiding occasional partners to avoid AIDS. They declare more often they had sexual intercourse with a woman who is not the spouse in the two preceding months. At the other end of the axis, we find associated together declared ignorance about the way to get AIDS or quotation of 'other sexual behavior' and individuals who favor the option of having only one sexual partner to avoid AIDS, and who have not a large number of partners in the two preceding months.

The map for women (see figure A2 in appendix B) closely resembles the map for men, however it does not include the 'number of sexual partners' variable. In the second axis the beliefs that AIDS can not be transmitted to children and that an ill person can not seem healthy, characterizing women who are not fully aware of the dangerousness of AIDS. Moreover, for wives, coordinates on each axis are correlated with coordinates of the husband, reflecting the collective (intra-household) nature of knowledge about AIDS.[10]

From these patterns of attitudes, it is not straightforward to draw a definitive conclusion about whom individuals are most susceptible to contract AIDS. As for men, the number of partners is positively correlated with correct knowledge of the main features of the illness and awareness about the dangerousness

[10]This correlation means two things: (i) the topological similarities between the two, independently constructed, bidimensionnal spaces, (ii) the correlation between individual answers of the two spouses.

of AIDS. Yet it is far from certain that knowledge and awareness necessarily lead to safe practice.

3 Risk variables and their observable factors

At the individual level, the probability of infection depends on the number of partners, the frequency of unprotected sexual intercourse with each partner, and the average level of infection of chosen partners. Drawing from the SI model adopted by Kremer (1996)[11] and omitting the i index, we write:

$$P = \rho\beta Y \tag{1}$$

where P is the probability of getting infected over a given period, ρ is the number of partners during this period, β the transmission rate and Y the average prevalence rate of partners.

Thus, the variation of risk across individuals relies on a complex combination of factors. ρ is the number of partners, but β depends on the frequency of unprotected sexual activity with each partner, that is on both sexual activity and protection behavior,[12] and Y depends on partner selection behavior, that is avoiding of / matching with potentially infected people.

First, one may remember that if people maximize a utility function like the one hypothesized by Kremer (1996): $u(\beta, \rho) - P(\beta, \rho)$, they may choose a (β, ρ) combination with a low β (condom use and/or low frequency of intercourse) and a high ρ.

Second, people may adopt a specific partner selection behavior which depends on utility derived from specific partners, however risky they are, and identification of partners' risk of infection.

The survey gives us a proxy for ρ that is the declared number of sexual partners in the last two months.

[11] Himself quoting the so-called standard 'susceptible-infected' (SI) epidemiological model, as set forth in Anderson and May (1992).

[12] Brouard (1994) quotes epidemiological studies which tend to show that the impact of the number of intercourse per partner is weak. Then, in developed countries, β would be around 0.1 for the transmission from women to men, and 0.2 for the transmission from men to women, whatever the level of sexual activity.

As for β, we may analyze the frequency of use of condoms, assuming a constant frequency of sexual intercourse with each partner.

The Y variable is the most difficult to measure from available data. 'Knowing somebody with AIDS' gives a clue about the infection of the social network surrounding the individual.[13]

3.1 The estimation procedure

Let us first describe the estimation procedure for the three variables entering the probability of infection, on the population of men aged between 15 and 59 years. We then adapt the procedure to the available information for women.

3.1.1 The case of men

We proxy ρ and β by the two following variables : 'Number of sexual partners in the last two months' and 'Use of condoms' (conditionally to the number of partners).

$$P\left(NP_i = k\right) = P(r_k < x_i b_\rho + \nu_i < r_{k+1}) = \Phi\left(X_i b_\rho - r_{k+1}\right) - \Phi\left(X_i b_\rho - r_k\right) \tag{2}$$

$$\widehat{\rho}_i = \sum_{k=0}^{k=4} k.\left[\Phi\left(X_i b_\rho - r_{k+1}\right) - \Phi\left(X_i b_\rho + r_k\right)\right] \tag{3}$$

$$\text{with } r_0 = -\infty, \quad \text{and} \quad r_5 = +\infty$$

$$P(C_i = 1) = P(X_i b_\beta + c.\rho_i + \varepsilon_i < 0) = 1 - \Phi\left(X_i b_\beta + c.\rho_i\right) \tag{4}$$

$$\widehat{\beta}_i = 1 - \Phi\left(X_i \widehat{b}_\beta\right) \tag{5}$$

X is a vector of observed variables containing age, education, localization, matrimonial status, household size, and head of household status. We assume normality and independence for ν and ϵ.

As the available measure for ρ is a discrete variable we choose an ordered probit specification to estimate the expected number of partners for each group. Three predictors of ρ might then be computed: the first with the whole set of variables entering X, ρ_{i1}, the second without the matrimonial

[13] 'Ignoring that an infected person may seem healthy', 'not considering that occasional partners may be risky', 'not quoting avoidance of prostitutes' may reflect a 'preferred matching' with partners of higher incidence rates, either by ignorance or by conscious choice. However, because of their ambiguous nature, such variables will not be used.

status in order to produce a maximum benchmark for the 'unfaithful married men' effect, ρ_{i2}. However, this correction should be taken as maximum maximorum because Y should be corrected as well for an arguable lower level of infection of wives, even if intramarital sexual intercourse is usually unprotected. Fortunately, when looking at the estimation results, we shall see that this correction turns out to be useless. The third, ρ_{i3}, is computed via an estimated equation where for married men, who have declared to have had only sexual intercourse with their wive, the number of sexual partners is coded as zero.

Note that we introduced the number of partners in equation (4), in order to control for the impact of sexual activity on the frequency of use of condoms. We then obtain a predictor for the probability of having had an unprotected intercourse for each partner encountered (holding fixed the number of partners). Under the additional assumption that the frequency of intercourse with a given partner does not vary with X, it provides an acceptable predictor for β.

For the third variable Y, we use two alternative assumptions. First, that Y is homogenous across observable groups, i.e. does not depend on X, denoted Y_1. Second, that Y varies with X like the probability of knowing somebody with AIDS, once controlled for the number of sexual partners, denoted Y_2. We assume additionally that Y does not vary with ν or ε, that is the unobservable part of ρ. This assumption is needed for the econometric identification of the effect of ρ. Note that ρ is eliminated in the predictor of Y_2 as for the predictor of β.

$$P(KN_i = 1) = P(X_i b_Y + d.\rho_i + \eta_i < 0) = 1 - \Phi\left(X_i b_Y + d.\rho_i\right) \quad (6)$$

$$\widehat{Y}_i = 1 - \Phi\left(X_i \widehat{b}_Y\right) \quad (7)$$

3.1.2 The case of women

For women, we would have implemented the same procedure, if information on the number of partners was available. To obtain a predictor for ρ, we may simply use the dichotomous information saying whether the person had a sexual intercourse in the preceding two months. However, such a choice

may give biased coefficients, and automatically restricts the spread of risk of infection. To correct for this latter problem, we could alternatively think to predict an expected number of partners with the estimated coefficients for men. But we have no reason to believe either that the same parameters apply for women sexual activity. In the absence of any satisfying solution, we give our preference to the direct estimation of risk differentials based on the available dichotomous variable.

3.2 Estimation results

We turn now to the results of estimation for the three basic variables, respectively the number of partners, the use of condoms, and having a relative who is infected by HIV/AIDS.

3.2.1 Sexual activity

For men, the number of sexual partners is only lower for ages between 15 and 19 years, the coefficients for all other age groups being non-significantly different from each other (left part of table 1). Household heads have a slightly higher expected number of sexual partners. Conversely, matrimonial status does not come out as significant. This means that we are not confronted with a high 'married man' bias on the declared number of partners. Most importantly, the declared number of partners grows in two steps with education, possibly because they have greater personal autonomy and spatial mobility, and are more often polygamous. It is slightly inferior in Abidjan, other things being equal.

For women, the probability of having had sexual intercourse within the two months period preceding the survey is now marked by a strong positive 'married woman' effect (right part of table 1). This suggests that this dichotomous variable is a mediocre proxy for the risk variable ρ. Nevertheless, it is interesting to observe that the results obtained for men with the polytomic variable are preserved for education and localization, that is sexual activity growing in two steps with education and slightly lower in the capital town Abidjan.

Table 1
Men 15 to 59 years old, Ordered Probit model
Number of sexual partners during last two months ($\rho_{1,2,3}$)
(0 = 0 partners, 1 = 1 p., 2 = 2 p., 3 = 3 p., 4 = 4 and more p.)

Women 15 to 49 years old, Probit model
Had sexual relation last two months (ρ_1)
(1 = yes, 0 = no)

	Men		Women	
Variables	Coeff.	Std. err.	Coeff.	Std. err.
Age group				
15-19	Ref.		Ref.	
20-24	0.662 *	(0.081)	0.166 *	(0.048)
25-29	0.728 *	(0.089)	0.150 *	(0.054)
30-34	0.761 *	(0.102)	0.044	(0.057)
35-39	0.726 *	(0.114)	0.044	(0.064)
40-44	0.734 *	(0.123)	-0.028	(0.069)
45-49	0.516 *	(0.135)	-0.089	(0.075)
50-54	0.500 *	(0.147)		
55-59	0.756 *	(0.162)		
Ever married	0.093	(0.073)	0.490 *	(0.044)
Household head	0.192 *	(0.068)		
Educational level				
analphabetic	Ref.		Ref.	
reading/writing	0.216 *	(0.068)	0.235 *	(0.043)
Primary school	0.282 *	(0.063)	0.270 *	(0.043)
Lower secondary[a]	0.585 *	(0.080)	0.393 *	(0.076)
Higher secondary	0.522 *	(0.105)		
Household size	0.007 *	(0.004)	-0.005 *	(0.002)
Abdijan	-0.203 *	(0.067)	-0.121 *	(0.043)
Other Cities	0.036	(0.054)	0.018	(0.034)
Rural areas	Ref.		Ref.	
Intercept			-0.225 *	(0.047)
Number of observations	2 446		7 552	
log likelihood	-2 627		-4 965	
dl	17		13	

Notes: * Coefficient significative at the 5% level. [a] For women the levels "lower secondary" and "higher secondary" are aggregated.
Source: DHS 1994; estimations by the authors.

3.2.2 Condom use

The models explaining the probability of using condoms (conditionally on sexual activity) give very similar results for both sexes (table 2).

