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The Microeconomics of the AIDS Epidemic in Africa

TOMAS PHILIPSON
RICHARD A. POSNER

The modeling of human behavior as a reflection of a rational calculus of gains and losses may not provide a completely satisfactory explanation of individuals' actions, or even of the aggregate outcomes of such actions. Such modeling, however, provides valuable insights into the understanding of human phenomena, insights often inaccessible to traditional modes of social analysis. Sexual behavior is no exception. Yet conventional epidemiological approaches to the analysis of sexually transmitted diseases fail to take into account the extent to which rational choice influences personal decisions that, in turn, influence the spread of a disease. As a result, those approaches may overlook policy choices that could help to stem the spread of an epidemic.

In our book on the AIDS epidemic, Private Choices and Public Health: The AIDS Epidemic in an Economic Perspective, we emphasized the role in the spread and control of the epidemic of voluntary, rational choice to engage or refrain from engaging in risky activities. We confined our analysis there to the developed world, with particular emphasis on the United States, devoting only two pages to the third world. We were, of course, aware that AIDS is a more serious problem in a number of third world countries, especially countries in sub-Saharan Africa, than it is in the United States or other Western countries; and in this note we extend our discussion to the third world. For the sake of simplicity and focus, we confine discussion to sub-Saharan Africa and, even more narrowly, to Central and Eastern Africa, comprising such countries as Kenya, Uganda (a country particularly hard-hit by AIDS), Zaire, and Zimbabwe. Analysis of the epidemic in Western Africa is complicated by the fact that a different strain of the AIDS
virus, HIV-2, is common there; although it appears that HIV-2 is considerably less virulent than HIV-1, the latter strain is now spreading rapidly in Western Africa. When we speak of "Africa," therefore, we mean primarily Eastern Africa, and when we speak of "HIV" we mean HIV-1.

Statistics on the disease in Africa are much less complete and reliable than in wealthy countries such as the United States, but certain features of the African data are clear. Especially in large cities and along major transportation routes, AIDS is far more prevalent than in comparable settings in Europe and North America. In sharp contrast to the situation in the United States, homosexual relations and the sharing of hypodermic needles by intravenous drug users are minor routes for the spread of the disease in Africa. The major route is heterosexual intercourse, estimated to account for 93 percent of all adult cases, followed by blood transfusions and the "vertical transmission" of the AIDS virus from mother to fetus. Also, in marked contrast to the United States, as many African women as men are infected; female prostitutes are an important source of disease transmission; and the likelihood of being infected with the AIDS virus is positively rather than, as in the United States and other developed countries, negatively related to income, at least in urban areas (there are inadequate data to determine the relation between income and infection in rural areas). And whereas our study of AIDS in the United States found that the disease has peaked, implying (because of the long incubation period of the disease—approximately ten years on average) that the number of new infections peaked years ago, the disease appears not to have peaked yet in Africa.

We argue here that the differences between the course of the disease in the United States and in Africa can be explained by the same model that we used to explain the behavior of the disease in the United States. Indeed, one part of our analysis—that of the different incidence of the disease in black compared with white women—seems, as we explain later, directly translatable to the African situation. The kinds of statistical analysis that we undertook in our book and in other work on the economics of AIDS are not feasible at present for Africa, given the quality of the African data; but we do present some statistical evidence here.

We now explain the course of the disease in Africa and the differences from the experience in the United States. We then offer a brief discussion of optimal policy interventions in the African setting.

Explaining the African AIDS epidemic

The demand for safe sex

We hypothesize that the earlier peak of the disease in the United States than in Africa is due to a difference between the two regions in the de-
mand for "safe sex" and hence in the substitution of safe for risky sex. Consider the factors influencing that demand. Because the long incubation period of the disease retards a purely intuitive recognition of its dangers and how to avoid them, we can expect the demand for safe sex to be positively related to levels of education. Africa has much lower levels of literacy than the United States; as a result many more Africans than Americans harbor serious misconceptions about the disease, although Africans' misconceptions about HIV-AIDS appear to be diminishing.

