THE ECONOMICS OF SEXUALITY: THE EFFECT OF HIV/AIDS ON SEXUAL BEHAVIOR, DESIRE, AND IDENTITY IN THE UNITED STATES

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Abstract

In this paper, I develop and test a simple economic model of sexuality. The key idea is that—taking the biological determinants of sexual preferences as given—social, cultural, and economic variables influence the development and expression of sexual behavior, desire, and identity. I apply the theory to make predictions about the effect of AIDS on sexuality, since AIDS dramatically altered the cost of sexual activities. Using a nationally representative dataset on sexuality in the United States, I estimate the effect of knowledge of AIDS and having a relative with AIDS, as well as examine the change in sexual behavior over time. I postulate that people who have a relative with AIDS, on average, have more knowledge, awareness, and fear of AIDS. Empirically, this variable is uncorrelated with a large number of individual background characteristics. I find that AIDS causes men to shift from homosexuality to heterosexuality, whereas AIDS causes women to shift from heterosexuality to homosexuality. Neither genetic nor hormonal theories of sexual orientation can explain these marginal effects. While biology may still play a crucial role, the findings in this paper suggest that it is not the sole determinant of sexual orientation. Economic variables affect sexual behavior, desire, and identity at the margin.

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1. INTRODUCTION AND SUMMARY

Early psychological theories of sexual orientation, which focused on the role of parental and other childhood influences (Bieber et al. 1962, Freud 1953), have largely fallen into disfavor in the last several decades. Today biological theories dominate. Biological theories attribute sexual orientation to either genes (Bailey and Pillard 1991, Hamer et al. 1993, Kallmann 1952, Pillard and Weinrich 1986) or prenatal hormones (Ehrhardt et al. 1985, Gladue et al. 1984, LeVay 1991, Swaab and Hofman 1990). Research on the economics of sexual orientation is scarce and mostly theoretical (Posner 1992, Posner and Philipson 1993). In this paper, I develop and empirically test an economic theory of sexuality. I find evidence that economic variables affect sexual behavior, desire, and identity at the margin.

In what follows, I propose a simple economic model of sexuality in which an individual rationally chooses between two sexual activities. Each activity is associated with a cost. The basic result is that as the cost of one sexual activity rises relative to the cost of the other, consumption of the first sexual activity decreases and consumption of the second increases, which is simply the law of demand. Hence, changes in the cost of sexual activities may affect the trade-off between safe and unsafe sex; promiscuity and monogamy; and heterosexual and homosexual sex. I assume that the substitutability between heterosexual and homosexual activity is greater than zero. Since sexuality lies on a continuum, the degree to which they are substitutes may vary much from person to person.

To test the theory, I examine the HIV/AIDS epidemic in the US, since AIDS dramatically altered the cost of sexual activities. AIDS has been deadly. Most people who were diagnosed with AIDS in the early 1990s died within two or three years (CDC 2003). Men have been much more likely to contract the disease than women. Over six times more men than women were

diagnosed with AIDS in 1992 (CDC 1993). The probability of HIV transmission varies widely across sexual activities. Anal receptive sex is by far the most dangerous sexual activity (Kingsley et al. 1987, Vittinghoff et al. 1999, Winkelstein et al. 1987). Anal insertive sex and vaginal receptive sex are both more dangerous than vaginal insertive sex (Downs and De Vincenzi 1996, Mastro et al. 1994, Padian et al. 1997). Oral sex is relatively safe (Rothenberg et al. 1998).

Applying the economic model, I make predictions about the effect of AIDS on sexuality. I predict that AIDS causes people to shift from less safe sexual activities to safer ones. Furthermore, I predict that people respond along the heterosexual-homosexual margin, and that the direction of the effect differs by gender. I hypothesize that AIDS causes men to move from homosexuality to heterosexuality. Not only are men considerably more likely to have HIV than women, but anal receptive sex is riskier than vaginal insertive sex. In contrast, I hypothesize that AIDS causes women to move from heterosexuality to homosexuality. Women are less likely to have HIV than men, and oral sex is safer than vaginal receptive sex.

I use a nationally representative survey of sexuality, conducted in the early 1990s (Laumann et al. 1994, 1995). The empirical work consists of two parts. In the main empirical part, I analyze sexual differences between respondents who have a relative with AIDS and those who do not. I postulate that people who have a relative with AIDS, on average, have more knowledge, awareness, and fear of AIDS. Empirically, this variable is uncorrelated with a large number of individual background characteristics. I also estimate the effect of knowledge of AIDS, which is based on the number of correct answers to questions about HIV transmission. In the second part, I analyze the change in sexual behavior over time comparing cohorts who lived in the pre- and post-AIDS eras, as well as looking at time series evidence.

Consistent with the economic model, men who have a relative with AIDS are significantly *less* likely to have had a male sexual partner in the last year; have had a male sexual partner in the last five years; say they are not only sexually attracted to women; rate having sex with someone of the same gender as appealing; and think of themselves as homosexual or bisexual. On the other hand, women who have a relative with AIDS are significantly *more* likely to say they are not only sexually attracted to men; and rate having sex with someone of the same gender as appealing. Both men and women who have a relative with AIDS are not significantly more or less likely to have ever done anything sexual with someone of the same gender since puberty. This is suggestive that people who have a relative with AIDS, before finding out their relative was infected, exhibited similar sexual behavior as those who do not.

Moreover, both men and women who have a relative with AIDS are significantly less likely to have syphilis. Men who have a relative with AIDS are more likely to have ever married a woman, had children, and engaged in oral sex with a woman. Men who have a relative with AIDS are more likely to have ever engaged in anal sex with a woman, which suggests that AIDS causes some men who would have had anal sex with men to have anal sex with women. In addition, both with and without controls, knowledge of AIDS is negatively associated with homosexuality in males.

Biological theories of sexual orientation cannot account for the sexual differences between people who have a relative with AIDS and those who do not. Genetic studies report that the rate of homosexuality is greater among men who have a male homosexual relative (Bailey and Pillard 1991, Hamer et al. 1993, Pillard and Weinrich 1986). Men who have a male homosexual relative may be over three times more likely to be homosexual than the general population (Hamer et al. 1993). If anything, having a relative with AIDS makes it more, not less,

likely a male respondent is homosexual, which runs counter to the findings in this paper. Hormonal studies maintain that a prenatal excess of androgen in females and a prenatal deficit of androgen in males are related to homosexuality (Ehrhardt et al. 1985, Gladue et al. 1984, LeVay 1991, Swaab and Hofman 1990). If the level of prenatal androgen has a family-specific component, having a relative with AIDS makes it more likely a male respondent is homosexual but less likely a female respondent is homosexual, which both run counter to the findings in this paper.

Examining behavioral change over time confirms the cross-sectional results. Cohorts who lived in the pre-AIDS era were more likely to report male homosexual behavior than cohorts who lived in the post-AIDS era. Also, time series data shows that male homosexual behavior increased in the mid-1990s following the introduction of AIDS treatments that greatly enhanced life expectancy and reduced the cost of AIDS.

The remainder of the paper is organized as follows. Section 2 presents an economic theory of sexuality. I then determine how the HIV/AIDS epidemic changed the relative cost of sexual activities, and I apply the theory to make predictions about the impact of AIDS on sexuality. Section 3 describes the data, variables, and identification strategy that I utilize to estimate the effect of AIDS. I introduce and interpret the empirical results in Section 4. Section 5 concludes.

2. THE ECONOMICS OF SEXUALITY

There is relatively little theoretical work in economics about sexuality (notable exceptions include Kremer 1996, Oster 2005, Posner 1992, Philipson and Posner 1993, 1994, 1995). In this section, I extend the standard utility framework to develop a simple economic

model of sexuality. Then, I discuss the ways in which the HIV/AIDS epidemic changed the cost of sexual activities, and using the economic model, I make predictions about the effect of AIDS on sexuality.

2.1 AN ECONOMIC THEORY OF SEXUALITY

I propose a simple economic model of sexuality in which an individual rationally chooses between two sexual activities. Consumption of sexual activities, broadly defined, incorporates three distinct but interrelated dimensions of sexuality: behavior, desire, and identity. Each activity is associated with a cost, which is all-encompassing in that it includes the potential costs of sexually transmitted diseases, pregnancy, social stigma, time, and direct or indirect monetary expenses. An individual is endowed with limited resources, capturing the notion that an individual has scarce time, money, and physical capacity. An individual optimally allocates resources between sexual activities so as to maximize his or her utility. The basic result of the model is that as the cost of one sexual activity rises relative to the cost of the other, consumption of the first sexual activity decreases, and consumption of the second increases, which is simply the law of demand.

The model sheds light on the trade-offs among sexual activities such as the trade-off between vaginal and oral sex; protected and unprotected sex; and promiscuity and monogamy. In particular, as the cost of vaginal sex rises, an individual substitutes toward oral sex. As the cost of unprotected sex increases, an individual engages in more protected and less unprotected sex. As the cost of promiscuity rises, an individual is more likely to practice monogamy. Moreover, the model elucidates the trade-off between heterosexual and homosexual sex.

While recognizing the potential contribution of biological factors, I contend that social, cultural, and economic variables also affect sexual orientation, which is jointly defined by sexual

behavior, desire, and identity. That is, there is a heterosexual-homosexual margin. I thus assume that the substitutability between heterosexual and homosexual activity is greater than zero. Since sexuality lies on a continuum, the degree to which they are substitutes may vary much from person to person.[1] At the margin, as the cost of homosexual activity increases, an individual is more likely to engage in heterosexual and less likely to engage in homosexual activity. Conversely, at the margin, as the cost of heterosexual activity increases, an individual is more likely to engage in homosexual and less likely to engage in heterosexual activity.[2]

The relationship between homosexuality and incarceration illustrates the substitutability between heterosexual and homosexual activity. Incarceration raises the cost of heterosexual activity relative to homosexual activity and, as a result, increases the likelihood of homosexual activity, because opposite-gender sexual partners are virtually unavailable in prison.[3] Table 1 compares respondents who have ever spent at least two days in a jail, prison, reform school, or detention center with those who have not.[4] Male respondents who were ever incarcerated are about twice as likely to have ever done anything sexual with a man and to think of themselves as homosexual or bisexual. Female respondents who were ever incarcerated are about three times more likely to have ever done anything sexual with a woman and to think of themselves as homosexual or bisexual.[5] Table 1 demonstrates that, to some degree, heterosexuality and homosexuality are substitutes.