Given the symmetric and at least partially homogamic characteristics of 'sexual matching', this first result increases our confidence in the estimates. They reveal rather straightforward effects: condom use decreases with age and with married status, and conversely increases with education[14]. For men, the number of partners comes out as significant, increasing condom use too. Remember we do not introduce this latter variable in the prediction of β. Place

[14]This result was also emphasized by Filmer (1998) and Deheneffe, Caraël and Noumbissi (1998)

Table 2
Used condom during last two months (β)
Probit models, Men 15 to 59, Women 15 to 49 years old

	Men		Women	
Variables	Coeff.	Std. err.	Coeff.	Std. err.
Age group				
15-19	Ref.		Ref.	
20-24	0.068	(0.145)	-0.058	(0.086)
25-29	-0.128	(0.156)	-0.238 *	(0.107)
30-34	-0.219	(0.180)	-0.273 *	(0.123)
35-39	-0.354	(0.203)	-0.279	(0.144)
40-44	-0.616 *	(0.237)	-0.554 *	(0.215)
45-49	-0.595 *	(0.273)	-0.659 *	(0.281)
50-54	-0.591 *	(0.317)		
55-59	-0.925 *	(0.412)		
Ever married	-0.444 *	(0.123)	-0.693 *	(0.080)
Household head	-0.025	(0.121)		
Educational level				
analphabetic	Ref.		Ref.	
reading/writing	0.118	(0.129)	0.402 *	(0.084)
Primary school	0.396 *	(0.114)	0.460 *	(0.082)
Lower secondary[a]	0.788 *	(0.128)	0.960 *	(0.113)
Higher secondary	0.562 *	(0.162)		
Household size	-0.007	(0.007)	0.000	(0.004)
Abdijan	0.116	(0.118)	0.084	(0.090)
Other Cities	0.183	(0.096)	0.085	(0.072)
Rural areas	Ref.		Ref.	
Number of sex. partners				
1 partner	Ref.			
2 partners	0.553 *	(0.105)		
3 partners	0.766 *	(0.163)		
4 and more partners	0.941 *	(0.188)		
Intercept	-0.726 *	(0.165)	-1.194 *	(0.095)
Number of observations	1 339		4 436	
log likelihood	-606		-947	
dl	20		13	

Notes: * Coefficient significative at the 5% level. [a] For women the levels "lower secondary" and "higher secondary" are aggregated.
Source: DHS 1994; estimations by the authors.

of dwelling comes out as insignificant, as well as head of household status in the case of men. For both sexes, the strong 'marriage effect' on condom use may be a matter of worry. It partially corresponds to a higher confidence in the partner, which theoretically should be reflected in the Y variable rather than in the β variable. Unfortunately again, we can not state satisfyingly on the respective weight of the 'faithfulness' and 'unprotected marital intercourse' factors. In our calibration of mortality rates, we cancel out this 'marriage effect' on condom use, in order to obtain an average (in our sense) benchmark.

3.2.3 AIDS infection among relatives

In the case of men, the probability of knowing somebody who is infected with HIV is lower for youngest inexperienced people (15-20 years old) and higher for household heads (see table 3). As already noted in the MCA, it increases with the declared number of partners. It also increases with the level of education. Of course, this effect of education may reflect an increasing size of the social network rather than a higher probability of matching with infected people. This is why we consider that the use of this variable tends to overestimate the 'true Y' for educated people. Conversely, living in Abidjan has a significant negative effect on the probability of knowing infected people. The interpretation may be that secrecy is better preserved in large towns than in other dwelling places where social links are more intimate and less anonymous.

In the case of women, age effects are almost insignificant, except for the 30-34 years old group. The positive effect of education is maintained. Other things being equal, married women know more often somebody who is infected. In contrast with men, the effect of living in Abidjan disappears. These two latter results may reflect gender differences in social networks (more extended and intimate knowledge of relatives for married women, whatever their place of dwelling).

Table 4 gives some statistics concerning the distribution of four different risk factors, denoted, $P1$ to $P4$, which are obtained by using the mentioned alternative predictions for ρ and Y. Figure 1 presents the corresponding Kernel density curves.

4 Derivation of AIDS mortality probabilities for population subgroups

The aim of this paper is to model mortality differentials between socio-demographic groups regarding the probability of dying through AIDS. In the former section we estimated risk factors of HIV/AIDS infection, P, for groups defined by age, sex, education, marital status, position in the household, household

Table 3
Knows somebody infected with HIV/AIDS (Y_2)
Probit models, Men 15 to 59, Women 15 to 49 years old

	Men		Women	
Variables	Coeff.	Std. err.	Coeff.	Std. err.
Age group				
15-19	Ref.		Ref.	
20-24	0.284 *	(0.100)	-0.054	(0.054)
25-29	0.193	(0.112)	0.083	(0.059)
30-34	0.398 *	(0.129)	0.171 *	(0.062)
35-39	0.268	(0.144)	0.104	(0.070)
40-44	0.386 *	(0.155)	0.114	(0.077)
45-49	0.585 *	(0.166)	0.087	(0.085)
50-54	0.426 *	(0.183)		
55-59	0.353	(0.208)		
Ever married	-0.033	(0.093)	0.145 *	(0.049)
Household head	0.166 *	(0.085)		
Educational level				
analphabetic	Ref.		Ref.	
reading/writing	0.361 *	(0.086)	0.283 *	(0.047)
Primary school	0.560 *	(0.078)	0.332 *	(0.046)
Lower secondary[a]	0.630 *	(0.100)	0.527 *	(0.077)
Higher secondary	0.719 *	(0.129)		
Household size	0.011 *	(0.004)	0.000	(0.002)
Abidjan	-0.215 *	(0.084)	-0.031	(0.048)
Other Cities	-0.097	(0.068)	-0.018	(0.037)
Rural areas				
Number of sex. partners				
0 partner	Ref.			
1 partner	0.133	(0.068)		
2 partners	0.281 *	(0.103)		
3 partners	0.493 *	(0.166)		
4 and more partners	0.828 *	(0.177)		
Had sex last two months			0.105 *	(0.034)
Intercept	-1.527 *	(0.106)	-1.125 *	(0.055)
Number of observations	2 422		7 536	
log likelihood	-1 253		-3 883	
dl	21		14	

Notes: * Coefficient significative at the 5% level. [a] For women the levels "lower secondary" and "higher secondary" are aggregated.
Source: DHS 1994; estimations by the authors.

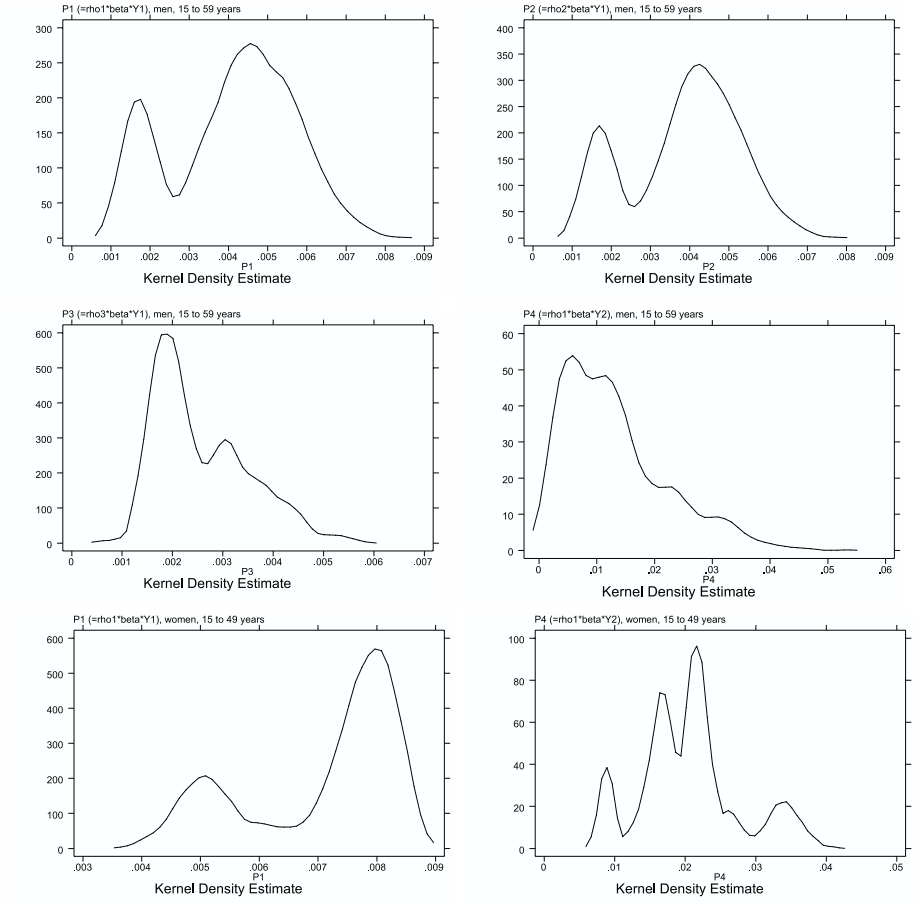
Table 4
Summary statistics of the alternative risk factors

Risk factor	Obs.	Mean	Std. dev.	Min.	Max.
MEN 15 TO 59 YEARS OLD					
$P1 = \rho_1 \beta Y_1$	2446	0,0041009	0,0015774	0,0009032	0,0083762
$P2 = \rho_2 \beta Y_1$	2446	0,0038631	0,0014032	0,0009032	0,0077560
$P3 = \rho_3 \beta Y_1$	2446	0,0025684	0,0009402	0,0005708	0,0058652
$P4 = \rho_1 \beta Y_2$	2446	0,0130047	0,0089671	0,0005516	0,0534365
WOMEN 15 TO 49 YEARS OLD					
$P1 = \rho_1 \beta Y_1$	7552	0,0070848	0,0012960	0,0037269	0,0087682
$P4 = \rho_1 \beta Y_2$	7552	0,0205611	0,0070826	0,0066786	0,0418143

Source: DHS 1994; estimations and calculations by the authors.

size, and region of residence using Ivoirian DHS data. Now we have to derive mortality tables for the so defined groups by introducing these risk factors in

Figure 1
Kernel density curves for the distribution of the different risk factors
(Men: P1, P2, P3, P4; Women P1, P4)



Source : DHS 1994 ; estimations and computations by the authors.

more aggregated mortality tables in a way that the overall mortality remains constant.

The most recent mortality tables for Côte d'Ivoire are those estimated by the INS using census data of 1988 and 1998 (INS 1992, 2001). However, the INS provides no estimations concerning mortality due to the AIDS epidemic. Another source are the United Nations' demographic projections in the long term for Côte d'Ivoire. These projections incorporate infant (${}_1q(1)$) and juvenile mortality (${}_5q(0)$) for both sexes together as well as the life expectancy at birth (e_0) for each sexe separately. These indicators are estimated for five-year periods until 2050 under two scenarios: the first taking into account the impact of AIDS, and the second under the hypothesis of an absence of AIDS

(see table 5).[15]

Comparing the United Nations' projections with the estimations of the INS (Table 5), one can note that both show a rise of mortality since 1985. The main reason is surely the AIDS epidemic. However, the United Nations' projections are little bit more optimistic concerning infant mortality and a little more pessimistic concerning adult mortality. In any case, both institutions consider their estimations as relatively uncertain. We calibrate our model on the United Nations projections, allowing to isolate (at least approximatively) mortality due to AIDS, and to work with coherent projections until 2015. Departing from these projections and by using the concept of model life tables, we construct mortality tables for both sexes and for five-year periods starting in 1990.