In general, these misconceptions, some fostered by folk healers (whose prevalence appears to be, as one would expect, inverse to the prevalence of health professionals), operate in two ways. First, they reduce perceived risk (as in "the belief of some men [in Uganda] that, if they pay women for sexual intercourse, they propitiate one of the lesser gods, who, if not properly placated, are well-known for activating the [HIV] infection," or the widespread belief that marriage confers immunity from infection). Second, they reduce the perceived efficacy of safe sex, as when AIDS and other sexually transmitted diseases are attributed to witchcraft rather than to intercourse. These misconceptions illustrate the general point, documented in the economic literature on health, that education increases wellbeing by reducing the costs of assimilating information about proper health care.

While a deficiency in education may lessen (or delay) demand for safe sex by reducing its perceived benefits, the lower life expectancy (apart from the effects of AIDS) of African compared to American adults lessens that demand by reducing the real benefits of safe sex. Lower adult life expectancy reduces the expected cost of AIDS (and hence the expected benefit of avoiding infection) by reducing the number of years of life that are likely to be lost by a person who becomes infected. Stated in the language of human-capital economics, the optimal investment in health human capital is lower the fewer the periods in which a return to the investment can be expected.

We also, of course, expect the demand for safe sex to be lower the higher the price. Condoms are an important input into safe sex, and their full cost is higher in Africa than in the United States because the poor distribution system in the former region makes their supply to consumers uncertain. Also important is the high price of condoms in Africa relative to earnings. In countries with very low per capita incomes—the average real per capita income in sub-Saharan Africa is little more than $1,300—condoms are costly in terms of the forgone consumption of expenditures on them. This is not true in a wealthy country. So while we would not expect changes in the price of condoms to have a marked effect on US consumption, we predict that they would have a substantial effect on consumption in African countries. The figures in Table 1 provide some sup-
TABLE 1 Condom prices and sales in Ghana and Zimbabwe, 1987-91

<table>
<thead>
<tr>
<th>Year</th>
<th>Average unit cost (US$)</th>
<th>Condoms sold (1000)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ghana</td>
<td>Zimbabwe</td>
<td>Ghana</td>
<td>Zimbabwe</td>
</tr>
<tr>
<td>1987</td>
<td>0.09</td>
<td>NA</td>
<td>2,532</td>
<td>NA</td>
</tr>
<tr>
<td>1988</td>
<td>0.08</td>
<td>1.81</td>
<td>3,501</td>
<td>50</td>
</tr>
<tr>
<td>1989</td>
<td>0.09</td>
<td>0.26</td>
<td>3,216</td>
<td>301</td>
</tr>
<tr>
<td>1990</td>
<td>0.08</td>
<td>0.17</td>
<td>3,587</td>
<td>769</td>
</tr>
<tr>
<td>1991</td>
<td>0.07</td>
<td>0.18</td>
<td>3,748</td>
<td>1,182</td>
</tr>
</tbody>
</table>

NA = Not available.


port for this prediction, showing a substantial negative relation between price and demand in two countries.\(^{20}\) But since awareness of AIDS was growing during the time covered by the table, much of the growth in demand may reflect an increase in the perceived benefits of condoms rather than a fall in their price.

As we have suggested, a better measure of the economic price of a condom than its nominal price is its cost in other consumption forgone. The United Nations has developed such a measure; it defines "ready and easy access" to contraceptives as the state in which "the recipient spends no more than an average of two hours a month to obtain contraceptive supplies and services," and that "a one-month supply of contraceptives should cost less than 1 percent of a month’s wages."\(^{21}\) In Table 2, we compare the percent of the population in 13 African countries (not limited to Central and Eastern Africa) that in 1982 had "ready and easy access" to condoms (one of the contraceptive supplies that the UN study tabulates separately) with the percent of the urban population of those countries estimated to be HIV-positive eight years later.

Figure 1 plots the data in Table 2, showing the clear negative relation between condom access and HIV prevalence. A standard regression analysis yielded a coefficient of \(-.205\) with \(t\) statistic of \(-1.49\). Although the \(t\) statistic does not indicate statistical significance at the conventional .05 level, this is not surprising in view of the coarseness of the data.