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[1] See the discussion of the sexual continuum in Section 4.

[2] It is possible to extend the model to allow an individual to actively construct his or her sexual desire and identity. In the simple model, they are consumption goods only. Desire and identity are, additionally, endogenous investment goods that complement sexual behavior.

[3] Related to this notion, Johnson and Raphael (2005) investigate the link between incarceration and the spread of HIV among African-Americans.

[4] One caveat is that respondents who have spent time in prison and those who have not may differ in ways that relate to homosexuality, e.g. risk aversion, social deviance.

[5] Although prison rape exists, it does not account for the differences. Subtracting those people whose first same gender experience was forced, of those who were ever incarcerated, 16% of men and 8% of women have ever done anything sexual with someone of the same gender.

To summarize, the key idea of the economics of sexuality is that—taking the biological and other exogenous determinants of sexual preferences as given—social, cultural, and economic variables play a critical role in the development and expression of sexual behavior, desire, and identity, i.e. sexual orientation. Not only does this idea underlie theoretical work on sexual behavior in economics but also empirical work (see Ahituv et al. 1996, Boozer and Philipson 2000, Chesson et al. 2000, Gertler et al. 2005, Goldman et al. 2004, Oettinger 1999). It is worth noting that the economics of sexuality contrasts with other theories which assume the development and expression of sexuality are largely exogenous. Biological theories attribute sexual orientation to either a person's genetic composition or prenatal hormonal environment (Byne and Parsons 1993). Psychological and sociological theories focus on parental, social, and other early childhood influences (Bearman and Brückner 2002, Bieber et al. 1962, Freud 1953, Greenberg et al. 2002, Nevid et al. 1995).

2.2 HIV/AIDS AND THEORETICAL PREDICTIONS

AIDS dramatically altered the cost of sexual activities. It is important to emphasize that AIDS is deadly. About half of the people who were diagnosed with AIDS in the early 1990s died within two years (CDC 2003). Most people who have contracted AIDS are male; men accounted for 86% of AIDS cases in 1992 (CDC 1993). The per-contact probability of HIV transmission varies widely across sexual activities (Royce et al. 1997). The per-contact probability of HIV transmission is the likelihood of getting HIV from having unprotected sex once with an HIV-infected person. Figure 1 depicts the per-contact probability of HIV transmission by sexual activity. Anal receptive sex is the most dangerous (Kingsley et al. 1987, Winkelstein et al. 1987). The per-contact probability of HIV transmission is 0.82%. For anal insertive sex, the per-contact probability of transmission is 0.06% (Vittinghoff et al. 1999). Vaginal receptive sex is more

dangerous than vaginal insertive sex. The per-contact male to female transmission probability is between 0.05% and 0.09%, while the female to male transmission probability is between 0.01% and 0.03% (Downs and De Vincenzi 1996, Mastro et al. 1994, Padian et al. 1997). There is little evidence that AIDS is transmitted through oral sex, although there are some reported cases (Rothenberg et al. 1998).

Taking into account the various changes in the cost of sexual activities, I utilize the economic model to make predictions about the effect of AIDS on sexuality. Not only do I predict that AIDS causes people to shift from less safe sexual activities to safer ones, but I also predict that people respond along the heterosexual-homosexual margin. I hypothesize that AIDS causes men to shift from homosexuality to heterosexuality. Not only are men considerably more likely to have HIV than women, but anal receptive sex is riskier than vaginal insertive sex. Indeed, as Table 2 shows, it is thousands of times more likely that a male would get HIV having sex with a man than having sex with a woman. In terms of AIDS-related mortality, the expected cost of having unprotected sex once with a man is almost $2,000, while the expected cost of having unprotected sex once with a woman is less than a dollar.[6] The AIDS epidemic most dramatically affects the costs of sexual activity for those who are at the margin.[7] Consequently, AIDS decreases the number of men who have sex with men, rate sex with a man as appealing, and self-identify as gay. In contrast, I hypothesize that AIDS causes women to shift from heterosexuality

[6] Assuming that HIV is randomly distributed in the male homosexual and female populations, the percentages of HIV infected people who are male homosexual and female are the same as those for AIDS cases in 1992, and sexual partners are randomly selected, a male is about 3,500 times more likely to get the AIDS virus having sex with a homosexual man than a woman. Assuming that the value of life is two million dollars and contracting the virus leads to sudden death, the expected cost of having unprotected sex once with a homosexual man is $1,924, and the expected cost of having unprotected sex once with a woman is 55 cents. See Table 2.

[7] The expected marginal cost of unprotected sex with a man decreases with the reference level of sexual activity. Table 2 estimates the expected marginal (or incremental) cost of going from zero sexual encounters to one. To compare, the expected marginal cost of unprotected sex with a man going from ten sexual encounters to eleven is $1,772. Thus, AIDS most dramatically affects the costs of sexual activity for those who are at the heterosexual-homosexual margin, which bolsters the empirical findings. Please refer to the discussion of the sexual continuum in Section 4.

to homosexuality. Women are less likely to have HIV than men, and oral sex is safer than vaginal receptive sex. It is almost impossible for a woman to get HIV having sex with another woman. Thus, AIDS increases the number of women who have sex with women, rate sex with a woman as appealing, and self-identify as lesbian. The increase in men's demand for female sexual partners, however, may moderate the effect, but this general equilibrium effect is likely to be small.[8]

3. EMPIRICAL STRATEGY

Numerous empirical studies estimate the impact of AIDS on sexual behavior, but they use unrepresentative survey data, look at heterosexuals and homosexuals separately, fail to overcome omitted variable bias, and/or ignore the heterosexual-homosexual margin.[9] In this section, I describe the empirical strategy that I employ to test the economic theory of sexuality. First, I discuss the data and survey year. Second, I explain the relationship between having a relative with AIDS and knowledge, awareness, and fear of AIDS. Third, I examine which background characteristics are and are not correlated with having a relative with AIDS. Fourth, I define the dependent variables and display summary statistics. Fifth, I outline how I analyze the change in sexual behavior over time.

[8] My theoretical predictions are generally consistent with those that other economists have made. Posner (1992) theorizes that AIDS causes a reduction in male homosexual activity; a decrease in the amount of unsafe sex; an increase in the use of condoms; an increase in marriage; a reduction in illegitimate births; and an increase in legitimate births. In addition, Posner and Philipson (1993) conjecture that AIDS causes an increase in the practice of oral sex; a reduction in the practice of anal sex; a decrease in the number of sexual partners; and an increase in the likelihood bisexual men switch from male to female partners.

[9] Many studies examine homosexual men, particular those in New York or San Francisco (Catania et al. 1991, Ekstrand et al. 1994, Kelly et al. 1990, McKusick et al. 1985a, McKusick et al. 1985b, Martin 1987, Siegel and Glassman 1989, St. Lawrence et al. 1989, Stall et al. 1988). Some studies examine heterosexuals (Becker and Joseph 1988, Catania et al. 1992, Coates 1990, Kanouse et al. 1991, Samuel et al. 1991). Others look at teen, male, or female sexual behavior (Ahituv et al. 1996, Anderson et al. 1990, Carroll 1988, Debuono et al. 1990, Detels et al. 1989, Jemmott et al. 1992, Klepinger et al. 1993, Ku et al. 1992, Lane 2002, Moran et al. 1990, Remez 1991).

3.1 DATA AND SURVEY YEAR

I use the National Health and Social Life Survey (NHSLS), a nationally representative dataset on sexual behavior in the United States (Laumann et al. 1994, 1995). The NHSLS covers the population aged 18-59. The sample size is almost 3,500. It was conducted in 1992 by the University of Chicago and National Opinion Research Center. At virtually 80%, the NHSLS response rate was quite high, as it exceeded the response rate of all other national sexual behavior surveys ever conducted, as well as the average response rate of the General Social Survey (GSS). Most of the survey was administered face-to-face. Self-administered questionnaires covered some of the more sensitive topics, e.g. masturbation, homosexuality, and drug use. The NHSLS designers took a number of measures to protect the confidentiality of the survey respondents. All identifying information about the respondent was destroyed as soon as possible following the interview. The respondents are truly anonymous (Laumann et al. 1994).

1992, the survey year, is a crucial year in the AIDS epidemic. During the years prior to 1992, both the annual number of AIDS cases and deaths in the US were growing rapidly.[10] Figure 2 plots annual HIV incidence, AIDS incidence, and AIDS deaths (Brookmeyer 1991, CDC 2002, 2003, 2004). Both the annual number of AIDS cases and deaths more than tripled between 1986 and 1991. Effective drugs to sustain the lives of those with AIDS were not yet available.[11] In 1992, men accounted for almost 86% of AIDS cases. The principal exposure category was men who have sex with men (CDC 1993). It is critical to note that the number of AIDS cases reaches its peak around 1992 and 1993. This is suggestive that, by 1992, behavioral change had already begun, since AIDS develops in most people several years after the initial

[10] For more on the economics of epidemics, refer to Philipson (2000).
[11] The AIDS cocktail, which dramatically extended life, was first approved by the FDA in the mid-1990s. Figure 2 illustrates the impact that the AIDS cocktail had on the annual number of AIDS deaths.

infection.[12] As Figure 2 shows, estimated annual HIV incidence peaks in the mid-1980s (Brookmeyer 1991).