Table 5
Estimations and projections of mortality in Côte d'Ivoire with and without AIDS

Indicator	1985-90	1990-95	1995-00	2000-05	2005-10	2010-15
Infant mortality						
with AIDS	0.102	0.094	0.089	0.081	0.072	0.063
without AIDS	0.098	0.086	0.079	0.071	0.064	0.056
census 1988 and 1998	0,097		0,104			
Mortality under five						
with AIDS	0.167	0.159	0.152	0.138	0.121	0.104
without AIDS	0.160	0.142	0.128	0.113	0.099	0.085
Life expectancy at birth						
with AIDS/Men	49.8	48.6	47.4	47.7	49.5	52.0
without AIDS/Men	51.0	52.8	54.9	57.0	59.0	61.1
census 1988 and 1998	53,6		49,2			
with AIDS/Women	52.8	50.8	48.1	48.1	50.1	52.9
without AIDS/Women	54.5	56.7	58.4	60.5	62.5	64.6
census 1988 and 1998	57,2		52,7			

Source: World Population Prospects 2000, version February 2001 (United Nations 2001), Populations census 1988 (INS 1992) and 1998 (INS 2001).

More precisely a set of mortality tables is calculated containing mortality rates for both sexes separately and for five year age intervals for the periods

[15] All these indicators are estimated within the World Population Prospects 2000, version February 2001 (United Nations 2001). The estimation method is explained in United Nations (1999). It is important to note that the UN reports the difference in the number of deaths produced by these two projections as the number of deaths 'associated with the disease'. That number is not equivalent to the number of deaths 'caused by AIDS' because it is affected by the dynamics of population's mortality and, particularly as one moves further into the future, the 'without AIDS' projection includes the deaths of persons that in the AIDS projections die earlier because of AIDS.

1990-95, 1995-2000, ..., 2010-15 by introducing in a Ledermann (1969) model life table (*pattern 100*) the United Nations life-expectancy projections under the hypothesis 'No AIDS'.[16] Then the mortality rates are proportionally adjusted such that they produce exactly the life-expectancy entered.[17] The mortality rates ${}_1q(0)$ and ${}_4q(1)$ are directly restricted to the United Nations projections. Then, a second set of mortality tables is constructed taking into account the impact of AIDS. Now, we use as entry for the model life-tables the United Nations 'with AIDS' life-expectancies at birth. As before, the mortality rates are adjusted such that they produce exactly the life-expectancy entered. But, to ensure that the mortality rates are in line with those of a population affected by the AIDS epidemic, the adjustment concerns now only the age intervals between 20 and 59 years. For ${}_1q(0)$ and ${}_4q(1)$, the 'with AIDS' rates estimated by the United Nations are directly used. For the mortality rates ${}_5q(5)$, ${}_5q(10)$, ${}_5q(15)$, ${}_5q(60)$ ... ${}_5q(80)$ those of the 'without AIDS' scenario are retained, that means we suppose no impact of AIDS for these age groups. In consequence, the adjustment increases strongly mortality in the intermediate adult age, and this the more the heavier the epidemic is supposed to be. For both types of tables—with AIDS and without AIDS—we fix the mortality rate beyond 87 years at one, such that there is no survivor at 88 years.

To derive now mortality tables for deaths due to AIDS taking into account the heterogeneity regarding the risk of infection we proceed as follows. In a first step we transform the mortality rates in the mortality tables, with and without AIDS, for age groups and five year periods in mortality rates for single ages a and years t. This is done by interpolating linearly the mortality rates for the five-year age groups between the tables of two neighboring periods and then by interpolating, likewise linearly, between to neighboring age groups.[18]

[16] Ledermanns model life tables are preferable to the standard OECD tables (Clairin *et al.* 1980) which are despite the fact that they are only based on data of developing countries judged as of poor quality (see Duchêne 1999). They are also more suitable than the "new" tables of the United Nations (1982) which do even not include sub-saharan Africa. The only represented African country is Tunisia.

[17] In this type of Ledermann model life table the entered life-expectancy is slightly different from that finally produced by the constructed table.

[18] In the demographic literature one can find more adequate interpolation methods, parametric and non-parametric ones (see e.g. Kostaki and Panousis 2001), but given the following

Then we normalize the individual risk factors P_i to one for each age a, between 15 and 59 years for men and 15 and 49 years for women, by multiplying them with the ratio between the number of individuals of the same age n_a and the sum of the risk factors in this age, which reads:

$$\tilde{P_{ia}} = P_{ia} \frac{n_a}{\sum_{i=1}^{n_a} P_{ia}} \tag{8}$$

The normalization assures that the introduction of the individual risk factors does not modify the overall mortality level given by the UN projections. However, it is clear that this normalization modifies the risk age pattern, in the sense that now the individual risk factor depends on the risk level and dispersion of his/her age-class mates. That means, an individual with a high risk who is surrounded by many other high risk persons can finally have a risk factor lower than that of a person with a initial moderate risk factor, but who is surrounded by many low risk persons. However this bias is, at least partly, redressed by the calibration of the AIDS mortality rates on the mortality age pattern derived above.

In a next step, we multiply for each individual the normalized risk multipliers $\tilde{P_{ia}}$ with the difference between the interpolated mortality rate with and without AIDS, such that we obtain for each individual a probability of dying by a cause other than AIDS and a probability of dying through AIDS, given the period and his individual characteristics.

The way our risk factors are constructed imply that they measure more the risk of infection than the risk of dying through AIDS. The HIV infection and the death trough AIDS are separated by the incubation period, which is the duration between the infection and the onset of clinical AIDS, and by the duration between the onset and death. The length of the incubation period is thought to depend upon at least four determinants: (a) mode of HIV transmission; (b) age of the person; (c) exposure to other disease; (d) other individual characteristics, including genetic make-up. Estimates of the mean incubation period range from 5.1 years to 10.6 years[19], and those of the period

introduction of risk multipliers in the mortality tables that will in any case modify the mortality age pattern, the use of these methods seems not necessary.

[19]The UN uses a median adult progression time of eight years for African countries (United Nations 1998). Mulder (1996) assumes a shorter interval of five to six years.

between the AIDS onset and death around 1.5 years, but the uncertainty associated with these estimates is substantial (Palloni and Glicklich 1991). We suppose thus implicitly that the risk of infection is proportional to the risk of dying through AIDS.

In the following tables figure the averages of the derived individual AIDS mortality probabilities per year for men (15 to 59 years old) and women (15 to 49 years old) stratified by educational attainment and area of residence. Of course, these tables could be derived for various other individual characteristics as well. They are each time confronted with the mortality probabilities of dying by a cause other than AIDS (first column). The sum of this latter probability with the probability of dying through AIDS is equal to the overall death probability. The results are presented for two of our four risk factors: $P1$ and $P4$ (see the definition section 3.1). Furthermore, we used different mortality levels, the one of 1994, year of the used DHS, and 2001, which would present the actual situation if the model is valid. All these simulations are done by using the female and male population covered by the Ivorian DHS women and men questionnaire respectively. As mentioned, the mortality probabilities for population subgroups are not independent of the population structure. The tables allow the following interpretations.

1. The risk of dying through AIDS increases continuously with age for men. For women it increases until the age of 35 and then remains more or less constant or even declines slightly (tables 6 to 9). The general increase is due to several reasons. First, as it can be seen in table 1, for men the number of sexual partners is, *ceteris paribus*, maximum for intermediate age groups. Second, condom use decreases with age for men and women (table 2). Third, the probability of knowing somebody with AIDS rises with age, likewise for men and women (table 3). Fourth, the way our Ledermann life tables are adjusted to the life-expectancy given by the UN projections makes age groups with a higher risk of dying by a cause other than AIDS also more likely to die through AIDS. This is not unrealistic, given that we consider here only age groups between 15 and 59 years, and that the risk of dying by opportunistic illnesses may indeed increase with

age. The fact that for women the risk is concentrated in the intermediate age groups is in line with the general finding in Côte d'Ivoire that women affected by AIDS are in average younger than affected men and is due the important age gap in couples and sexual relations (see Garenne *et al. 1995*).

2. In line with the UN projections (compare with table 5) on which our mortality probabilities are calibrated, the risk of dying through AIDS is in 2001 significantly higher than in 1994 for all stratifications chosen in tables 6 to 9. For the male age groups 20 to 45 years and the female age groups 20 to 49 the risk of dying through AIDS is equal or sometimes even higher, especially for women, than by dying of another cause than AIDS. Thus, AIDS is for these age groups by far the major cause of death.

3. The urban-rural differential shows an interesting pattern. The AIDS death probabilities for men are higher in rural areas for the age groups 15 to 39, whereas there are lower for the age groups 40 to 54 (the last age group is rather small in rural areas and should thus considered with caution). For women, they are in 1994 always higher in rural areas. In contrast, in 2001, they are for all age groups older than 25 slightly higher in urban areas. It may surprising that the AIDS death probabilities are not significantly lower in rural areas than in urban areas, but it should be noted that (a) as mentioned in section 2.1 the epidemic reached very rapidly all regions in Côte d'Ivoire; (b) the number of sexual partners for men and sexual activity in general for women is, in rural areas significantly higher than in urban areas (see table 1), which can for men partly be explained by a higher proportion of polygamous men in rural areas; (c) condom use seems less frequent than in urban areas (see table 2); (d) people know more often somebody with AIDS than in urban areas (see table 3). Furthermore, even if this is not in the used demographic projections, but it supports however our results, the general mortality level in rural areas is higher than in urban areas, and thus the risk of

dying by opportunistic illnesses may be too.

4. The AIDS mortality probabilities increase for each age group with educational attainment, especially for men, and a little less for women in urban areas (see table 6 to 9). This increase is larger the higher the age and maximum for the age group 40 to 44 for men and 44 to 49 for women. For instance, in urban areas the probability in the year 2001 is for the male age group 25 to 29, using P1, 25% higher for individuals with at least secondary high school than for those who know neither reading nor writing. In contrast, this increase is more than 35% for the age group 40 to 44. If we use the risk factor $P4$ instead of $P1$, the risk heterogeneity becomes, as expected, even higher, because then the probability of knowing somebody with AIDS determines the prevalence level of the individual's environment (see section 3.2), and this probability increases strongly with education (see table 3). For instance, in urban areas in the year 2001 the probability for individuals having a higher secondary schooling level is 2.3 to 4 times higher than that of individuals having no schooling at all.