Another factor contributing to the later peak of the disease in Africa is the greater prevalence of female prostitution there than in Europe and North America.\(^{22}\) Prostitution is likely to be common in poor societies in which women have limited job opportunities and in which many men cannot afford to support a wife. Migrant work, very common in Africa, also increases the demand for prostitution. Polygyny, by raising the average age at which men marry, increases the demand for prostitution before mar-
TABLE 2  Condom access in 16 African countries in 1982 and HIV prevalence in the urban population in 1990

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent of population with access to condoms in 1982</th>
<th>Percent of urban population HIV-positive in 1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>4</td>
<td>24.1</td>
</tr>
<tr>
<td>Rwanda</td>
<td>4</td>
<td>20.1</td>
</tr>
<tr>
<td>Zambia</td>
<td>4</td>
<td>17.2</td>
</tr>
<tr>
<td>Congo</td>
<td>6</td>
<td>10.2</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>8</td>
<td>10.0</td>
</tr>
<tr>
<td>Malawi</td>
<td>0</td>
<td>9.5</td>
</tr>
<tr>
<td>Cen. Afr. Rep.</td>
<td>6</td>
<td>7.8</td>
</tr>
<tr>
<td>Zaire</td>
<td>8</td>
<td>7.1</td>
</tr>
<tr>
<td>Ghana</td>
<td>10</td>
<td>4.7</td>
</tr>
<tr>
<td>Burundi</td>
<td>2</td>
<td>4.3</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>54</td>
<td>3.2</td>
</tr>
<tr>
<td>Kenya</td>
<td>24</td>
<td>2.7</td>
</tr>
<tr>
<td>Cameroon</td>
<td>10</td>
<td>1.1</td>
</tr>
<tr>
<td>Mozambique</td>
<td>12</td>
<td>1.0</td>
</tr>
<tr>
<td>Sudan</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>Nigeria</td>
<td>20</td>
<td>0.1</td>
</tr>
</tbody>
</table>

NOTE and SOURCE: There is not a long lag between unshielded sex and HIV infection, as there is between HIV infection and full-fledged AIDS, but we do not have even remotely reliable statistics on HIV infection in Africa before 1990. The source of the access data in Table 2 (and Figure 1) is the United Nations study cited in note 21 (see Table 15 and Table A.II.2); the source of the estimates of HIV is an unpublished paper by Mead Over, “The economic impact of fatal adult illness from AIDS and other causes in sub-Saharan Africa: A research proposal” (World Bank 1990).

riage, and marital abstinence customs increase married men’s demand for nonmarital sex.23

Prostitutes are highly vulnerable to infection with the AIDS virus because of their multiple sexual partners. Knowing this, men who patronize prostitutes will consider the real price of prostitution to have risen even if the nominal price remains unchanged.24 How will the market respond? If prostitutes have very poor alternative earnings prospects, making the supply of their services highly inelastic, they will adjust to the prospect of a reduced demand for those services (due to the reduction in the quality of those services) by lowering the nominal price rather than by curtailing supply.25 The result is that the amount of potentially infective sexual activity by prostitutes will not fall in response to the higher risk of infection.

We predict that the AIDS epidemic has reduced the nominal price of prostitution in Africa. We are not aware of any data that would permit this prediction to be tested empirically, but there is anecdotal evidence that,
for example, the AIDS epidemic has increased the premium for very young prostitutes, who are less likely to be infected.  

The same factors that generate demand for female prostitution generate male demand for other forms of casual, nonmonogamous sex. Whatever the precise contractual form, nonmonogamous sex, especially when it involves frequent change in sexual partners, is more likely than monogamous sex to spread a sexually transmitted disease. The frequency of nonmarital sex in Africa appears to be very high by world standards. Since homosexual intercourse is not an important method of transmitting HIV in Africa, and since the risk of infection per sexual episode is greater for the female than for the male, the fact that as many men as women are infected in Africa is evidence that men indeed have more sexual partners on average than women do.  