3.2.1 HAVING A RELATIVE WITH AIDS: KNOWLEDGE, AWARENESS, AND FEAR

In the main empirical part, I estimate the effect of having a relative with AIDS on sexual behavior, desire, and identity. I postulate that respondents who have a relative with AIDS, on average, have more knowledge, awareness, and fear of AIDS than those who do not. I briefly explain each of the three causal pathways. The first pathway is knowledge. As a consequence of having a relative with AIDS, people may gain more information about HIV transmission and prevention, medical treatment of AIDS, and the tragic cost of the disease.[13] The second pathway is awareness. Having a relative with AIDS may make AIDS more salient and come to mind more frequently, thus raising consciousness. The third pathway is fear. Having a relative with AIDS may involve some graphic, shocking, and horrifying experiences that increase the fear of AIDS. Indeed, several empirical studies find that people who know someone with AIDS are more likely to adopt safer sexual practices (Ekstrand and Coates 1990, Gregson et al. 1998, Hingson et al. 1990, Macintyre et al. 2001). One of these studies looks at having a relative with AIDS. Gregson et al. (1998) discover that in Zimbabwe women who have a close relative or household member with AIDS are more likely to report condom use, as well as other behavioral changes.[14]

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[12] An alternative interpretation is that HIV incidence decreased when nearly all highly susceptible people were infected, and the virus began to spread to less susceptible people.

[13] Empirically, both men and women who have a relative with AIDS have more knowledge of AIDS than those who do not, but the difference is not statistically significant.

[14] The question remains whether or not this effect is rational. Some commentators do not believe that people who modify their behavior because they know someone with AIDS are acting rationally (Philipson and Posner 1993). They maintain that people do not need to know someone with AIDS to correctly assess the risk of HIV. Misperceiving the risk associated with HIV/AIDS, people who have a relative with AIDS may have overreacted due to fear, which some argue is irrational. I contend that, while knowing someone with AIDS is not a necessary condition to understand and respond to the risk of HIV, it may, in fact, cause rational behavioral modification. First, as I have discussed above, learning more about HIV/AIDS is an unintended, secondary consequence of having a relative with AIDS. This additional knowledge may spur people to react rationally to the AIDS epidemic. Second,

3.2.2 HAVING A RELATIVE WITH AIDS: EMPIRICAL DEFINITION AND CORRELATES

Thus, examining sexual differences between respondents who have a relative with AIDS and those who do not, I estimate the joint effect of knowledge, awareness, and fear of AIDS.[15] Empirically, I cannot distinguish among the three causal pathways.[16] Specifically, having a relative with AIDS is a dummy variable which equals one if the respondent has a relative other than a son or daughter, living or dead, who came down with AIDS and equals zero otherwise.[17] This includes a brother, sister, uncle, aunt, or cousin who came down with AIDS. The NHSLS does not have information about the respondent's exact family connection to the relative; when the relative contracted the disease; or when the respondent found out.[18] In the sample, more than four percent of respondents, i.e. 150 observations, have a relative with AIDS. About 87% of these respondents have a male relative with AIDS, which nearly matches the percentage of male

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seeing, hearing of, and thinking about the consequences of HIV infection may increase a person's fear of AIDS, which induces or reinforces behavioral modification. Seeing an AIDS patient in the hospital is like watching a television advertisement that does not convey explicit factual information, but instead contains graphic visual images that aim to inspire behavioral change. Mental imagery may underlie the effect (Francis 2005). McKusick et al. (1985b) provide direct evidence that supports this idea. They find that men who could remember the visual image of someone in the advanced stages of AIDS deterioration were more likely to reduce the number of sexual partners they had. Nevertheless, to settle this question is beyond the scope of the paper. I empirically estimate the impact of AIDS whether or not people responded in an entirely rational way.

[15] This empirical strategy identifies partial, not general, equilibrium effects.

[16] Although I have a measure of knowledge of AIDS, I cannot identify the effect of knowledge alone. Awareness and fear, which are unobservable, remain in the error term, and are correlated with having a relative with AIDS. I would be able to identify the effect of knowledge if awareness and fear were not correlated with having a relative with AIDS, or if they were both observable and uncorrelated with the error term.

[17] The NHSLS asks detailed questions about the three persons with AIDS whom the respondent knows best. It is possible that some respondents who know more than three persons with AIDS, in fact, have a relative with AIDS, but the relative is not among the three best known persons. In this paper, people who are at the heterosexual-homosexual margin are the main group of interest. The number of people at the margin is several times greater than the number of strict homosexuals (please refer to Section 4). 94% of male respondents who are at the margin know three or fewer persons with AIDS, and 97% of male respondents who are neither at the margin nor strict homosexuals know three or fewer persons. This suggests that the number of respondents at the margin missing from the subsample of men who have a relative with AIDS is much less than one. Even though a higher percentage of strict homosexuals report that they know more than three persons with AIDS, since this group is so small, the number of strict homosexual respondents missing from the subsample of men who have a relative with AIDS is also less than one.

[18] The typical respondent was probably in his or her late 20s or early 30s when he or she found out. The median age in the sample was 35 years old. In the survey year, about half of all AIDS cases were diagnosed by 1988.

AIDS cases in 1992 (CDC 1993). Because the sample size is relatively small, I report the p-values associated with an exact hypothesis test when I analyze differences between respondents who have a relative with AIDS and those who do not (see Table 7).

Table 3 compares the background characteristics of respondents who have and do not have a relative with AIDS. Having a relative with AIDS is uncorrelated with gender, age, education, income, marital status, number of brothers, number of sisters, childhood family structure, religious affiliation, religious attendance, opinion of homosexuality, incarceration, having a co-worker with AIDS, and country of birth. Any apparent differences are not statistically significant using a test on the equality of proportions. Having a relative with AIDS is somewhat correlated with ethnicity and childhood region. Based on a test on the equality of proportions, respondents who have a relative with AIDS are significantly more likely to be black or Hispanic and to live in the Middle Atlantic or Pacific regions at age 14, and they are less likely to be white and to live in the East South Central region at age 14.[19] This is because ethnicity and childhood region are family-related and HIV prevalence varies along ethnic and regional lines.[20][21] In the empirical work, I control for ethnicity and childhood region, along with

[19] Black men accounted for about 27% of all male AIDS cases reported through 1992, which matches the proportion of respondents who have a relative with AIDS that are black (CDC 1993).

[20] There are no major differences in male homosexuality between whites and blacks or between whites and Hispanics: anything sexual with a man (9.6% w, 8.0% b, 7.6% h), attraction to only men, mostly men, or both men and women (3.7% w, 3.9% b, 5.2% h), homosexual or bisexual identity (3.3% w, 2.9% b, 6.0% h). The only difference in male homosexuality associated with a p-value less than 0.20 using Fisher's Exact Test is homosexual or bisexual identity between whites and Hispanics (p-value 0.092). Note that the potential bias is in the opposite direction of my findings. Likewise, there are no major differences in female homosexuality between whites and blacks or between whites and Hispanics: anything sexual with a woman (4.7% w, 2.8% b, 3.6% h), attraction to only women, mostly women, or both men and women (1.9% w, 1.5% b, 1.7% h), homosexual or bisexual identity (2.0% w, 1.8% b, 1.7% h). The only difference in female homosexuality associated with a p-value less than 0.20 using Fisher's Exact Test is anything sexual with a woman between whites and blacks (p-value 0.092). Note that the potential bias is in the opposite direction of my findings. Thus, potential racial differences in homosexuality, including differential underreporting, do not explain the empirical findings.

[21] Having a relative with AIDS may be correlated with local HIV prevalence. Some may claim that people who have a relative with AIDS make changes in their sexual behavior, not because they have a relative per se, but because local prevalence is high. However, having a co-worker with AIDS and six of nine regions are uncorrelated with having a relative with AIDS. The regression estimates are robust to the addition of region controls. Furthermore,

other characteristics. Moreover, potential biological effects run counter to the effects of HIV/AIDS that I identify. Based on the biological theories of sexual orientation, having a male homosexual relative, if at all, raises the likelihood that a male respondent is homosexual but lowers the likelihood that a female respondent is homosexual.[22]

3.2.3 DEPENDENT VARIABLES AND SUMMARY STATISTICS

I concentrate on three dimensions of sexuality: behavior, desire, and identity (Laumann et al. 1994). I look at a number of outcome variables: (behavior) same-gender sexual partners, cohabitation with a same-gender partner, cohabitation with an opposite-gender partner, marriage, divorce, children, oral sex, anal sex, syphilis; (desire) appeal of having sex with someone of the same gender, sexual attraction to someone of the same gender; (identity) homosexual or bisexual identity. Table 4 defines the dependent variables. Table 5 displays summary statistics for the principal independent variable and the dependent variables. Inspecting the summary statistics, differences among the three dimensions of sexuality are apparent. For male respondents, 9.1% have ever done anything sexual with a man since puberty (behavior), 4.5% say having sex with a man is very appealing or somewhat appealing (desire), and 3.3% think of themselves as homosexual or bisexual (identity).[23] While the three dimensions are interrelated, they are clearly distinct. Accordingly, the empirical analysis must address each.

3.3 ANALYZING THE CHANGE IN SEXUAL BEHAVIOR OVER TIME

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high prevalence is positively associated with male homosexuality, which runs counter to the findings for male respondents.

[22] I explain in greater detail the biology of sexual orientation in Section 4.

[23] Perhaps surprisingly, few men (only about 0.7% of all male respondents) think of themselves as bisexual. While identity is rather polarized, behavior and desire are not. There is considerable middle ground between strict heterosexuality and strict homosexuality. I discuss the sexual continuum at the beginning of the next section.

In the second empirical part, I analyze the change in sexual behavior over time to confirm the cross-sectional results. First, using the GSS, I plot the percentage of men who had a male partner in the past year from 1988 to 1998. Next, using the NHSLS, I compare the eras before and after AIDS is discovered. The pre-AIDS era is that before August 1982 when the disease was named AIDS. The post-AIDS era is that after February 1983 when the New York Times began to publish articles about AIDS.[24] Detailed information on respondents' lifetime sexual history is limited in the NHSLS. Exact dates only exist for the beginning and ending of cohabitation/marriage. The dataset contains the number and gender of sexual partners before, after, between, and during cohabitation/marriage periods. Figure 3 depicts a sample lifetime sexual history for a person who cohabited or married twice. I focus on four periods, including (A) the period between age 18 and first cohabitation/marriage; (B) the period during first cohabitation/marriage; (C) the period between first and second cohabitation/marriage; and (D) the period during second cohabitation/marriage. For each period, I investigate differences in the number and gender of sexual partners between respondents who experience the period in the pre-AIDS era and those who experience the period in the post-AIDS era.[25] Given the nature of the data, it is difficult to eliminate cohort effects when comparing sexual behavior in pre- and post-AIDS eras. However, the two cohorts are less than a generation apart. The average age difference between pre- and post-AIDS respondents is between ten and twenty years.