Table 6
AIDS mortality probabilities p.a. x100 by educational attainment
Men, urban Côte d'Ivoire

Age group	other causes	mortality attributable to AIDS all	anlph.	read.	prim.	losec.	hisec.
	risk factor: $\rho_1\beta Y_1$, using the mortality level of 1994						
15-19	0.376	0.014	0.008	0.013	0.002	0.049	0.136
20-24	0.540	0.258	0.268	0.279	0.230	0.255	0.266
25-29	0.562	0.398	0.368	0.429	0.401	0.388	0.457
30-34	0.608	0.434	0.397	0.483	0.442	0.439	0.494
35-39	0.713	0.471	0.424	0.514	0.469	0.485	0.537
40-44	0.900	0.522	0.441	0.564	0.602	0.585	0.605
45-49	1.183	0.547	0.487	0.562	0.602	0.737	0.518
50-54	1.609	0.606	0.615	0.558	0.542		0.647
55-59	2.237	0.601	0.576	0.601	0.667		0.894
	risk factor: $\rho_1\beta Y_2$, using the mortality level of 1994						
15-19	0.376	0.013	0.000	0.007	0.004	0.058	0.180
20-24	0.540	0.238	0.122	0.231	0.255	0.323	0.339
25-29	0.562	0.387	0.176	0.380	0.474	0.474	0.721
30-34	0.608	0.418	0.218	0.455	0.510	0.543	0.658
35-39	0.713	0.442	0.213	0.455	0.526	0.619	0.726
40-44	0.900	0.534	0.249	0.571	0.771	0.859	0.910
45-49	1.183	0.554	0.325	0.640	0.807	1.064	0.819
50-54	1.609	0.611	0.483	0.671	0.786		1.110
55-59	2.237	0.572	0.443	0.740	1.202		1.325
	risk factor: $\rho_1\beta Y_1$, using the mortality level of 2001						
15-19	0.312	0.052	0.043	0.052	0.037	0.099	0.231
20-24	0.446	0.508	0.518	0.550	0.465	0.502	0.522
25-29	0.463	0.727	0.670	0.782	0.732	0.705	0.838
30-34	0.503	0.791	0.724	0.874	0.806	0.799	0.897
35-39	0.596	0.860	0.777	0.937	0.852	0.905	0.973
40-44	0.767	0.961	0.824	1.033	1.069	1.098	1.112
45-49	1.036	1.004	0.897	1.023	1.106	1.316	1.050
50-54	1.440	1.099	1.093	1.062	1.042		1.207
55-59	2.036	1.087	1.040	1.222	1.278		1.368
	risk factor: $\rho_1\beta Y_2$, using the mortality level of 2001						
15-19	0.312	0.050	0.011	0.039	0.042	0.119	0.316
20-24	0.446	0.472	0.251	0.462	0.511	0.627	0.657
25-29	0.463	0.707	0.322	0.694	0.865	0.861	1.317
30-34	0.503	0.761	0.400	0.822	0.931	0.989	1.195
35-39	0.596	0.807	0.392	0.830	0.956	1.148	1.315
40-44	0.767	0.983	0.478	1.045	1.372	1.594	1.663
45-49	1.036	1.015	0.607	1.162	1.474	1.901	1.591
50-54	1.440	1.107	0.857	1.263	1.478		2.032
55-59	2.036	1.036	0.804	1.470	2.231		2.152

Notes: anlph.=analphabetic; read.=reading/writing; prim.=primary school; losec.=lower secondary; hisec.=higher secondary and +.
Source: Estimations by the authors.

Table 7
AIDS mortality probabilities p.a. x100 by educational attainment
Men, rural Côte d'Ivoire

Age group	other causes	mortality attributable to AIDS all	anlph.	read.	prim.	losec.	hisec.
	risk factor: $\rho_1\beta Y_1$, using the mortality level of 1994						
15-19	0.376	0.021	0.020	0.029	0.000	0.081	
20-24	0.540	0.325	0.293	0.333	0.362	0.343	
25-29	0.562	0.455	0.419	0.491	0.467	0.514	
30-34	0.608	0.473	0.428	0.522	0.485	0.539	
35-39	0.713	0.512	0.449	0.551	0.524	0.598	
40-44	0.900	0.525	0.488	0.609	0.574	0.692	
45-49	1.183	0.552	0.522	0.614	0.619	0.702	
50-54	1.609	0.588	0.562	0.726	0.679		
55-59	2.237	0.622	0.609	0.709	0.869		
	risk factor: $\rho_1\beta Y_2$, using the mortality level of 1994						
15-19	0.376	0.021	0.000	0.027	0.005	0.108	
20-24	0.540	0.344	0.170	0.362	0.513	0.521	
25-29	0.562	0.462	0.267	0.524	0.648	0.813	
30-34	0.608	0.487	0.282	0.561	0.648	0.800	
35-39	0.713	0.545	0.279	0.572	0.719	0.934	
40-44	0.900	0.513	0.355	0.734	0.811	1.181	
45-49	1.183	0.546	0.416	0.702	0.890	1.156	
50-54	1.609	0.585	0.490	0.998	1.232		
55-59	2.237	0.633	0.578	1.064	1.237		
	risk factor: $\rho_1\beta Y_1$, using the mortality level of 2001						
15-19	0.312	0.067	0.059	0.081	0.038	0.149	
20-24	0.446	0.629	0.570	0.650	0.690	0.657	
25-29	0.463	0.830	0.765	0.895	0.852	0.935	
30-34	0.503	0.864	0.783	0.951	0.888	0.986	
35-39	0.596	0.943	0.833	0.996	0.971	1.103	
40-44	0.767	0.966	0.904	1.107	1.045	1.268	
45-49	1.036	1.008	0.953	1.133	1.132	1.278	
50-54	1.440	1.080	1.037	1.304	1.264		
55-59	2.036	1.135	1.114	1.313	1.322		
	risk factor: $\rho_1\beta Y_2$, using the mortality level of 2001						
15-19	0.312	0.069	0.028	0.077	0.060	0.207	
20-24	0.446	0.663	0.344	0.703	0.967	0.983	
25-29	0.463	0.843	0.488	0.955	1.182	1.479	
30-34	0.503	0.890	0.517	1.022	1.185	1.461	
35-39	0.596	1.004	0.524	1.033	1.325	1.712	
40-44	0.767	0.944	0.664	1.333	1.472	2.151	
45-49	1.036	0.996	0.763	1.290	1.618	2.090	
50-54	1.440	1.076	0.908	1.787	2.248		
55-59	2.036	1.154	1.059	1.948	1.991		

Notes: anlph.=analphabetic; read.=reading/writing; prim.=primary school; losec.=lower secondary; hisec.=higher secondary and +.
Source: Estimations by the authors.

Table 8
AIDS mortality probabilities p.a. x100
by educational attainment
Women, urban Côte d'Ivoire

Age group	other causes	mortality attributable to AIDS all	anlph.	read.	prim.
risk factor: $\rho_1 \beta Y_1$, using the mortality level of 1994					
15-19	0.285	0.020	0.019	0.032	0.012
20-24	0.383	0.473	0.501	0.482	0.430
25-29	0.429	0.630	0.644	0.642	0.601
30-34	0.471	0.660	0.661	0.689	0.645
35-39	0.539	0.657	0.658	0.668	0.647
40-44	0.632	0.643	0.632	0.678	0.668
45-49	0.789	0.605	0.597	0.634	0.645
risk factor: $\rho_1 \beta Y_2$, using the mortality level of 1994					
15-19	0.285	0.020	0.000	0.038	0.019
20-24	0.383	0.486	0.391	0.564	0.561
25-29	0.429	0.651	0.533	0.770	0.796
30-34	0.471	0.681	0.560	0.839	0.886
35-39	0.539	0.682	0.558	0.824	0.902
40-44	0.632	0.671	0.565	0.884	0.989
45-49	0.789	0.632	0.550	0.895	1.034
risk factor: $\rho_1 \beta Y_1$, using the mortality level of 2001					
15-19	0.237	0.060	0.060	0.080	0.048
20-24	0.321	0.887	0.937	0.904	0.809
25-29	0.361	1.157	1.182	1.179	1.105
30-34	0.399	1.203	1.205	1.255	1.176
35-39	0.463	1.184	1.185	1.207	1.168
40-44	0.554	1.142	1.120	1.206	1.195
45-49	0.710	1.052	1.036	1.125	1.125
risk factor: $\rho_1 \beta Y_2$, using the mortality level of 2001					
15-19	0.237	0.062	0.045	0.091	0.064
20-24	0.321	0.911	0.734	1.056	1.050
25-29	0.361	1.195	0.980	1.414	1.460
30-34	0.399	1.241	1.022	1.526	1.613
35-39	0.463	1.229	1.005	1.486	1.625
40-44	0.554	1.192	1.003	1.568	1.762
45-49	0.710	1.099	0.956	1.576	1.796

Notes: anlph.=analphabetic; read.=reading/writing; prim.=primary school and +.
Source: Estimations by the authors.

Table 9
AIDS mortality probabilities p.a. x100
by educational attainment
Women, rural Côte d'Ivoire

Age group	other causes	mortality attributable to AIDS all	anlph.	read.	prim.
risk factor: $\rho_1 \beta Y_1$, using the mortality level of 1994					
15-19	0.285	0.027	0.030	0.021	0.020
20-24	0.383	0.506	0.523	0.494	0.450
25-29	0.429	0.666	0.663	0.684	0.667
30-34	0.471	0.683	0.677	0.702	0.701
35-39	0.539	0.682	0.676	0.706	0.701
40-44	0.632	0.654	0.649	0.718	0.693
45-49	0.789	0.613	0.613	0.636	0.621
risk factor: $\rho_1 \beta Y_2$, using the mortality level of 1994					
15-19	0.285	0.026	0.000	0.029	0.028
20-24	0.383	0.491	0.433	0.599	0.597
25-29	0.429	0.648	0.569	0.849	0.905
30-34	0.471	0.663	0.589	0.870	0.946
35-39	0.539	0.662	0.588	0.895	0.970
40-44	0.632	0.630	0.595	0.939	0.984
45-49	0.789	0.598	0.582	0.918	0.982
risk factor: $\rho_1 \beta Y_1$, using the mortality level of 2001					
15-19	0.237	0.074	0.079	0.066	0.062
20-24	0.321	0.950	0.980	0.928	0.850
25-29	0.361	1.223	1.217	1.257	1.225
30-34	0.399	1.244	1.234	1.279	1.278
35-39	0.463	1.229	1.219	1.271	1.264
40-44	0.554	1.159	1.149	1.273	1.232
45-49	0.710	1.066	1.064	1.120	1.108
risk factor: $\rho_1 \beta Y_2$, using the mortality level of 2001					
15-19	0.237	0.072	0.065	0.083	0.081
20-24	0.321	0.922	0.814	1.122	1.120
25-29	0.361	1.190	1.046	1.558	1.660
30-34	0.399	1.209	1.074	1.584	1.724
35-39	0.463	1.193	1.061	1.610	1.745
40-44	0.554	1.116	1.054	1.662	1.745
45-49	0.710	1.040	1.010	1.607	1.731

Notes: anlph.=analphabetic; read.=reading/writing; prim.=primary school and +.
Source: Estimations by the authors.

5 Conclusion

The aim of this paper was to model and estimate individual heterogeneity regarding AIDS mortality. Knowledge in this field seems indispensable to quantify the economic impact of AIDS and to set up adequate AIDS prevention and therapy policies.

A main result of our study is that the risk of infection and therefore the risk of dying through AIDS is increasing with educational attainment. The driving force behind this relation is that educated people are more likely to have several sexual partners. However, this effect is partly offset by a higher probability of condom use. If we account for heterogeneity in the individual risk environment, we find again a positive association between risk and education. Some argue that this excess infection levels seen among more educated groups may disappear as the epidemic progresses because educated people may adopt quicker than other groups new, less risky lifestyles (Ainsworth and Semali 1998; Gregson, Waddell and Chandiwana 2001). We checked this hypothesis by running the same regressions on the Demographic and Health Survey (DHS) of 1998/99.[20] However, we found very similar regression coefficients to 1994, especially the measured associations between risk and education hold.