An important factor in the transmission of the AIDS virus in Africa is that many Africans are already infected with other sexually transmitted diseases, which increase the infectivity of the virus. Also, female circumcision and the absence of male circumcision, which are other cofactors for AIDS, are common in Africa. (One reason that female prostitution is an important source of transmission of HIV in Africa but not in the United States is that African men are on average far more vulnerable to infection by vaginal intercourse, because of cofactors, than American men are.) But
these factors do not explain the later peak of the disease in Africa. It is true that the faster the disease spreads, the more people who will be infected before knowledge of the causes and prevention of the disease becomes widely diffused. But that is no reason for the disease to peak later. It might indeed cause it to peak earlier, by accelerating the attainment of a level of risk high enough to induce substantial behavioral changes designed to reduce the risk of becoming infected. In the United States, the disease appears to have peaked earliest in the group in which it first reached a high prevalence: male homosexuals in San Francisco.31

Several factors that we have identified as reducing the demand for safe sex in Africa—including low levels of education and literacy, and high real prices of condoms—support a prediction that the prevalence of the disease would have to reach a higher level in Africa than in the United States before the real or perceived benefits of safe sex would exceed the costs for a large fraction of the endangered population. A factor working in the opposite direction is the higher probability in Africa that a sexual encounter will result in infection, a factor that increases the expected cost of risky sex. The expected cost may still be lower in Africa than in the United States, however, because of ignorance about the transmission and prevention of AIDS and because of lower adult life expectancy, which reduces the gains from safe sex.

Income and infection

Since education is positively correlated with income, and since one expects that, at least at low levels (by American standards) of income, the demand for condoms will be positively correlated with income, how can one explain the positive correlation between income and AIDS in Africa?32 One possibility is that the demand for travel is positively correlated both with income and with the demand for prostitutes' services. Another is that income and urban residence are highly positively correlated and that the effect of urban residence in increasing the risk of infection by lowering the cost of finding multiple sexual partners dominates the negative effect of income on the likelihood of becoming infected. In a society in which women are very poor, prosperous men have ready access to multiple sexual partners because the "price" of women's sexual services, both in the prostitution market and in less explicit sex markets, is very low.33

Female demand for safe sex

We have been discussing the demand for safe sex chiefly among men, and must now consider more carefully the demand conditions on the other side of the sexual exchange. In our book we ascribed the very high preva-
lence of AIDS among black compared to white women in the United States (almost ten times higher) to the poor bargaining position of black women vis-à-vis black men.\textsuperscript{34} The ratio of marriageable black men to marriageable black women is abnormally low in the United States, implying that a black woman will often have to offer a net transfer to a black man to induce marriage or any other form of long-term sexual relationship. That net transfer might take the form of forgoing insistence that the man use a condom, a use to which many men are averse. Superficially, the bargaining position of African women might seem more favorable. Polygyny increases the effective demand for women as wives; and as a result of the prevalence of migrant labor, many African cities and towns have a very high ratio of men to women. Nevertheless, because of legal disabilities and pervasive discrimination, the African woman's bargaining position appears on balance to be very poor.\textsuperscript{35} For example, migrant workers are not looking for wives since they often will have left a wife at home, and restrictions on women's employment may largely confine unmarried women's job opportunities to prostitution.

The prevalence of prostitution may provide an additional explanation for why, even though women are more susceptible to becoming infected with the AIDS virus in heterosexual intercourse than men, and even though male homosexual intercourse and (mostly male) intravenous drug use are not important sources of HIV transmission in Africa, as many African men as African women are HIV-positive. Since prostitutes have a much larger number of sexual partners on average than do promiscuous men, a small number of prostitutes can infect a large number of men even though the disease is more easily transmitted from men to women than vice versa.