4. EMPIRICAL RESULTS AND DISCUSSION

[24] The short gap between the pre- and post-AIDS eras is the time when select groups, e.g. the homosexual community in San Francisco, had some knowledge of AIDS but the nation did not.

[25] For example, I compute the percentage of respondents who had a same-gender sexual partner in period A for both male respondents who experience period A in the pre-AIDS era and male respondents who experience period A in the post-AIDS era.

In this section, I present and interpret the empirical results. First, I discuss the sexual continuum, a concept that is crucial to the interpretation of the effects of AIDS on sexuality. Second, I demonstrate that, with and without controls, knowledge of AIDS is negatively associated with homosexuality in males. Third, I show that, with and without controls, having a relative with AIDS is negatively related to homosexuality in males, but positively related to homosexuality in females, which is consistent with an economic theory of sexuality. I then consider several alternative hypotheses to explain the findings, including genetic and hormonal theories of sexual orientation, as well as stigma-related survey bias. Fourth, to corroborate the cross-sectional results, I analyze the change in sexual behavior over time.

4.1 THE SEXUAL CONTINUUM

The data reveal that sexuality lies on a continuum. The sexual continuum is a concept that is the key to interpreting the marginal effects of the HIV/AIDS epidemic on sexual orientation. Few people actually consider themselves bisexual. About 0.7% of male respondents and 0.5% of female respondents think of themselves as bisexual. Nonetheless, many people exhibit sexual desire for both genders; many people have had sex with both genders. It is only identity that is polarized. That is, a number of respondents self-identify as heterosexual but have sex with people of the same gender and/or express same gender desire. Vice versa, other respondents self-identify as homosexual but have sex with people of the opposite gender and/or express opposite gender desire. There is substantial middle ground between strict heterosexuality and strict homosexuality. This middle ground is the heterosexual-homosexual margin. For people who are at the heterosexual-homosexual margin, the substitutability between heterosexual and homosexual activity is relatively high.

Using a measure based on desire, about 4.2% of men and 4.1% of woman are at the heterosexual-homosexual margin. Using a measure based on behavior and identity, about 7.3% of men and 3.5% of woman are at the margin.[26] Note that I find that the number of people at the heterosexual-homosexual margin is two or three times greater than the number of strict homosexuals. Applying this interpretation, I find that changes in the cost of sexual activities due to HIV/AIDS cause people who occupy the middle ground between strict heterosexuality and strict homosexuality, the heterosexual-homosexual margin, to move along the sexual continuum toward one endpoint or the other.

4.2 KNOWLEDGE OF AIDS

Both with and without controls, knowledge of AIDS is negatively associated with male homosexuality. Knowledge is a variable based on the number of correct answers to five questions about HIV transmission. Table 6 implies that as knowledge of AIDS increases, men are less likely to have had sex with a man during the last sexual event; have had a male sexual partner in the last year; have had a male sexual partner in the last five years; ever cohabit with a man; say they are sexually attracted to only men, mostly men, or both women and men; say they are not only sexually attracted to women; and think of themselves as homosexual or bisexual. An increase in knowledge of about one standard deviation (one unit) is associated with a decrease in having had a male sexual partner in the last five years by 2.2 percentage points and a decrease in attraction to not only women by 2.5 percentage points.

[26] One measure of the heterosexual-homosexual margin, i.e. the middle ground between strict heterosexuality and strict homosexuality, is based on desire. It is the percentage of respondents who say they are not only attracted to the opposite gender minus the percentage who say they are only attracted to the same gender. For men, this is 6.65% - 2.46% = 4.19%; for women, 4.42% - 0.37% = 4.05%. Another measure is based on behavior and identity. It is the percentage of respondents who have ever done anything sexual with someone of the same gender minus the percentage who think of themselves as homosexual. For men, this is 9.07% - 1.79% = 7.28%; for women, 4.13% - 0.62% = 3.51%.

This evidence is suggestive that knowledge of AIDS may have a negative effect on male homosexual behavior, desire, and identity. However, omitted variable bias may frustrate the identification of a causal link between knowledge of AIDS and behavioral change, which may explain why other empirical studies have been unable to establish a consistent relationship between knowledge and behavior (Anderson et al. 1990, Klepinger et al. 1993, McKusick et al. 1985a, St. Lawrence et al. 1989). Knowledge may be correlated with other variables that are related to sexual behavior, such as the unobserved biological determinants of sexual orientation. For instance, men who are sexually attracted to men may have a higher demand for information about HIV and may be more likely to engage in anal receptive sex as well. As a result, it may appear that knowledge is unrelated to, or even negatively related to, safer sexual practices when the actual causal effect is positive.

4.3.1 HAVING A RELATIVE WITH AIDS AND HOMOSEXUALITY

I explore the relationship between having a relative with AIDS and homosexuality in order to estimate the joint effect of knowledge, awareness, and fear of AIDS on sexual orientation. I find that, at the margin, AIDS causes men to shift from homosexuality to heterosexuality, whereas AIDS causes women to shift from heterosexuality to homosexuality. Table 7 compares respondents who have a relative with AIDS and those who do not. It is important to keep in mind that the sample size is relatively small. 60 male respondents and 90 female respondents have a relative with AIDS. Hence, I will report, whenever possible, the p-values associated with an exact hypothesis test.

Consistent with the economic model of sexuality, having a relative with AIDS is negatively related to homosexuality in males. 1.7% and 6.9% of male respondents who have and do not have a relative with AIDS, respectively, say they are not only sexually attracted to women.

A difference this or more extreme is 8.1% likely to occur by chance alone if the true proportions were equal. 0.0% and 4.6% of male respondents who have and do not have a relative with AIDS, respectively, rate having sex with someone of the same gender as appealing, which is 6.2% likely to occur by chance alone if the true proportions were equal. However, the evidence suggests that the two groups exhibited similar sexual behaviors prior to having a relative with AIDS. 7.5% and 9.1% of male respondents who have and do not have a relative with AIDS, respectively, have ever done anything sexual with a man, which are not significantly different.

Also consistent with the economic model, having a relative with AIDS is positively related to homosexuality in females. 12.2% and 5.3% of female respondents who have and do not have a relative with AIDS, respectively, rate having sex with someone of the same gender as appealing. A difference this or more extreme is 1.1% likely to occur by chance alone if the true proportions were equal. 4.4% and 1.7% of female respondents who have and do not have a relative with AIDS, respectively, think of themselves as homosexual or bisexual, which is 8.1% likely to occur by chance alone if the true proportions were equal. However, the evidence suggests that the two groups exhibited similar sexual behaviors prior to having a relative with AIDS. 5.9% and 4.0% of female respondents who have and do not have a relative with AIDS, respectively, have ever done anything sexual with a woman, which are not significantly different.

Studies of the genetic basis of sexual orientation report that the rate of homosexuality is greater among men who have a male homosexual relative. Pillard and Weinrich (1986) estimate a 22% rate of homosexuality or bisexuality in non-twin brothers given one brother is homosexual, while Bailey and Pillard (1991) estimate a 9.2% rate. In perhaps the most cited study in the field, Hamer et al. (1993) estimate that men who have a male homosexual relative are 3.1 times more

likely to be homosexual than the general population.[27] If Hamer's estimates are true, and about half of respondents who have a relative with AIDS have a male homosexual relative specifically, men who have a relative with AIDS are twice as likely to be homosexual than the general population. In the last column of Table 7, I report the p-values under the null hypothesis that the proportion in column (2) is twice that of column (1). For several variables, a difference in male homosexuality as or more extreme than that actually observed is less than 1% likely to occur by chance alone if the genetic model were true, which validates the economic theory of sexuality.

Using a linear probability model, I regress the appeal of having sex with someone of the same gender on having a relative with AIDS and a number of controls.[28] Since desire generally precedes or complements behavior, changes in homosexual desire are a rational response to the AIDS epidemic. Table 8 displays the regressions. Both with and without controls, I find that men who have a relative with AIDS are significantly less likely to rate same gender sex as appealing, whereas women who have a relative with AIDS are significantly more likely. Men who have a relative with AIDS are 5.0 percentage points less likely to rate same gender sex as appealing. In contrast, women who have a relative with AIDS are 7.5 percentage points more likely to rate same gender sex as appealing. To confirm this result, I regress the appeal of watching other people doing sexual things, a variable which is presumably unrelated to AIDS and homosexuality, on having a relative with AIDS and controls. Having a relative with AIDS has no effect on how men and women rate watching other people doing sexual things as appealing.

Table 9 displays regressions of homosexual behavior, desire, and identity. Both with and without controls, men who have a relative with AIDS are significantly less likely to have had sex

[27] 6.2% homosexuality in brothers, uncles, and cousins of random probands compared with 2.0% homosexuality in the population. See Hamer et al. (1993), page 322.
[28] Controls include age and dummies for education, income, ethnicity, childhood region, childhood religious affiliation, and family structure.

with a man during the last sexual event; have had a male sexual partner in the last year; have had a male sexual partner in the last five years; ever cohabit with a man; say they are only sexually attracted to men; say they are sexually attracted to only men, mostly men, or both women and men; say they are not only sexually attracted to women; and think of themselves as homosexual or bisexual. Specifically, men who have a relative with AIDS are 5.1 percentage points less likely to have had a male sexual partner in the last five years; 4.8 percentage points less likely to say they are not only sexually attracted to women; and 4.0 percentage points less likely to think of themselves as homosexual or bisexual. For women, the effect goes the other way. Both with and without controls, women who have a relative with AIDS are more likely to say they are not only sexually attracted to men. Women who have a relative with AIDS are 6.2 percentage points more likely to say they are not only sexually attracted to men.[29]

To strengthen the results, it is critical to verify that people who have a relative with AIDS, before finding out their relative was infected, exhibited the same sexual behavior as those who do not have a relative with AIDS. Recall that the typical respondent was most likely in his or her late 20s or early 30s when he or she found out. I check for differences in having ever done anything sexual with someone of the same gender. There should be no systematic difference between men who have a relative with AIDS and men who do not, except when having a relative with AIDS deters a male respondent's first sexual encounter with a man. There should be no systematic difference between women who have a relative with AIDS and women who do not, except when having a relative with AIDS causes a female respondent's first sexual encounter with a woman. Table 9 displays the regressions. Although the coefficient is negative, men who have a relative with AIDS are not significantly less likely to have ever done anything sexual with

[29] Including knowledge of AIDS as an additional control variable does not modify the male or female results, underscoring the importance of fear and awareness as causal pathways.

a man since puberty. Indeed, nearly eight percent of men who have a relative with AIDS have ever done anything sexual with a man. Although the coefficient is positive, women who have a relative with AIDS are not significantly more likely to have ever done anything sexual with a woman since puberty. Prior to learning that their relative came down with AIDS, people who have a relative with AIDS exhibited similar sexual behavior.