Would this relation between education and risk of infection be confirmed, the economic implications would be very important. From a macro-economic point of view this could imply a massive destruction of human capital. From a micro-economic point of view, one could expect an appraisal of new categories of poor through transitions from the top to the bottom of the distribution of income.

An advantage of our model is that it is based on econometrically estimated equations and commonly available individual and household characteristics. Therefore, it can be used to forecast risk differentials for other data sources as well, household living standard surveys for example, which would allow to analyze the impact of AIDS on inequality and poverty.

[20] We used however the DHS 1994 because the DHS 1998/99 has a much smaller sample size (8 099 women and 2 552 men vs. 3 040 and 886 respectively) (Macro International Inc. 1999).

However, we are conscious of the simplicity of our model specification. Dynamics, which are generally important in epidemiology, are only added to our model through the calibration of our risk factors on demographic projections, but they do not directly affect individual behavior. Furthermore, the used variables are only imperfect proxies or sexual behavior. First, the measurement of the number of sexual partners may be biased, especially for married men. Second, frequency of sexual intercourse should be taken into account. And last but not least, partners matching is far from being adequately dealt with. However, the retained variables for the estimation are surely those which are the most likely to reflect individual risk of infection, in contrast with knowledge, opinions and attitudes regarding the epidemic.

In spite of its methodological caveats, we think that this study is a first step in modelling the distribution of AIDS over socio-economic groups. A more detailed model will be feasible when better data, especially a representative survey about HIV infection, becomes available.

Appendix A: Descriptive statistics of the variables describing attitudes and knowledge with regard to AIDS

Table A1
Did you hear of an illness called AIDS?
If yes, did you already assist to a conference concerning AIDS?

	Heard about it			If heard about it, assisted at a conference		
	Ab.	OC.	Rur.	Ab.	OC.	Rur.
MEN, 15 TO 59 YEARS OLD						
All	99.3	97.8	93.9	31.1	26.9	21.6
Age group						
15-24	100.0	97.7	93.8	35.5	32.2	27.2
25-34	97.6	98.0	95.5	28.3	27.6	19.7
35-44	100.0	98.6	93.4	28.4	23.1	15.1
45-59	100.0	96.7	90.2	27.3	13.6	14.2
Educational level						
analphabetic	98.2	96.5	89.5	4.6	9.1	8.3
reading/writing	100.0	97.4	96.7	25.0	14.6	17.1
Primary school	99.2	98.5	97.3	25.8	34.2	33.3
Lower secondary	100.0	100.0	100.0	58.6	59.1	62.0
Higher secondary	100.0	100.0	100.0	68.5	68.2	63.6
Religion						
catholic	99.1	96.7	94.8	45.3	38.8	30.6
protestant	100.0	98.7	97.4	40.4	35.1	31.4
islam	99.5	97.7	93.2	16.7	18.6	14.1
traditional	(100.0)	(100.0)	93.7	(46.7)	(40.0)	16.6
without rel./other	98.3	98.8	91.5	39.3	33.3	17.5
Household size						
$0 < \cdot \leq 2$	100.0	97.7	89.9	15.7	31.2	18.0
$2 < \cdot \leq 5$	99.1	98.2	92.6	23.4	18.6	19.5
$5 < \cdot$	99.2	97.7	94.6	39.2	28.7	22.5
Number of observations	426	719	1 391	421	718	1 298
WOMEN, 15 TO 49 YEARS OLD						
All	97.9	96.6	89.6	20.0	12.9	6.5
Age group						
15-24	98.5	97.7	90.8	22.8	16.5	8.0
25-34	96.9	97.6	90.8	18.7	10.8	6.1
35-44	98.5	92.9	86.0	15.0	7.7	4.3
45-49	97.9	89.7	83.7	15.2	2.9	3.6
Educational level						
analphabetic	95.9	94.3	86.5	8.5	3.3	2.6
reading/writing	100.0	99.2	97.7	17.7	12.5	10.9
Primary school	99.4	99.8	100.0	31.3	25.7	21.6
Lower secondary	100.0	100.0	100.0	46.5	57.1	43.2
Higher secondary	(100.0)	/	/	(72.7)	/	/
Religion						
catholic	98.9	98.3	94.4	24.8	23.8	10.5
protestant	98.8	99.2	96.8	26.7	18.2	10.1
islam	96.1	95.0	88.7	12.8	7.2	2.7
traditional	100.0	97.4	82.9	9.4	8.1	3.3
without rel./other	98.6	96.5	84.4	16.0	8.9	5.7
Household size						
$0 < \cdot \leq 2$	96.1	94.5	90.4	24.3	14.5	7.1
$2 < \cdot \leq 5$	97.1	95.4	86.8	19.9	12.1	6.7
$5 < \cdot$	98.4	97.1	90.0	19.6	13.0	6.5
Number of observations	1 264	2 588	4 247	1 238	2 498	3 807

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Table A2
In your opinion, how can one get AIDS?

	Sexual relations			Use of unsteril. needles			Eating from the same plate than an infected pers.		
	Ab.	OC.	Rur.	Ab.	OC.	Rur.	Ab.	OC.	Rur.
% OF MEN, 15 TO 59 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	91.7	93.7	92.1	60.1	50.1	47.3	18.7	9.0	5.2
Age group									
15-24	93.5	94.9	92.7	61.5	51.5	48.5	17.8	8.1	6.2
25-34	92.6	92.2	93.7	61.5	51.0	49.2	15.6	13.5	5.4
35-44	90.9	96.5	93.4	59.1	45.8	42.7	21.6	9.7	3.7
45-59	84.1	88.6	84.0	52.3	50.0	43.4	25.0	1.1	2.8
Educational level									
analphabetic	81.7	87.7	88.2	53.2	49.6	43.2	9.2	3.6	2.7
reading/writing	87.7	94.6	92.9	63.1	59.1	50.1	12.3	9.1	4.9
Primary school	95.2	97.5	95.2	58.9	46.9	52.6	16.1	7.7	4.5
Lower secondary	98.6	100.0	100.0	62.9	58.1	49.0	24.3	22.6	15.5
Higher secondary	100.0	100.0	100.0	69.1	27.3	45.5	43.6	20.5	23.3
Religion									
catholic	92.5	97.3	95.9	59.8	45.6	53.9	19.6	12.2	5.5
protestant	100.0	97.4	93.4	66.7	52.0	52.5	24.6	9.1	8.3
islam	88.2	91.5	91.0	59.1	53.0	44.7	16.1	7.8	4.0
traditional	(93.3)	(100.0)	82.7	(66.7)	(40.0)	40.9	(33.3)	(5.0)	5.5
without rel./other	93.0	95.2	94.3	54.4	46.4	44.1	15.8	9.5	4.0
Household size									
$0 < \cdot \leq 2$	85.7	91.2	89.4	54.3	48.0	47.0	14.3	9.6	4.6
$2 < \cdot \leq 5$	92.9	92.0	93.0	62.8	51.9	45.2	15.9	7.4	4.4
$5 < \cdot$	92.9	95.1	92.2	60.4	50.0	47.8	21.3	9.5	5.5
Number of observations	388	719	1 304	423	719	1 304	423	719	1 304
% OF WOMEN, 15 TO 49 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	79.5	84.9	78.8	35.6	31.0	28.0	8.0	4.8	2.6
Age group									
15-24	81.4	85.6	80.7	36.0	33.5	28.3	6.8	5.1	2.9
25-34	80.6	85.6	79.9	37.4	30.2	27.9	9.5	5.1	2.7
35-44	72.0	82.8	76.8	30.5	26.8	28.4	8.5	4.0	2.1
45-49	78.3	78.9	63.6	37.0	22.1	24.9	8.7	2.9	2.1
Educational level									
analphabetic	65.2	77.9	74.3	31.1	26.0	25.2	2.7	1.4	1.4
reading/writing	89.3	92.1	88.0	39.5	32.3	35.1	6.2	4.6	2.8
Primary school	90.8	94.3	93.6	39.1	38.4	35.4	9.9	7.0	8.3
Lower secondary	97.4	96.6	98.8	41.2	49.7	38.3	29.0	28.2	19.8
Higher secondary	(100.0)	/	/	(27.3)			(54.6)	/	/
Religion									
catholic	86.5	91.9	85.6	34.6	38.8	32.6	9.5	8.8	4.1
protestant	88.8	92.7	90.4	40.0	35.2	33.6	11.7	7.0	3.6
islam	65.6	79.0	73.0	33.9	27.8	25.2	5.1	2.7	0.8
traditional	84.4	89.2	68.7	46.9	27.0	22.8	6.3	0.0	2.4
without rel./other	79.2	84.9	73.6	34.0	24.3	24.6	5.6	3.6	2.6
Household size									
$0 < \cdot \leq 2$	64.9	87.0	76.1	29.7	31.9	35.4	8.1	5.8	2.7
$2 < \cdot \leq 5$	78.4	82.1	77.3	39.2	32.1	23.3	9.6	4.1	3.2
$5 < \cdot$	81.1	85.5	79.1	34.9	30.6	28.6	7.4	5.0	2.5
Number of observations	1 238	2 499	3 815	1 238	2 499	3 815	1 238	2 499	3 815

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Table A3
By what kind of sexual relation one can get AIDS?