Given the high risk of infection to which prostitutes are exposed by virtue of their large number of sexual partners, it might seem that prostitutes would insist on safe sex. But this is by no means clear. Besides our earlier point about the inelasticity of the supply of prostitutes' services in societies in which women's alternative earnings prospects are poor, the expected benefits of safe sex, while positively related to the risk that one's sexual partner is infected, are negatively related to the risk that oneself is infected.\textsuperscript{36} If one is already infected, safe sex confers no benefit (or very little: there is conjecture that reinfection accelerates conversion from the latent to the active disease state). So the likelier one is to be infected already, the smaller the expected benefits of safe sex. Once infection with the AIDS virus becomes common in a population, and in the absence of widespread testing that would enable a person to determine his or her actual infection status, the average expected benefit of safe sex declines. In fact, women who perceive themselves to be at high risk of being already infected would tend to self-select into prostitution—and for the additional reason that their marriageability would be impaired by that risk. And once
a woman has been a prostitute for a significant period of time without practicing safe sex, the probability that she is infected may be so high that the benefit of substituting safe for risky sex may be negligible.\textsuperscript{37} So a woman who had been a risky-sex prostitute for a long time, perhaps because she thought that AIDS was caused by witchcraft or perhaps simply because she had no other way of supporting herself, might upon discovering the true cause of the disease have no incentive to switch to safe sex, so likely would it be that she was already infected.

If prostitutes have few incentives to adopt safe sex, the burden of protection against risky sex falls on their customers. But the point about the reduced demand for safe sex when the probability that one is already infected is high applies to the customers as well. If they think they are probably already infected with the AIDS virus, they will perceive a smaller benefit from safe sex than if they think they are probably not carriers of the virus.

**Policy interventions in the African epidemic**

The analysis presented above has implications for combating the African AIDS epidemic. Oddly, perhaps, the analysis implies that the opportunities for effective public intervention may be greater in Africa than in the United States. In the United States, everyone can afford condoms and almost everyone is adequately informed about the transmission, consequences, and prevention of AIDS; hence neither condom subsidies nor public education about AIDS is likely to be a highly effective policy tool.\textsuperscript{38} In Africa, where the price (in forgone consumption of alternative goods and services) of condoms appears to be sufficiently high to reduce the demand for condoms appreciably, and where many people are still inadequately informed about the disease, public subsidization of condoms and public provision of AIDS education are likely to have a significant impact.\textsuperscript{39} Although the countries of sub-Saharan Africa are very poor (apart from the Republic of South Africa) and hence limited in their ability to sponsor costly public interventions, substantial international aid is available for AIDS programs.\textsuperscript{40}

In the longer term, efforts to lessen the economic inequality between men and women in Africa could, by reducing the incidence of prostitution and strengthening the ability of women generally to bargain for safe sex, reduce the spread of the disease.\textsuperscript{41} But care must be taken to avoid possibly illusory “quick fixes,” such as unionization of, or the application of minimum-wage laws to, prostitutes. It is true that such measures, if (as seems doubtful) they are feasible for African governments to implement effectively, would reduce the demand for prostitution. But by doing so, they would also reduce the employment of women in prostitution, and if those women's alternative earnings opportunities remained poor, the ex-prostitutes might well end up engaging in risky sex with men in exchange for
gifts and other financial support—prostitution in all but name, and conceivably even more difficult to monitor. A better prescription, though one both costly and long-term, would be to increase the education of African women.42

Another example of how intuitively attractive policy prescriptions can become less attractive when one allows for rational adjustments to policy measures concerns measures to reduce the prevalence of other sexually transmitted diseases. Since such diseases are cofactors with (or, in economic terms, complements of) AIDS, it might seem obvious that reducing the former would reduce the latter. No doubt it would. But the reduction might be small if people with other sexually transmitted diseases, knowing they are at greater risk of AIDS, are more likely to adopt safe sex because the expected benefits are greater. A factor tugging the other way, however, is that sexually transmitted diseases are frequent causes of female infertility, which in Africa tends to exclude women from marriage, thus increasing the supply (and so reducing the price) of prostitution.43

An example of an AIDS program that is less likely to work in Africa than in the United States is partner notification ("contact tracing"), that is, notifying partners of persons with AIDS (or HIV) so that they can take steps to avoid becoming infected or, if they are already infected (but don’t know it), to avoid transmitting the infection to others. If, because of the cofactors we have mentioned, a single act of intercourse is more likely to result in transmission of the virus in an African society than in the United States, there is a greater likelihood that by the time a partner of a person with AIDS has been located and notified he or she has already become infected and has in turn transmitted the virus to someone else. In addition, notification of a prostitute’s partners is very difficult because of the fleeting, often anonymous, nature of the encounter between prostitute and customer; and, as we have emphasized, prostitution is a major source of HIV infection in Africa, as it is not in the United States.