The findings on the heterosexual-homosexual margin shed light on the economics of identity. I discover that the cost of HIV/AIDS influences sexual identity at the margin. Identity, to some degree, responds to prices and is, thereby, endogenous. This contrasts somewhat with the theory of identity put forward by Akerlof and Kranton (2000, 2002), who model self-image as a function of an individual's actions and others' actions, as well as exogenously assigned social categories, prescriptions, and individual characteristics. It is unclear in their model how prices relate to identity and how identity might change. The results in this paper suggest, though, that endogenous identity change is not as "limited" as Akerlof and Kranton believe (see Akerlof and Kranton 2000, pages 725-726).

4.3.2 HAVING A RELATIVE WITH AIDS AND OTHER SEXUAL ACTIVITIES

I examine the relationship between having a relative with AIDS and other sexual activities, such as marriage, oral sex, and anal sex. I find that, at the margin, AIDS causes people to shift from less safe sexual activities to safer ones. Table 10 displays the regressions. Both men and women who have a relative with AIDS are significantly less likely to have syphilis than those who do not have a relative with AIDS. This indicates that AIDS inspired men and women to choose sexual partners more carefully and practice safer sex. Men who have a relative with AIDS are more likely to have ever cohabited with a woman, married a woman, had children, and engaged in oral sex with a woman. Both men and women who have a relative with AIDS are no

more likely to have ever divorced. In particular, men who have a relative with AIDS are over 11 percentage points more likely to have ever married a woman and about 14 percentage points more likely to have ever had children, which both suggest that AIDS increased monogamy. They are 11 percentage points more likely to have ever received oral sex from a woman, which reveals that AIDS spurred a rise in oral sex, as it is one of the safest sexual practices. Men who have a relative with AIDS have a greater number of children, implying that the AIDS epidemic, at least temporarily, may have raised the birth rate. Men and women who have a relative with AIDS are no more likely to have had an illegitimate birth than those who do not. I do not find that people who have a relative with AIDS are more likely to use condoms during last event vaginal sex (not reported in the table).[30] In summary, the evidence is broadly consistent with previous empirical studies that find that people adopted safer sexual practices because of AIDS.

Interestingly, men who have a relative with AIDS are more likely to have ever engaged in anal sex with a woman. Table 10 shows that men who have a relative with AIDS are about 16 percentage points more likely to have ever engaged in anal sex with a woman. Together with the findings on the heterosexual-homosexual margin, this suggests that AIDS causes some men who would have had anal sex with men to have anal sex with women. Anal sex is a risky activity. Nevertheless, anal insertive sex with a woman is considerably less risky than anal insertive or

[30] Among never married respondents, last event anal sex condom use (37%) is greater than last event vaginal sex condom use (32%), which makes sense since anal sex is riskier. Among never married respondents, respondents who have a relative with AIDS and those who do not both report condom usage during last event vaginal sex at 32%. However, white males who are not currently married and have a relative with AIDS report 38% condom usage, whereas white males who are not currently married and do not have a relative with AIDS report 30% usage. The difference, though, is not statistically significant, because sample size is low.

One reason why I may not identify an effect is that the empirical strategy picks up the differential effect on condom use between respondents who have a relative with AIDS and those who do not. If HIV/AIDS increases condom usage by the same magnitude for both groups, then the effect is differenced out. Another reason may be related to partner selection. The quality of partner selection is an unobserved variable that is inversely related to condom usage. For example, the never married are three times more likely to use condoms than the currently married, and, at 45%, never married black males are more likely to use a condom than any other gender-race category. Failure to fully control for the quality of partner selection may bias estimates of condom usage. Other empirical studies, which link condom sales to regional variation in AIDS prevalence or education, are better able to identify the effect of HIV/AIDS on condom usage (Ahituv et al. 1996, Moran et al. 1990).

receptive sex with a man. Moreover, in terms of the per-contact probability of HIV transmission, anal and vaginal insertive sex are of the same order of magnitude. As a result, an increase in anal sex with women may be a rational response to AIDS, especially if some men have a strong preference for anal sex.

4.3.3 ALTERNATIVE HYPOTHESIS: BIOLOGICAL THEORIES OF SEXUAL ORIENTATION

Neither genetic nor hormonal theories of sexual orientation can explain the sexual differences between people who have a relative with AIDS and those who do not. Studying the sexual orientation of twins, researchers claim that male homosexuality has a genetic basis (Bailey and Pillard 1991, Kallmann 1952, Kendler et al. 2000, Pillard and Weinrich 1986, Whitam et al. 1993). These studies find that the concordance rate for homosexuality is higher among identical twins than among fraternal twins. Moreover, as I have mentioned previously, studies report that the rate of homosexuality is greater among men who have a male homosexual relative (Bailey and Pillard 1991, Hamer et al. 1993, Pillard and Weinrich 1986). A notable study links male homosexuality to a region on the X-chromosome (Hamer et al. 1993). Nevertheless, not all researchers believe that the evidence proves male homosexuality has a genetic basis (Eckert et al. 1986, Heston and Shields 1968, King and McDonald 1992, McConaghy and Blaszczynski 1980, McGuire 1995, Parker 1964, Rice et al. 1999). Thus, if at all, having a relative with AIDS makes it more, not less, likely a male respondent is homosexual, assuming that the relative is a male who acquired the disease through homosexual contact. This runs counter to the effect of AIDS that I identify.

Studying hormones and sexual behavior in animals, some researchers claim that a prenatal excess of androgen in females is related to female homosexuality, and a prenatal deficit of androgen in males is related to male homosexuality (Bell et al. 1981, Ehrhardt et al. 1968,

Ehrhardt et al. 1985, Ellis and Ames 1987, Gladue et al. 1984, Goy and McEwen 1980, Meyer-Bahlburg 1979, Meyer-Bahlburg 1984, Ward 1972). This is the so-called prenatal hormonal hypothesis. Physical differences in the hypothalamus between homosexual and heterosexual men may underscore the role of hormones (LeVay 1991, Swaab and Hofman 1990). However, there is no evidence that sexual orientation and adult hormonal constitution are related (Downey et al. 1987, Feder 1984, Meyer-Bahlburg 1984). Consequently, if the level of prenatal androgen has a family-specific component, having a relative with AIDS makes it more likely a male respondent is homosexual but less likely a female respondent is homosexual, which both run counter to the effects that I identify.

4.3.4 ALTERNATIVE HYPOTHESIS: STIGMA-RELATED SURVEY BIAS

The issue of stigma is important. We may never really know if respondents are being fully honest or how respondents truly feel, which is a potential problem with any survey, especially one about sexuality. Thus, some may claim that men who have a relative with AIDS are especially stigmatized and are, hence, more likely to distort their survey responses to avoid appearing homosexual. Nevertheless, the findings are not simply an artifact of stigma-related survey bias. First, male respondents who have a relative with AIDS report ever having done anything sexual with a man at about the same rate as men who do not have a relative with AIDS. Second, there is no evidence that men who have a relative with AIDS live in a social environment that is less tolerant of homosexuality. Having a relative with AIDS is uncorrelated with respondents' opinion of homosexuality, which is presumably correlated with the opinions of people living in their social environment (see Table 3). Third, the NHSLS design ensures confidentiality and builds trust in a way which minimizes stigma, e.g. self-administered questionnaires cover sensitive topics. Fourth, it would be difficult for respondents to distort

survey responses about children and marriage. Fifth, stigma does not rationalize why men who have a relative with AIDS are more likely to report ever having had anal sex with a woman. Sixth, evidence on the change in sexual behavior over time, which I introduce shortly, is unrelated to having a relative with AIDS, but echoes the cross-sectional findings. Lastly, stigma-related survey bias does not explain why women who have a relative with AIDS are more likely to report homosexuality.

4.4 BEHAVIORAL CHANGE OVER TIME

Examining behavioral change over time confirms the cross-sectional results. Prior to the AIDS epidemic, there was no credible data on homosexuality. Despite a total lack of probability sampling, Kinsey et al. (1948) estimated that 10% of white males were more or less exclusively homosexual. The GSS has the earliest time series data on homosexuality. It contains two variables: homosexual behavior in the past year and past five years. Figure 4 displays the percentage of men who had a male partner in the past year from 1988 to 1998. When AIDS cases and deaths are rising during the late 1980s and early 1990s, the level of homosexual behavior is relatively low. Consistent with Goldman et al. (2004), when AIDS cases and deaths are falling (in part due to the AIDS cocktail and other HIV breakthroughs) during the mid and late 1990s, the level of homosexual behavior is relatively high. This is prima facie evidence that the AIDS epidemic may have initially lowered the rate of homosexual behavior by about two percentage points, that is, by as much as 50%.