	Occasional intercourse			Don't know			Intercourse with partner		
	Ab.	OC.	Rur.	Ab.	OC.	Rur.	Ab.	OC.	Rur.
% OF MEN 15 TO 59 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	44.0	54.4	54.0	3.1	2.4	1.7	16.1	17.0	10.1
Age group									
15-24	41.4	50.5	49.5	3.6	2.0	2.1	15.4	15.6	11.2
25-34	44.3	54.2	57.9	4.1	2.1	0.5	17.2	24.0	10.5
35-44	52.3	65.3	61.7	2.3	2.1	2.5	13.6	14.6	9.5
45-59	36.4	50.0	50.7	0.0	4.6	2.4	20.5	10.2	5.7
Educational level									
analphabetic	36.7	51.8	51.9	4.6	2.5	1.9	8.3	12.7	7.3
reading/writing	29.2	48.2	53.2	3.1	2.7	1.5	16.9	16.4	10.6
Primary school	54.8	54.6	54.9	2.4	3.6	2.0	14.5	16.8	10.0
Lower secondary	44.3	61.3	65.5	4.3	0.0	0.0	17.1	24.7	13.7
Higher secondary	50.9	70.5	60.6	0.0	0.0	2.6	32.7	29.6	15.2
Religion									
catholic	47.7	64.0	55.4	4.7	0.7	1.4	17.8	18.4	10.2
protestant	49.1	48.1	57.6	3.5	3.9	0.7	15.8	15.6	9.6
islamic	36.6	51.4	59.6	2.7	2.1	0.8	13.4	16.3	8.1
traditional	(60.0)	(70.0)	42.5	(0.0)	(10.0)	8.1	(20.0)	(15.0)	5.8
without rel./other	50.9	54.8	49.6	1.8	2.4	0.3	21.1	19.1	15.1
Households size									
$0 < \cdot \leq 2$	42.9	55.2	51.0	0.0	1.6	1.3	14.3	14.4	10.6
$2 < \cdot \leq 5$	44.3	57.4	53.9	4.4	1.9	0.3	6.2	21.0	9.7
$5 < \cdot$	44.2	53.0	54.4	3.3	2.8	2.1	21.3	16.2	10.1
Number of observations	423	719	1 304	423	719	1 304	423	719	1 304
% OF WOMEN 15 TO 49 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	43.2	64.2	57.7	4.7	0.8	1.0	17.6	12.8	11.1
Age group									
15-24	45.0	63.2	59.0	5.6	1.0	1.0	17.4	12.0	10.0
25-34	40.4	66.9	58.7	4.0	0.7	1.2	19.2	14.5	13.0
35-44	45.5	63.4	56.5	2.5	0.5	0.4	15.0	12.7	12.0
45-49	34.8	60.6	44.7	8.7	1.0	0.6	17.4	10.6	6.9
Educational level									
analphabetic	35.5	58.9	54.7	4.8	0.9	0.8	10.8	9.8	8.7
reading/writing	52.3	73.5	64.4	5.8	1.5	0.9	22.2	15.0	17.3
Primary school	49.3	69.2	65.9	4.3	0.2	1.5	22.7	17.2	17.7
Lower secondary	44.7	69.8	73.2	3.5	1.3	3.7	27.2	19.5	17.3
Higher secondary	(54.6)	/	/	(0.0)	/	/	(27.3)	/	/
Religion									
catholic	43.6	66.0	62.2	5.8	0.7	1.1	21.1	16.1	14.8
protestant	53.8	72.9	65.6	3.3	1.0	1.0	22.5	15.6	15.1
islamic	35.1	60.7	55.2	3.9	0.8	0.5	11.5	10.2	8.0
traditional	59.4	70.3	48.6	9.4	0.0	0.4	9.4	16.2	14.0
without rel./other	42.4	62.8	53.1	4.9	0.0	1.4	17.4	13.2	7.7
Households size									
$0 < \cdot \leq 2$	32.4	67.4	54.0	0.0	0.7	0.0	18.9	18.8	11.5
$2 < \cdot \leq 5$	39.9	62.1	61.9	5.7	0.4	0.5	17.6	14.0	11.1
$5 < \cdot$	45.3	64.5	57.0	4.8	1.0	1.0	17.5	12.0	11.1
Number of observations	1 238	2 499	3 815	1 238	2 499	3 815	1 238	2 499	3 815

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Table A4
Can a woman pass AIDS to her baby?
Can a with AIDS infected person seem healthy?

	Transmission mother-baby						Seem healthy					
	Ab.		OC.		Rur.		Ab.		OC.		Rur.	
	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
% OF MEN 15 TO 59 YEARS OLD, COMPLEMENT TO 100% = "DON'T KNOW"												
All	70.2	16.6	70.0	17.9	71.3	15.4	51.2	42.2	43.0	50.5	31.7	61.4
Age group												
15-24	71.6	18.9	69.8	23.4	70.6	20.3	57.1	38.1	47.1	49.5	36.4	58.9
25-34	69.7	15.6	74.5	14.1	77.0	10.8	57.4	35.3	47.4	44.8	32.1	62.0
35-44	75.0	15.9	69.4	16.7	68.5	14.8	38.6	54.6	38.9	54.9	28.7	65.3
45-59	56.8	11.4	61.4	10.2	64.1	14.1	36.4	52.3	26.1	59.1	22.7	61.6
Educational level												
analphabetic	60.6	11.0	57.3	18.5	64.5	15.3	24.1	63.0	22.5	65.2	20.5	67.4
reading/writing	56.9	29.2	66.4	23.6	73.5	15.2	29.2	61.5	34.6	60.9	34.9	62.1
Primary school	71.0	21.0	80.1	16.3	77.4	16.9	50.8	44.4	56.1	40.8	35.5	62.0
Lower secondary	84.3	10.0	80.7	17.2	85.3	13.7	88.6	10.0	66.7	31.2	35.3	64.7
Higher secondary	85.5	10.9	90.9	9.1	87.9	12.1	83.6	14.6	84.1	15.9	15.2	84.9
Religion												
catholic	77.6	15.0	79.6	14.3	75.4	15.0	63.6	31.8	55.1	41.5	39.9	57.7
protestant	80.7	12.3	77.9	15.6	79.7	16.0	61.4	35.1	49.4	45.5	36.3	59.4
islamic	61.3	18.8	61.2	21.7	63.6	17.1	38.9	51.4	34.1	57.9	21.8	68.3
traditional	(80.0)	(6.7)	(90.0)	(5.0)	60.0	16.9	(60.0)	(40.0)	(60.0)	(30.0)	36.3	50.0
without rel./other	71.9	19.3	82.1	11.9	78.7	11.8	56.1	38.6	52.4	42.9	31.2	63.5
Households size												
$0 < \cdot \leq 2$	65.7	12.9	68.8	13.6	63.6	17.2	42.9	48.6	39.2	52.8	25.8	69.5
$2 < \cdot \leq 5$	75.2	13.3	77.8	9.9	70.8	13.1	43.8	48.2	38.9	50.0	33.3	55.4
$5 < \cdot$	69.2	19.2	67.4	22.2	72.8	15.8	57.1	37.5	45.6	50.0	32.2	61.7
Number of observations	423		719		1 304		422		719		1 304	
% OF WOMEN 15 TO 49 YEARS OLD, COMPLEMENT TO 100% = "DON'T KNOW"												
All	73.0	11.5	73.7	10.9	68.9	13.2	33.0	58.3	31.4	59.6	22.3	65.3
Age group												
15-24	73.8	13.7	72.0	13.8	70.5	14.8	31.8	61.9	34.0	58.8	24.8	66.7
25-34	73.1	10.7	77.3	8.6	69.7	11.9	36.7	54.9	31.5	59.9	22.0	64.4
35-44	71.0	9.0	73.7	7.4	66.0	12.7	29.5	56.0	25.7	60.5	18.5	64.3
45-49	71.7	0.0	68.0	3.9	59.6	10.1	30.4	52.2	18.3	64.4	15.1	62.1
Educational level												
analphabetic	62.2	10.6	66.8	10.6	64.0	13.9	19.6	65.0	21.8	64.7	17.7	66.3
reading/writing	82.3	11.1	77.8	13.0	77.3	13.5	26.3	69.6	68.5	26.7	30.3	65.8
Primary school	79.6	13.5	83.0	11.4	86.2	10.1	44.7	52.6	47.1	50.0	34.4	63.5
Lower secondary	86.8	12.3	92.0	6.0	92.7	2.4	76.3	21.1	75.8	23.5	73.2	24.4
Higher secondary	(100.0)	(0.0)	/	/	/	/	(90.1)	(9.1)	/	/	/	/
Religion												
catholic	78.9	12.3	82.7	10.1	74.5	12.9	39.9	55.0	42.7	54.0	27.9	65.9
protestant	79.2	10.8	79.7	10.9	79.6	11.8	35.8	59.2	34.9	60.7	27.6	67.0
islamic	64.4	11.0	67.5	11.6	60.2	14.5	29.0	56.2	26.0	60.8	16.2	66.3
traditional	68.8	9.4	78.4	13.5	64.9	10.4	12.5	75.0	32.4	67.6	26.7	50.1
without rel./other	69.4	11.8	73.4	8.9	66.2	14.2	22.9	68.8	27.0	62.8	18.9	66.8
Households size												
$0 < \cdot \leq 2$	70.3	14.9	71.0	10.1	67.3	16.8	37.8	51.4	31.9	58.7	22.1	64.6
$2 < \cdot \leq 5$	70.1	12.3	71.4	14.0	63.5	12.6	29.2	61.1	30.9	61.5	23.5	58.0
$5 < \cdot$	74.3	10.9	74.5	10.0	69.8	13.2	33.8	57.9	31.5	59.1	22.1	66.5
Number of observations	1 238		2 498		3 813		1 238		2 499		3 813	

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Table A5
Can AIDS be cured?
Do you know/did you know a with AIDS infected person?

	Can be cured						Know/knew sb. with AIDS					
	Ab.		OC.		Rur.		Ab.		OC.		Rur.	
	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
% OF MEN 15 TO 59 YEARS OLD, COMPLEMENT TO 100% = "DON'T KNOW"												
All	19.9	71.2	12.0	79.3	7.0	87.1	22.0	76.8	23.8	75.5	23.7	75.9
Age group												
15-24	17.8	75.2	10.2	82.4	7.2	88.7	18.9	81.1	19.0	79.7	21.8	78.3
25-34	26.2	62.3	15.1	76.0	7.3	86.6	21.5	75.2	25.0	75.0	26.0	73.6
35-44	14.8	79.6	14.6	77.1	5.8	86.3	21.6	78.4	29.2	70.8	24.9	73.9
45-59	20.5	63.6	6.8	79.6	6.6	84.0	36.4	61.4	28.4	70.5	23.0	76.5
Educational level												
analphabetic	11.0	70.6	5.8	80.1	6.7	85.3	11.9	86.2	14.1	85.5	17.5	81.9
reading/writing	21.5	72.3	13.6	77.3	5.6	88.7	16.9	83.1	20.9	76.4	23.6	76.4
Primary school	17.7	78.2	17.4	78.1	9.8	86.3	25.8	74.2	29.1	70.4	31.2	68.5
Lower secondary	28.6	64.3	16.1	78.5	4.3	93.6	25.7	72.9	35.5	64.5	35.5	64.5
Higher secondary	29.1	63.6	13.6	86.4	7.7	92.3	35.2	61.1	43.2	56.8	36.4	63.6
Religion												
catholic	18.7	72.9	15.7	80.3	10.0	85.9	23.6	74.5	31.3	68.0	29.9	69.0
protestant	29.8	68.4	16.9	74.0	7.9	87.1	28.1	71.9	32.5	67.5	31.0	69.0
islam	18.3	68.8	7.2	81.9	4.2	90.4	18.3	80.7	17.8	81.7	17.4	82.6
traditional	(20.0)	(66.7)	(25.0)	(60.0)	8.6	80.1	(20.0)	(80.0)	(40.0)	(60.0)	23.4	75.7
without rel./other	17.5	79.0	20.2	76.2	5.7	88.6	26.3	71.9	25.0	72.6	20.3	79.7
Household size												
$0 < \cdot \leq 2$	20.0	65.7	11.2	74.4	7.3	86.8	15.7	81.4	23.2	76.0	26.5	72.9
$2 < \cdot \leq 5$	18.6	75.2	11.7	80.9	5.7	87.0	18.8	79.5	19.1	80.9	21.2	78.1
$5 < \cdot$	20.4	70.8	12.3	80.1	7.2	87.2	25.4	74.2	25.7	73.4	24.0	75.8
Number of observations	423		719		1 304		422		719		1 297	
% OF WOMEN 15 TO 59 YEARS OLD, COMPLEMENT TO 100% = "DON'T KNOW"												
All	7.9	84.7	3.9	91.5	2.9	90.1	22.2	77.1	21.6	78.0	20.7	78.6
Age group												
15-24	7.3	88.0	3.5	93.5	2.7	92.6	15.9	83.6	18.9	80.9	20.0	79.4
25-34	7.5	85.8	4.3	90.5	3.0	89.2	26.7	72.1	24.3	75.2	22.8	76.4
35-44	12.0	74.0	4.2	88.6	3.4	88.0	29.7	69.9	25.1	74.1	19.6	79.8
45-49	2.2	78.3	4.8	84.6	2.1	82.5	30.4	69.6	22.6	76.5	16.9	81.3
Educational level												
analphabetic	5.5	82.5	2.9	90.4	2.8	88.2	17.7	80.7	18.1	81.3	17.8	81.3
reading/writing	5.8	89.3	4.3	94.4	2.9	95.5	22.6	77.4	24.0	76.0	27.4	72.6
Primary school	11.8	85.2	6.1	91.1	2.7	95.4	26.0	74.0	25.9	73.6	28.0	72.0
Lower secondary	14.0	83.3	4.0	95.3	7.3	89.0	29.8	70.2	31.5	68.5	45.3	54.7
Higher secondary	(9.1)	(90.9)	/	/	/	/	(54.6)	(45.5)	/	/	/	/
Religion												
catholic	7.9	87.7	4.9	92.2	3.0	93.1	24.1	75.9	24.0	75.6	23.8	75.8
protestant	10.0	85.0	5.0	91.2	4.8	92.2	30.4	68.8	25.1	74.9	26.4	73.3
islamic	6.7	82.1	3.1	90.8	1.6	89.3	16.5	82.0	19.4	80.0	15.0	84.0
traditional	12.5	78.1	5.4	91.9	3.3	84.3	21.9	78.1	24.3	75.7	15.1	83.9
without rel./other	6.9	83.3	4.0	93.1	2.5	88.8	18.1	81.3	21.1	78.6	21.2	77.8
Households size												
$0 < \cdot \leq 2$	8.1	83.8	4.4	90.6	4.4	86.7	23.3	74.0	18.8	80.4	19.5	80.5
$2 < \cdot \leq 5$	7.3	83.7	3.9	91.1	2.5	85.3	23.6	76.1	19.9	79.7	20.7	78.2
$5 < \cdot$	8.1	85.1	3.9	91.7	2.9	91.0	21.6	77.8	22.3	77.3	20.7	78.6
Number of observations	1 238		2 499		3 815		1 237		2 493		3 806	