Conclusion

Obviously, our economic analysis of the AIDS epidemic in Eastern and Central Africa is limited in both breadth and scope. Much more work remains to be done, and the analysis should be extended to other non-Western regions in which AIDS is highly prevalent, such as Thailand and other areas of Southeast Asia, as well as to differences between African countries and regions. We have also not addressed the macroeconomic effects of AIDS in poor countries hard hit by the epidemic.44 We hope, however, that we have shown that a rational-choice perspective holds promise for understanding the pattern of AIDS in the developing world, as in the developed countries, and for evaluating methods of combating the epidemic.
The authors gratefully acknowledge the excellent research assistance of Betsy Mukama, Andrew Trask, and John Wright, and the helpful comments of Mead Over and other participants in a seminar at the World Bank, where an earlier version of this paper was presented on 17 March 1994.


5 See, for example, United Nations, cited in note 4, p. 11. We are not aware of systematic data on homosexuality in Africa. But a series of surveys in Ghana conducted between 1987 and 1989 reported that only 0.6 percent of men and 0.0 percent of women had ever had any homosexual contact; none of the survey respondents reported ever having had anal intercourse. Alfred R. Neequaye, Janet E. Neequaye, and Robert J. Biggar, "Factors that could influence the spread of AIDS in Ghana, West Africa: Knowledge of AIDS, sexual behavior, prostitution, and traditional medical practices," *Journal of Acquired Immune Deficiency Syndrome* 4 (1991): 914. "A growing number of investigations support the view that homosexual transmission [of HIV] and transmission by intravenous drug use are negligible [in Africa]." Caldwell and Caldwell, cited in note 2, p. 818.

6 Caldwell and Caldwell, cited in note 2, p. 818.


11 According to United Nations Development Programme, Human Development Report 1995 (New York: Oxford University Press, 1995), the adult literacy rate in sub-Saharan Africa is only 55 percent, compared with 99 percent in the United States (pp. 155 and 157).

12 See, for example, Genevieve Mwale and Philip Burnard, Women and AIDS in Rural Africa: Rural Women’s Views of AIDS in Zambia (Brookfield: Avebury, 1992), pp. 69–70.


14 Green, cited in note 13, p. 19.


18 Life expectancy at birth in sub-Saharan Africa was 50.8 years in 1992, compared to 76.0 in the United States. United Nations Development Programme, cited in note 11, pp. 155 and 157.

19 Ibid., p. 157.

20 Notice how sales rose in Ghana between 1987 and 1988, and then again between 1989 and 1991, as price fell, yet fell between 1988 and 1989, when price rose. The only anomaly in the table is the rise in demand in Zimbabwe between 1990 and 1991, despite the increase in price.


22 We are not aware of any reliable worldwide census of prostitutes. The statement in the text is therefore conjectural, but it appears to be well supported. See especially Caldwell and Caldwell, cited in note 2, pp. 838–840; also Neequaye, Neequaye, and Biggar, cited in note 5, p. 916; Chipfakacha, cited in note 7, p. 40; Barnett and Blaikie, cited in note 4, pp. 28–29, 78; and Green, cited in note 13, pp. 99–100. For example, Neequaye, Neequaye, and Biggar (p. 916) report that 4 percent of the men in their study had had sex with a prostitute within the previous month. On the importance of African prostitution as a source of HIV transmission, see, for example, Peter O. Way and Karen A. Stanecki, "An epidemiological review of HIV/AIDS in Sub-Saharan Africa," US Bureau of the Census, Center for International Research, November 1993, p. 3; Job Bwayo et al., "Human immunodeficiency virus infection in long-distance truck drivers in East Africa," Archives of Internal Medicine 154 (1994): 1391.


24 Prostitutes’ customers can protect themselves by using condoms, but since, as we explained, condoms are costly, customers will still perceive the real price of prostitutes’ services to have risen.