Comparing sexual behavior before and after AIDS is discovered also validates the cross-sectional results. Based on the NHSLS, Table 11 displays two behavioral measures: the percentage of respondents with zero or one partner and the percentage of respondents with a

same-gender partner.[31] For each of the four periods, I contrast respondents who experience the period in the pre-AIDS era and those who experience the period in the post-AIDS era (see Figure 3). I find that, in the post-AIDS era, the number of sexual partners decreases for both men and women. In all but one case, the percentage of respondents with zero or one partner increases in the post-AIDS era. For male respondents in periods C and D and female respondents in period C, the difference is statistically significant using a test on the equality of proportions. Additionally, there is clear evidence that, in the post-AIDS era, the percentage of men who had a male sexual partner sharply falls. The percentage of male respondents with a same-gender partner drops by about half or more in all four periods. The difference is statistically significant in periods B and D. I do not find evidence that the percentage of women who had a female partner increases, which may be partially attributed to the increase in men's demand for female sexual partners, a general equilibrium effect.

5. CONCLUSION

In this paper, I create and test a simple economic model of sexuality. The key idea of the economics of sexuality is that—taking the biological and other exogenous determinants of sexual preferences as given—social, cultural, and economic variables play a critical role in the development and expression of sexual behavior, desire, and identity. I then estimate the effect of AIDS on sexuality to test the theoretical model. Specifically, I analyze sexual differences between respondents who have a relative with AIDS and those who do not, estimate the effect of knowledge of AIDS, investigate the change in sexual behavior over time comparing cohorts who lived in the pre- and post-AIDS eras, as well as look at time series evidence.

[31] For the periods during cohabitation/marriage, i.e. periods B and D, the two measures refer to sexual partners other than the partner with whom the respondent cohabits or to whom the respondent is married.

In short, I find that AIDS causes men to shift from homosexuality to heterosexuality, whereas AIDS causes women to shift from heterosexuality to homosexuality. Changes in the cost of sexual activities cause people who occupy the middle ground between strict heterosexuality and strict homosexuality to shift along the sexual continuum. While biology may still play a crucial role, the findings in this paper suggest that it is not the sole determinant of sexual orientation. Economic variables affect sexual behavior, desire, and identity at the margin.

This paper makes several contributions. I develop an economic theory of sexuality, which is distinct from biological and psychological theories. Empirically, I test the theory estimating the effect of AIDS. Moreover, the economic theory of sexuality may help policy makers and interest groups evaluate the effect of public policies and social norms, which affect the cost of sexual activities. For example, as the social stigma associated with homosexuality diminishes and the homosexual rights movement gains ground, not only may more people become openly homosexual, but the overall prevalence of homosexual behavior, desire, and identity may rise. As medical treatment for AIDS becomes more effective and affordable, men may move from heterosexuality to homosexuality, and women may move from homosexuality to heterosexuality.

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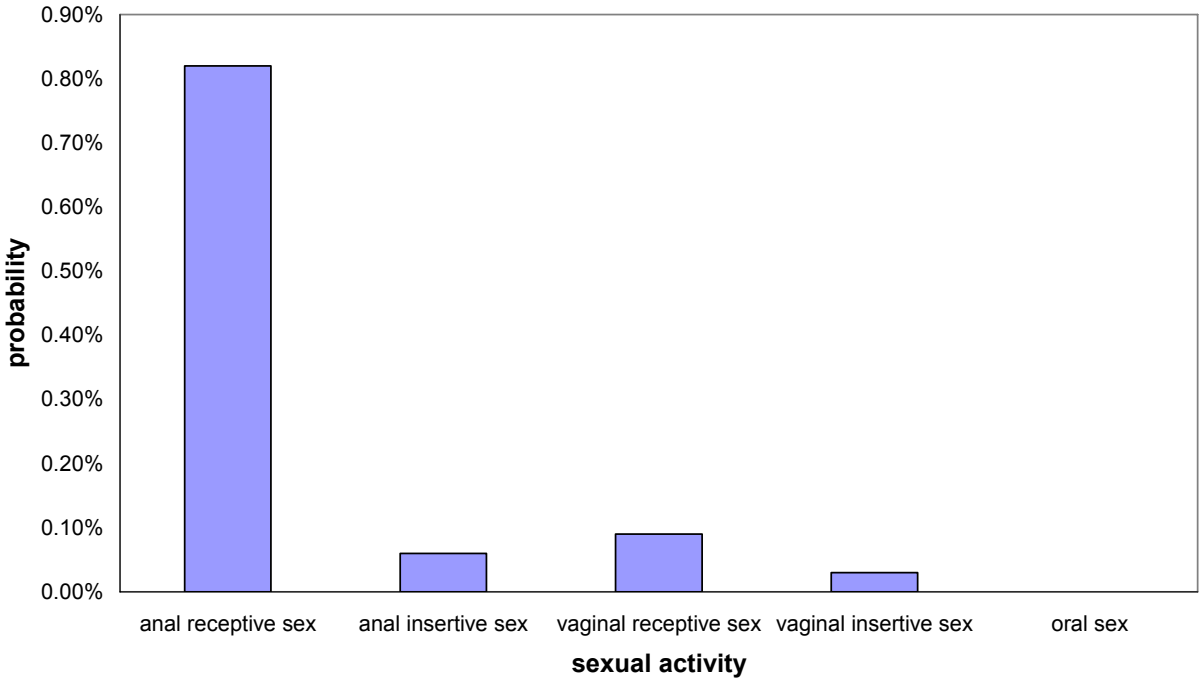
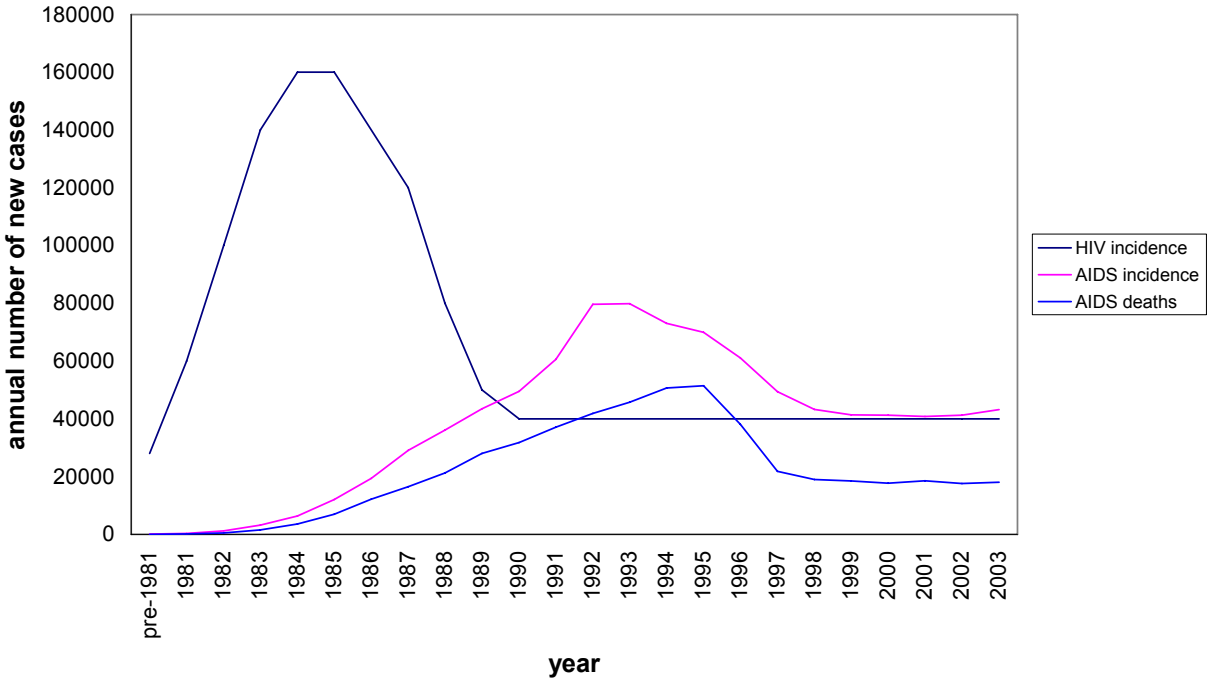
Figure 1
Per-contact probability of HIV transmission by sexual activity



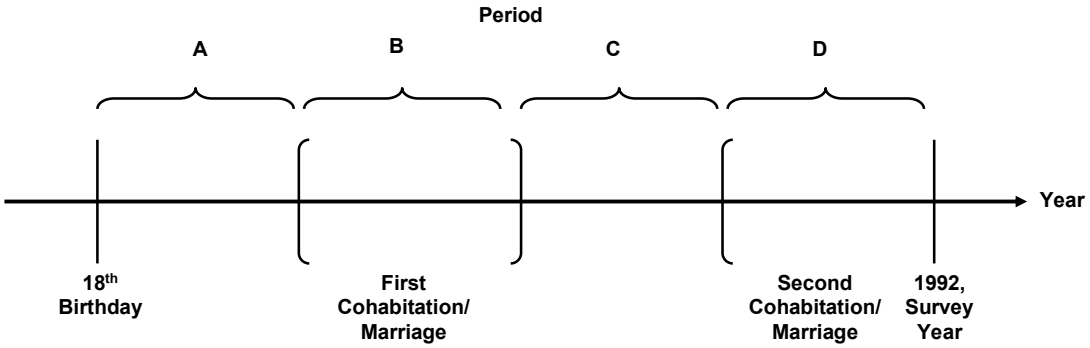
NOTE. The per-contact probability of HIV transmission is the likelihood of getting HIV from having unprotected sex once with an HIV-infected person. Source: Downs and De Vincenzi 1996, Mastro et al. 1994, Padian et al. 1997, Rothenberg et al. 1998, Vittinghoff et al. 1999.