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Table A6
How avoid AIDS?

	Only one partner			Avoid prostitutes			Stop intercourse		
	Ab.	OC.	Rur.	Ab.	OC.	Rur.	Ab.	OC.	Rur.
% OF MEN 15 TO 59 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	13.7	13.1	7.0	64.1	62.6	53.5	52.0	64.0	62.4
Age group									
15-24	13.6	13.6	8.3	74.0	77.6	70.4	46.2	57.6	52.0
25-34	14.8	14.1	5.2	63.9	64.1	55.3	55.7	59.4	65.8
35-44	11.4	13.2	6.3	58.0	48.6	30.0	60.2	76.4	76.7
45-59	15.9	9.1	7.6	38.6	31.8	15.2	47.7	75.0	73.9
Educational level									
analphabetic	4.6	8.7	6.3	45.9	42.0	33.5	45.0	60.5	64.9
reading/writing	7.7	13.6	5.9	66.2	66.4	62.0	47.7	60.0	57.6
Primary school	12.1	10.2	5.5	72.6	74.5	73.2	46.8	64.8	60.4
Lower secondary	28.6	29.0	13.4	75.7	83.9	76.8	65.7	75.3	66.9
Higher secondary	23.6	18.2	18.2	63.6	84.1	75.8	65.5	68.2	69.7
Religion									
catholic	14.0	12.9	7.7	74.8	70.8	63.6	45.8	68.7	61.7
protestant	19.3	18.2	9.5	57.9	70.1	60.2	63.2	79.2	66.8
islam	9.1	12.7	5.2	56.5	57.9	39.8	48.9	57.6	67.7
traditional	(6.7)	(5.0)	5.0	(60.0)	(55.0)	47.5	(80.0)	(70.0)	52.9
without rel./other	24.6	13.1	7.5	75.4	65.5	58.9	54.4	70.2	58.7
Household size									
$0 < \cdot \leq 2$	10.0	11.2	9.9	54.3	58.4	42.4	50.0	61.6	58.9
$2 < \cdot \leq 5$	13.3	12.4	6.4	57.5	59.9	45.2	51.3	68.5	63.9
$5 < \cdot$	15.0	13.9	6.7	70.0	64.8	56.6	52.9	63.0	62.5
Number of observations	423	719	1 304	423	719	1 304	423	719	1 304
% OF WOMEN 15 TO 59 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	8.6	4.0	3.5	49.2	40.8	23.0	51.7	64.3	65.5
Age group									
15-24	10.8	4.7	3.5	57.4	48.4	30.9	47.2	59.9	62.8
25-34	6.7	2.7	2.9	47.1	38.1	20.8	55.9	68.5	69.0
35-44	6.0	3.7	3.9	35.0	27.1	11.6	55.0	69.2	68.4
45-49	8.7	5.8	6.2	23.9	16.4	6.8	58.7	70.2	58.0
Educational level									
analphabetic	8.0	3.0	3.8	26.7	21.6	12.4	49.1	65.5	65.8
reading/writing	3.3	4.1	2.2	65.0	55.7	43.0	51.0	67.4	65.2
Primary school	8.2	5.2	3.0	66.8	68.1	58.5	54.3	59.0	64.8
Lower secondary	24.6	8.7	6.1	77.2	80.5	75.6	56.1	63.1	57.3
Higher secondary	(9.1)	/	/	(81.8)	/	/	(81.8)	/	/
Religion									
catholic	9.7	5.3	3.9	61.0	61.7	38.5	51.5	61.0	62.1
protestant	9.6	6.0	4.2	58.3	51.8	30.8	54.6	68.5	72.2
islamic	6.9	2.7	2.7	33.3	27.6	12.4	50.0	65.3	64.8
traditional	12.5	8.1	3.5	46.9	27.0	12.6	59.4	81.1	61.8
without rel./other	7.6	4.0	3.7	42.4	41.8	19.3	50.7	58.9	64.4
Households size									
$0 < \cdot \leq 2$	12.2	3.6	5.3	43.2	51.5	22.1	52.7	65.2	63.7
$2 < \cdot \leq 5$	7.6	3.9	4.8	45.2	37.6	21.0	51.5	64.0	65.6
$5 < \cdot$	8.7	4.1	3.3	51.1	40.9	23.4	51.7	64.3	65.5
Number of observations	1 238	2 499	3 815	1 238	2 499	3 815	1 238	2 499	3 815

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Table A7
Where can one be tested for AIDS?
Did you have any sexual relations during the last two months?
If you had sexual relations during the last two months, did you use condoms?

	Don't know where test			Had sexual relation			Used condom		
	Ab.	OC.	Rur.	Ab.	OC.	Rur.	Ab.	OC.	Rur.
% OF MEN 15 TO 59 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	6.4	5.7	7.8	50.4	56.6	56.6	29.9	28.7	19.6
Age group									
15-24	3.6	5.4	9.3	37.3	37.0	40.7	42.9	50.0	37.4
25-34	7.4	5.2	5.7	58.2	70.3	64.3	29.2	29.9	21.0
35-44	8.0	4.2	7.4	60.2	77.8	71.0	26.4	13.3	8.3
45-59	11.4	10.2	8.6	59.1	58.0	61.8	7.7	13.7	3.1
Educational level									
analphabetic	13.8	9.1	11.5	40.4	51.8	55.0	20.5	15.8	10.4
reading/writing	4.6	4.6	4.2	49.2	47.3	53.9	21.9	19.2	22.4
Primary school	3.2	3.6	5.0	43.6	56.1	54.1	32.7	35.1	24.7
Lower secondary	5.7	4.3	3.9	67.1	66.7	73.5	48.9	50.0	41.3
Higher secondary	1.8	0.0	0.0	65.5	90.9	78.8	19.4	37.5	(38.5)
Religion									
catholic	5.6	7.5	4.6	58.9	65.3	59.0	31.8	35.7	27.3
protestant	5.3	3.9	3.3	43.9	46.8	52.6	28.0	27.8	16.7
islamic	7.0	5.7	12.0	43.0	54.3	56.0	27.2	23.6	17.9
traditional	(6.7)	(5.0)	11.3	(80.0)	(60.0)	56.4	(25.0)	(41.7)	14.3
without rel./other	7.0	3.6	6.1	56.1	59.5	58.0	37.5	34.0	18.9
Households size									
$0 < \cdot \leq 2$	15.7	8.8	10.6	57.1	55.2	53.5	37.5	37.7	22.4
$2 < \cdot \leq 5$	3.5	7.4	7.9	49.6	63.6	61.2	32.1	19.1	14.3
$5 < \cdot$	5.0	4.2	7.2	48.8	54.4	55.7	26.3	30.4	20.8
Number of observations	423	719	1 304	423	719	1 304	213	407	704
% OF WOMEN 15 TO 59 YEARS OLD HAVING GIVEN THE RESPECTIVE ANSWER									
All	11.2	8.7	12.7	55.6	59.6	59.2	9.1	8.9	4.76
Age group									
15-24	9.5	8.1	11.1	49.8	55.1	56.9	11.5	15.0	9.51
25-34	11.0	6.9	12.3	63.3	66.7	62.0	7.7	5.1	2.32
35-44	14.0	10.6	15.9	59.0	63.4	59.3	7.5	1.2	1.3
45-49	21.7	22.1	18.6	47.8	51.0	58.5	4.6	0.0	0.56
Educational level									
analphabetic	21.4	12.0	16.2	49.8	56.4	58.3	4.1	3.7	2.38
reading/writing	3.3	5.1	3.8	60.5	64.9	59.7	7.5	12.2	10.97
Primary school	3.0	4.4	2.7	61.2	61.1	62.7	13.3	12.7	10.95
Lower secondary	0.0	2.7	1.2	57.0	71.1	70.4	21.5	30.2	21.05
Higher secondary	(0.0)	/	/	(72.7)	/	/	/	/	/
Religion									
catholic	5.1	5.5	9.0	57.8	59.3	61.1	11.6	13.6	9.02
protestant	5.4	4.7	5.9	54.2	62.8	60.4	10.6	10.4	6.26
islamic	19.7	11.4	13.1	51.3	57.3	58.9	5.8	6.1	2.9
traditional	15.6	2.7	17.2	65.6	51.4	53.2	0.0	0.0	2.7
without rel./other	14.6	9.9	18.7	60.4	66.5	58.8	10.3	10.2	2.63
Households size									
$0 < \cdot \leq 2$	14.9	15.9	16.8	68.9	79.0	81.4	5.6	9.5	5.05
$2 < \cdot \leq 5$	12.6	7.6	14.0	59.1	63.8	66.0	8.7	5.6	3.62
$5 < \cdot$	10.3	8.5	12.4	53.2	57.0	56.9	9.7	9.8	5.02
Number of observations	1 238	2 499	3 815	1 238	2 499	3 815	700	1 532	2 439

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Table A8
With how many partners did you have
sexual intercourse during the last two months?
(% of men 15 to 59 years old)