25 Consistent with this suggestion, there is evidence that the higher the price charged by a prostitute, the more likely her customers are to use condoms. Helen Pickering et al., "Determinants of condom use in 24,000 prostitute/client contacts in The Gambia," AIDS 7 (1993): 1093. Assuming that the disutility of a condom to the customer is a fixed cost, the greater the value of the prostitute’s service the smaller that cost will be as a percentage of the total cost of the product and therefore the smaller will be the effect on demand. It is the same principle according to which expensive goods are expected to be sold farther away from the place of production than cheap goods.


30 Heavily emphasized in Caldwell and Caldwell, cited in note 2, pp. 820–824. See also Bwayo et al., cited in note 22, pp. 1393–1396; David J. Hunter et al., "Sexual behavior, sexually transmitted diseases, male circumcision and risk of HIV infection among women in Nairobi, Kenya," *AIDS* 8 (1994): 93. Male circumcision makes men more vulnerable to being infected with HIV (and other sexually transmitted diseases that are cofactors for HIV infection) by women, because it increases the likelihood of penile abrasions, which provide an entry route for vaginal fluids. Female circumcision (infibulation and clitoridectomy) fosters HIV infection of women primarily because it is often performed with HIV-contaminated equipment. The risk is particularly great when, as is common, a group of girls are circumcised at the same time with the same knife. Leslie Hartley Gise, "Women's mental health in Africa" (Book Review), *Journal of the American Medical Association* 268 (1992): 1940.

31 See Philipson and Posner, cited in note 1, pp. 63–64 and Figure 2-5; and pp. 132–133 and Figure 5-1.

32 We acknowledge that the correlation could be spurious. It is possible that HIV or AIDS is simply more likely to be diagnosed in higher-income people, if they are more apt to consult physicians or other health professionals rather than folk healers.

33 A survey of married men in Ghana revealed that 54 percent had a sexual partner in addition to their wife. Neequaye, Neequaye, and Biggar, cited in note 5, p. 916.

34 Philipson and Posner, cited in note 1, pp. 75–78.

35 As emphasized in Green, cited in note 10, p. 100. See also Over and Piot, cited in note 4, p. 464. In tribal Africa, women's bargaining position was strong, because they were highly productive in traditional agriculture. The frequency of polygamy in Africa implies, as supported by empirical analysis, that women were productive, for otherwise it would be difficult for a man to support several wives. See, for example, Gary S. Becker and Richard A. Posner, "Cross-cultural differences in family and sexual life: An economic analysis," *Rationality and Society* 5 (1993): 421. Increased substitution of cash crops for subsistence agriculture has reduced the agricultural productivity of women and hence the terms that they can obtain in bargaining with men. See, for example, Ester Boserup, "Economic and demographic interrelationships in sub-Saharan Africa," *Population and Development Review* 11 (1985): 383, 388–389. Productivity, moreover, need not translate into higher income or greater political power, given the possibility of exploitation.

36 As in $EU_e = B - C(1 - P)(P_w)$, where $EU$ is the expected utility of risky sex, $B$ the gross benefits of risky sex, $C$ the net costs, and $P$ the probability of being already infected. See Philipson and Posner, cited in note 1, Ch. 1. The subscripts denote male and female respectively. So the expected utility of risky sex to the female is greater the greater the probability that she is already infected ($P_w$), as can be seen most easily by rewriting the righthand side of the equation as $B - CP_m + C_{f}P_m$.

37 A study in Abidjan, Ivory Coast, found that in 1992–93 86 percent of prostitutes were HIV-positive. US Bureau of the Census, Health Studies Branch, "Recent HIV seroprevalence levels by country: December 1993," Research Note No. 11, December 1993, p. 24, Table 3. Although this was the highest percentage reported, figures ranging from 30 to 60 percent were reported for a
number of other African cities; pp. 23–27, Table 3.

38 Philipson and Posner, cited in note 1, Ch. 6.


40 See, for example, World Bank, cited in note 4, p. 140.

41 As emphasized in Over and Piot, cited in note 4.


44 There is a growing literature on that subject. See, for example, Ainsworth and Over, cited in note 8.