Figure 2
Annual HIV incidence, AIDS incidence, and AIDS deaths



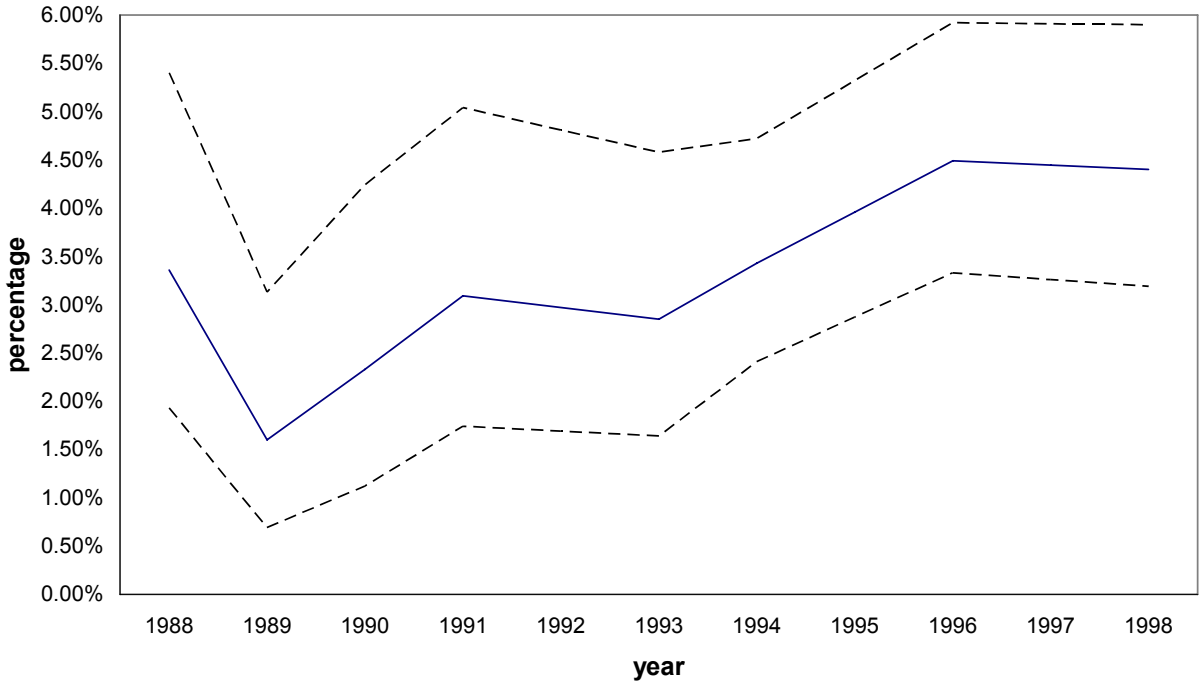
NOTE. Brookmeyer (1991) provides estimates of annual HIV incidence from 1978 to 1990. HIV incidence from 1991 to 2003 is based on the figure used by the CDC. Annual AIDS incidence and AIDS deaths come from CDC reports (CDC 2002, 2003, 2004). Up until 1998, the numbers for AIDS incidence and AIDS deaths are reported cases. From 1998, the numbers are estimated by the CDC adjusting for reporting delays. The numbers are not adjusted for incomplete reporting.

Figure 3
Sample lifetime sexual history



NOTE. The figure depicts a sample lifetime sexual history for a person who cohabited or married twice. The four periods include (A) the period between age 18 and first cohabitation/marriage; (B) the period during first cohabitation/marriage; (C) the period between first and second cohabitation/marriage; and (D) the period during second cohabitation/marriage.

Figure 4
Percentage of men who had a male partner in the past year



NOTE. The figure displays the percentage of male respondents who either had exclusively male or both male and female sexual partners in the past year. The dashed lines mark 95% binomial exact confidence intervals. The estimates for 1992, 1995, and 1997 are averages of the years before and after. Source: GSS (waves 1988-1991, 1993-1994, 1996, and 1998).

Table 1
Homosexuality and incarceration

	Ever incarcerated? No		Yes	Fisher's Exact Test p-value
For male respondents				
Anything sexual with a man	7.7%	*	17.2%	0.000
Homosexual or bisexual identity	3.1%		4.9%	0.112
	(N=1282)		(N=226)	
For female respondents				
Anything sexual with a woman	3.9%	*	12.0%	0.015
Homosexual or bisexual identity	1.7%	*	5.6%	0.076
	(N=1861)		(N=54)	

NOTE. The p-value associated with Fisher's Exact Test is the exact probability of observing a difference in proportions as extreme or more extreme than the difference actually observed if the true proportions are equal. An asterisk indicates significance at the 10% level. 15.0% of men and 2.8% of women have ever spent at least two days in a jail, prison, reform school, or detention center. Anything sexual with someone of the same gender is the percentage of respondents who have ever done anything sexual with someone of the same gender since puberty. Homosexual or bisexual identity is the percentage of respondents who think of themselves as homosexual or bisexual. Data source: NHSLS.

Table 2
Estimating the risk and cost of HIV/AIDS for a male in 1992

Parameters	
Number of men in US, 1992 [a]	124,000,000
Number of women in US, 1992 [a]	131,000,000
Number of HIV infected, 1992 [b]	800,000
Percentage of AIDS cases male [c]	85%
Percentage of AIDS cases female [c]	15%
Percentage of AIDS cases homosexual men [c]	60%
Percentage of male population homosexual [d]	3.3%
HIV transmission probability if male partner positive [e]	0.82%
HIV transmission probability if female partner positive [e]	0.03%
Number of sexual encounters	1
Value of life [f]	$2,000,000
Estimates	
Number of homosexual men with HIV	480,000
Probability a homosexual male partner HIV positive [g]	11.73%
Probability of getting HIV if homosexual male partner HIV positive	0.82%
Overall probability of getting HIV from a homosexual man	0.096188%
Number of women with HIV	120,000
Probability a female partner HIV positive	0.09%
Probability of getting HIV if female partner HIV positive	0.03%
Overall probability of getting HIV from a woman	0.000027%
Analysis	
Ratio of probability of getting HIV from a homosexual man versus a woman	3,500
Expected cost of having unprotected sex with a homosexual man	$1,923.75
Expected cost of having unprotected sex with a woman	$0.55

NOTE. I assume that HIV is randomly distributed in the male homosexual and female populations, the percentages of HIV infected people who are male homosexual and female are the same as those for AIDS cases in 1992, sexual partners are randomly selected, and contracting the virus leads to sudden death. The expected cost of AIDS-related mortality is the value of life multiplied by the overall probability of getting HIV. Parameter values are based on (a) US Census Bureau estimates (www.census.gov), (b) the number of HIV infected minus the number of AIDS cases cumulative through 1991 (Brookmeyer 1991, CDC 2002), (c) Centers for Disease Control and Prevention estimates (CDC 1993), (d) the percentage of men who had a male partner in the last year (Table 5), (e) Downs and De Vincenzi 1996, Mastro et al. 1994, Padian et al. 1997, and Vittinghoff et al. 1999, and (f) a modest estimate of the value of a statistical life (Viscusi 1993). (g) My estimate is comparable to other estimates of HIV prevalence among men who have sex with men in the US (Catania et al. 2001, 17%, Hays et al. 1997, 18.7%).

Table 3
Comparing respondents who have a relative with AIDS and those who do not

	Relative with AIDS? No		Yes		Relative with AIDS? No		Yes
	proportion				*proportion*		
Gender				Religious affiliation			
male	0.44		0.40	none	0.11		0.13
female	0.56		0.60	protestant	0.54		0.57
Age				catholic	0.27		0.23
18-40	0.65		0.65	jewish	0.02		0.01
41-60	0.35		0.35	other	0.06		0.05
Education				Religious attendance			
< 12th grade	0.15		0.17	never	0.15		0.15
high school graduate	0.30		0.31	once or sev times a year	0.39		0.40
some college	0.33		0.31	once or sev times a mon	0.21		0.19
college graduate	0.16		0.12	every week or more	0.26		0.26
> college graduate	0.07		0.10	Opinion of homosexuality			
Income				always wrong	0.66		0.67
$0-5000	0.13		0.11	almost always wrong	0.05		0.02
$5001-15k	0.16		0.12	wrong only sometimes	0.08		0.07
$15001-30k	0.23		0.23	not wrong at all	0.21		0.24
$30001-50k	0.24		0.27	Incarceration			
$50001+	0.24		0.26	at least once	0.13		0.13
Marital status				never	0.87		0.87
never married	0.29		0.29	Co-worker with AIDS			
currently married	0.53		0.55	yes	0.05		0.04
divorced	0.14		0.12	no	0.95		0.96
widowed	0.02		0.01	Country of birth			
separated	0.02		0.03	US	0.92		0.94
Number of brothers				Another country	0.08		0.06
0	0.18		0.21	Ethnicity			
1	0.31		0.26	white	0.72	*	0.59
2+	0.50		0.53	black	0.16	*	0.27
Number of sisters				hispanic	0.09	*	0.14
0	0.23		0.24	other	0.03	*	0.00
1	0.30		0.30	Childhood region			
2+	0.47		0.46	new england	0.06		0.05
Childhood family structure				middle atlantic	0.15	**	0.21
both mom & dad	0.72		0.66	east north cent.	0.17		0.12
dad & stepmom	0.02		0.02	west north cent.	0.11		0.09
mom & stepdad	0.07		0.07	south atlantic	0.17		0.15
dad & no mom/stepmom	0.02		0.02	east south cent.	0.08	*	0.03
mom & no dad/stepdad	0.13	*	0.19	west south cent.	0.09		0.10
male & female relatives	0.04		0.03	mountain	0.05		0.05
				pacific	0.11	*	0.18

NOTE. 150 respondents have a relative with AIDS, and 3,282 do not. Some proportions do not sum to one due to rounding. I use Pearson's Chi-Square Test, but when the expected proportion is especially high or low, I use Fisher's Exact Test. An asterisk indicates significant difference in proportions at the 5% level. A double asterisk indicates significance at the 10% level. Data source: NHSLS.