	0	only spouse	1	2	3	4 and more
All	45.1	27.0	13.8	9.0	2.9	2.3
Residence						
Abidjan	49.4	20.8	16.6	9.7	/	/
Other cities	43.3	28.0	13.4	9.2	(3.6)	(2.6)
Rural areas	44.6	28.5	13.2	8.6	3.0	(2.2)
Age group						
15-24	61.5	8.7	16.8	7.8	(2.9)	(2.4)
25-34	35.7	32.2	14.6	11.2	(3.4)	(2.9)
35-44	29.2	46.4	10.7	8.9	(2.9)	/
45-59	40.6	40.9	(7.9)	(7.3)	/	/
Educational level						
analphabetic	48.8	30.0	10.5	6.5	(2.0)	(2.3)
reading/writing	48.8	23.5	13.4	8.7	(4.1)	/
Primary school	47.4	22.9	14.4	10.7	(2.8)	(1.8)
Lower secondary	30.6	26.0	22.3	12.5	(5.3)	/
Higher secondary	22.7	36.4	(21.2)	(13.6)	/	/
Religion						
catholic	40.0	25.6	16.1	12.0	(3.2)	(3.2)
protestant	50.6	28.0	12.4	(5.8)	/	/
islamic	47.6	27.1	12.9	7.7	(2.4)	(2.2)
traditional	42.1	28.7	(13.9)	(10.8)	/	/
without rel./other	42.8	26.7	14.1	9.4	(5.0)	/
Households size						
$0 < \cdot \leq 2$	46.2	19.7	16.8	11.6	/	(3.5)
$2 < \cdot \leq 5$	41.0	32.7	13.1	8.9	(2.6)	(1.9)
$5 < \cdot$	46.2	26.6	13.4	8.4	3.2	2.2
Number of observations	1 102	660	338	219	71	56

Notes: Ab. = Abidjan; OC = Other cities; Rur. = Rural areas. ( ) = group ≤ 30 ; / = group ≤ 10.
Source: DHS 1994; computations by the authors.

Appendix B: Graphical output of the multiple correspondence analysis

Figure A1

Coordinates of the first and second dimension given by the multiple correspondence analysis (men, 15 to 59 years)

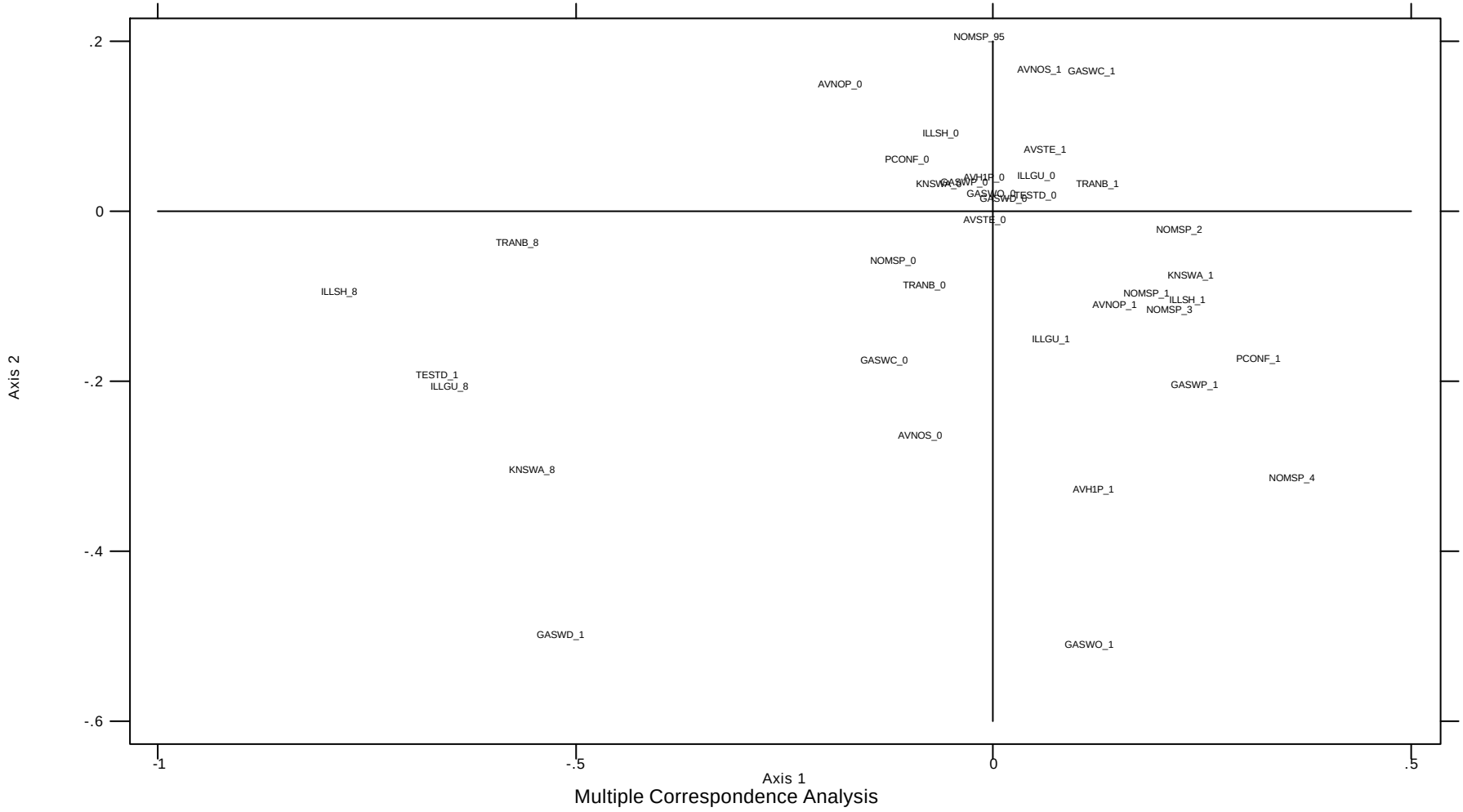
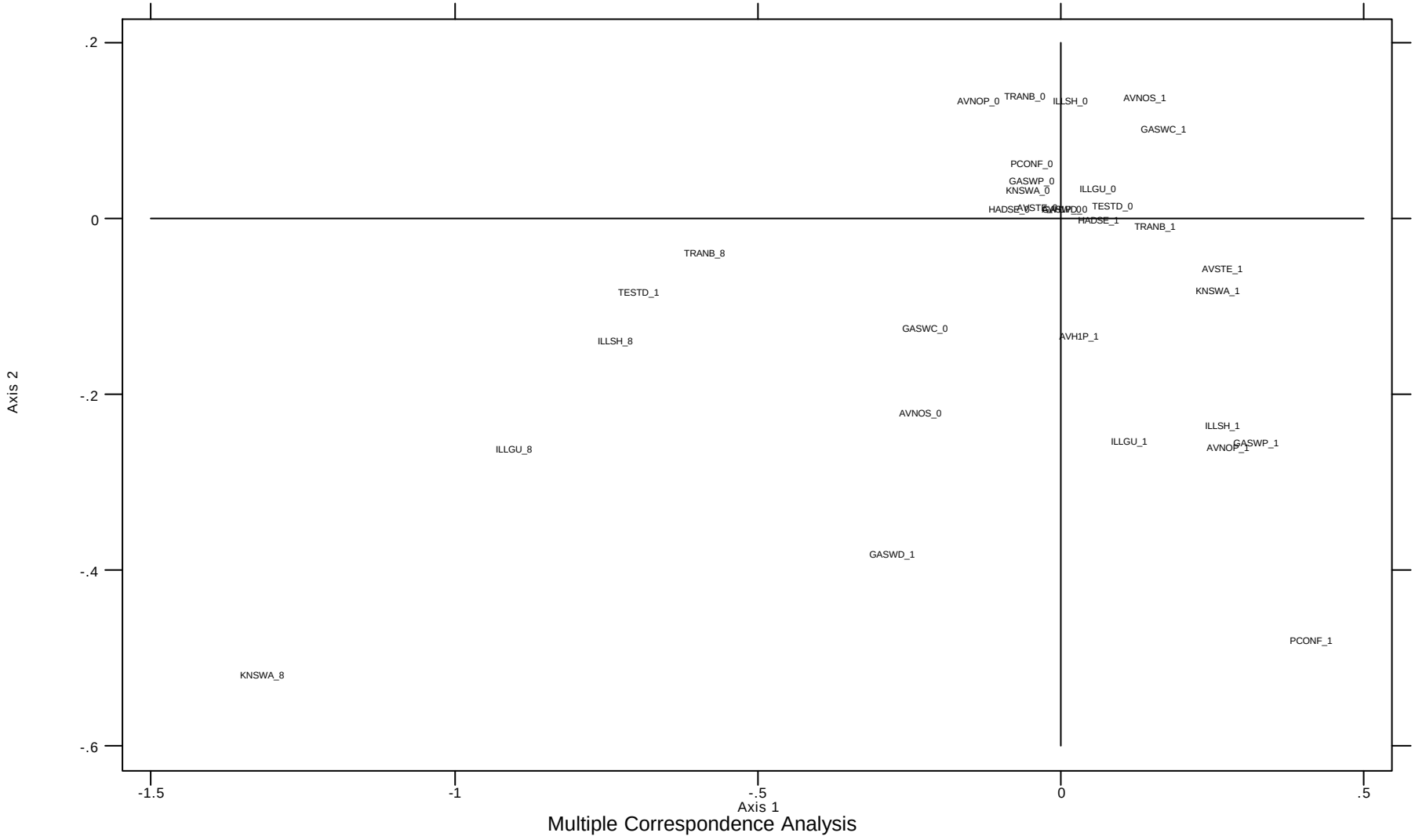


Figure A2
Coordinates of the first and second dimension given by the multiple correspondence analysis (women, 15 to 49 years)



Multiple Correspondence Analysis

Table A9
Glossary of the variable names used in the MCA analysis

AVH1P	= Avoid AIDS by having only one partner (1=cited)
AVSTE	= Avoid AIDS by using sterilized needles for medical injections (1=cited)
AVNOP	= Avoid AIDS by avoiding prostitutes (1=cited)
AVNOS	= Avoid AIDS by stopping sexual intercourse (1=cited)
GASWP	= Getting AIDS by sexual intercourse with partner/spouse (1=yes)
GASWC	= Getting AIDS by sexual intercourse with occasional partners (1=yes)
GASWO	= Getting AIDS by other sexual behavior (1=yes)
GASWD	= Do not know how to get AIDS (1=do not know)
ILLSH	= Ill person can seem healthy (1=yes, 0=no, 8=do not know)
ILLGU	= AIDS can be cured (1=yes, 0=no, 8=do not know)
KNSWA	= Do/did you know sb with AIDS (1=yes, 0=no, 8=do not know)
NOMSP	= Number of sexual partners during the two months prior to the survey (0=0, 1=1, 2=2, 3=3, 4=4 et +, 95= only spouse/partner)
HADSE	= Had sexual contact the two months preceding the survey
PCONF	= Participated at conference about AIDS (1=yes)
TRAB0	= Transmission mother- baby possible (1=yes, 0=no, 8=do not know)
TESTD	= Do not know where getting an AIDS test (1=do not know)

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