Table 4
Definition of dependent variables

Appeal of sex with same gender	equals one if having sex with someone of the same gender is very appealing or somewhat appealing; zero if not appealing or not at all appealing
Appeal of watching other people	equals one if watching other people doing sexual things is very appealing or somewhat appealing; zero if not appealing or not at all appealing
Same gender partner last event	equals one if a respondent had sex with someone of the same gender during the last sexual event; zero if with someone of the opposite gender
Same gender partner last year	equals one if a respondent had at least one same gender partner in the last year; zero if op. gender only
Same gender partner last five years	equals one if a respondent had at least one same gender partner in the last five years; zero if op. gender only
Cohabitation with same gender	equals one if a respondent has ever cohabited with someone of the same gender; zero otherwise
Attraction to only same gender	equals one if a respondent says he or she is sexually attracted to only the same gender; zero otherwise
Attraction to only or mostly same gender, or both genders	equals one if a respondent says he or she is sexually attracted to only the same gender, mostly the same gender, or both genders; zero otherwise
Attraction to not only op. gender	equals one if a respondent says he or she is sexually attracted to only the same gender, mostly the same gender, both genders, or mostly the opposite gender; zero if attracted to only the opposite gender
Homosexual or bisexual identity	equals one if a respondent thinks of him or herself as homosexual or bisexual; zero if he or she thinks of him or herself as heterosexual or straight
Anything sexual with same gender	equals one if a respondent has ever done anything sexual with someone of the same gender since puberty; zero otherwise
Syphilis	equals one if a respondent has ever been told by a doctor he or she had syphilis; zero otherwise
Cohabitation with opposite gender	equals one if a respondent has ever cohabited with someone of the opposite gender; zero otherwise
Marriage	equals one if a respondent has ever married someone of the opposite gender; zero otherwise
Any children	equals one if a respondent has ever had at least one child; zero otherwise
Oral sex with op. gender, performed	equals one if a respondent has ever performed oral sex on someone of the opposite gender; zero otherwise
Oral sex with op. gender, received	equals one if someone of the opposite gender has ever performed oral sex on a respondent; zero otherwise
Divorce	equals one if a respondent has ever divorced; zero otherwise
Number of children	equals the number of children a respondent has
Illegitimate birth	equals one if a respondent's first child was born while he or she was not married; zero if born while married
Anal sex with opposite gender	equals one if a respondent has ever had anal sex with someone of the opposite gender; zero otherwise

Table 5
Summary statistics

	M/F	N	Mean	Min	Max
Relative with AIDS	both	3,432	0.044	0	1
Knowledge of AIDS	male	1,501	4.143	0	5
Appeal of sex with same gender	male	1,505	0.045	0	1
Appeal of sex with same gender	female	1,914	0.056	0	1
Appeal of watching other people	both	3,418	0.263	0	1
Male partner last event	male	1,426	0.029	0	1
Male partner last year	male	1,427	0.033	0	1
Male partner last five years	male	1,427	0.042	0	1
Cohabitation with a man	male	1,511	0.016	0	1
Attraction to only men	male	1,504	0.025	0	1
Attraction to only men, mostly men, both	male	1,504	0.038	0	1
Attraction to not only women	male	1,504	0.066	0	1
Homosexual or bisexual identity	male	1,499	0.033	0	1
Anything sexual with a man	male	1,378	0.091	0	1
Attraction to not only men	female	1,901	0.044	0	1
Anything sexual with a woman	female	1,790	0.041	0	1
Syphilis	both	3,423	0.008	0	1
Cohabitation with a woman	male	1,511	0.785	0	1
Marriage	male	1,511	0.668	0	1
Any children	male	1,499	0.580	0	1
Oral sex with a woman, performed	male	1,412	0.758	0	1
Oral sex with a woman, received	male	1,410	0.780	0	1
Divorce	both	3,432	0.257	0	1
Number of children	male	1,499	1.356	0	9
Illegitimate birth	both	2,265	0.255	0	1
Anal sex with a woman	male	1,399	0.257	0	1

NOTE. M/F indicates whether the summary statistics are calculated for male respondents, female respondents, or both. The standard deviation of knowledge of AIDS and number of children is 0.971 and 1.544, respectively. Data source: NHSLS.

Table 6
Knowledge of AIDS and male homosexuality

	Independent variable: Knowledge of AIDS	
Dependent variable	without controls	with controls
For male respondents		
Male partner last event	-0.009	-0.013
	(0.005) *	(0.005) *
Male partner last year	-0.012	-0.019
	(0.005) *	(0.006) *
Male partner last five years	-0.016	-0.022
	(0.006) *	(0.007) *
Cohabitation with a man	-0.008	-0.012
	(0.004) *	(0.004) *
Appeal of sex with same gender	-0.006	-0.013
	(0.005)	(0.006) *
Attraction to only men	-0.007	-0.004
	(0.004) **	(0.005)
Attraction to only men, mostly men, both	-0.010	-0.010
	(0.005) *	(0.006) **
Attraction to not only women	-0.023	-0.025
	(0.007) *	(0.008) *
Homosexual or bisexual identity	-0.015	-0.020
	(0.005) *	(0.006) *

NOTE. Numbers in parentheses are robust standard errors. An asterisk indicates significance at the 5% level. A double asterisk indicates significance at the 10% level. Knowledge of AIDS is a variable based on the number of correct answers to five questions about HIV transmission. The standard deviation of knowledge is 0.971. Controls include age and dummies for education, income, ethnicity, childhood region, childhood religious affiliation, and family structure. The maximum possible sample size is 1,511. The actual sample size varies somewhat depending on the variables included in the regression. See Table 5 for more information about the sample size associated with each of the dependent variables. See Table 4 for definitions of the dependent variables. Data source: NHSLS.

Table 7
Sexual differences between respondents who have a relative with AIDS and those who do not

	Relative with AIDS? No (1)	Yes (2)	Fisher's Exact Test Difference, (1) - (2) p-value	Binomial Exact Test Genetic Model True p-value
For male respondents				
Male partner last year	3.4%	0.0%	0.148	0.019 *
Male partner last five years	4.4%	0.0%	0.086 *	0.006 *
Appeal of sex with same gender	4.6%	0.0%	0.062 *	0.003 *
Attraction to not only women	6.9%	1.7%	0.081 *	0.001 *
Homosexual or bisexual identity	3.5%	0.0%	0.134	0.015 *
Anything sexual with a man	9.1%	7.5%	0.465	0.025 *
	(N=1451)	(N=60)		
For female respondents				
Female partner last year	1.6%	4.5%	0.063 *	-
Female partner last five years	2.3%	4.5%	0.159	-
Appeal of sex with same gender	5.3%	12.2%	0.011 *	-
Attraction to not only men	4.1%	10.0%	0.016 *	-
Homosexual or bisexual identity	1.7%	4.4%	0.081 *	-
Anything sexual with a woman	4.0%	5.9%	0.273	-
	(N=1831)	(N=90)		

NOTE. The p-value associated with Fisher's Exact Test is the exact probability of observing a difference in proportions between columns (1) and (2) as extreme or more extreme than the difference actually observed if the true proportions are equal. Studies of the genetic basis of sexual orientation report that the rate of homosexuality is greater among men who have a male homosexual relative. Hamer et al. (1993) estimate that men who have a male homosexual relative are 3.1 times more likely to be homosexual than the general population (6.2% homosexuality in brothers, uncles, and cousins of random probands compared with 2.0% homosexuality in the population). If Hamer's estimates are true, and about half of respondents who have a relative with AIDS have a male homosexual relative specifically, men who have a relative with AIDS are *twice* as likely to be homosexual than the general population. Thus, the p-value associated with the Binomial Exact Test is the exact probability of observing a proportion in column (2) as extreme or more extreme than the one actually observed if the true proportion is twice that of column (1). An asterisk indicates significance at the 10% level. 150 respondents have a relative with AIDS, and 3,282 do not. The behavior variables are missing a small number of values. Data source: NHSLS.

Table 8
The heterosexual-homosexual margin: desire

	Independent variable: Relative with AIDS	
Dependent variable	without controls	with controls
For male respondents		
Appeal of sex with same gender	-0.046	-0.050
	(0.006) *	(0.011) *
Appeal of watching other people	0.045	0.054
	(0.065)	(0.072)
For female respondents		
Appeal of sex with same gender	0.069	0.075
	(0.035) *	(0.036) *
Appeal of watching other people	0.060	0.059
	(0.045)	(0.047)

NOTE. Numbers in parentheses are robust standard errors. An asterisk indicates significance at the 5% level. Controls include age and dummies for education, income, ethnicity, childhood region, childhood religious affiliation, and family structure. The maximum possible sample size is 1,511 for male respondents and 1,921 for female respondents. The actual sample size varies somewhat depending on the variables included in the regression. See Table 5 for more information about the sample size associated with each of the dependent variables. Data source: NHSLS.

Table 9
The heterosexual-homosexual margin: behavior, desire, and identity

	Independent variable: Relative with AIDS	
Dependent variable	without controls	with controls
For male respondents		
Male partner last event	-0.030	-0.034
	(0.005) *	(0.008) *
Male partner last year	-0.034	-0.041
	(0.005) *	(0.010) *
Male partner last five years	-0.044	-0.051
	(0.006) *	(0.011) *
Cohabitation with a man	-0.017	-0.023
	(0.003) *	(0.007) *
Attraction to only men	-0.026	-0.026
	(0.004) *	(0.006) *
Attraction to only men, mostly men, both	-0.039	-0.041
	(0.005) *	(0.009) *
Attraction to not only women	-0.052	-0.048
	(0.018) *	(0.022) *
Homosexual or bisexual identity	-0.035	-0.040
	(0.005) *	(0.009) *
Anything sexual with a man	-0.016	-0.018
	(0.037)	(0.042)
For female respondents		
Attraction to not only men	0.059	0.062
	(0.032) **	(0.032) **
Anything sexual with a woman	0.018	0.029
	(0.026)	(0.027)

NOTE. Numbers in parentheses are robust standard errors. An asterisk indicates significance at the 5% level. A double asterisk indicates significance at the 10% level. Controls include age and dummies for education, income, ethnicity, childhood region, childhood religious affiliation, and family structure. The maximum possible sample size is 1,511 for male respondents and 1,921 for female respondents. The actual sample size varies somewhat depending on the variables included in the regression. See Table 5 for more information about the sample size associated with each of the dependent variables. Data source: NHSLS.

Table 10
Sexual activities and other margins of change

	Independent variable: Relative with AIDS	
Dependent variable	without controls	with controls
For male respondents		
Syphilis	-0.009	-0.012
	(0.002) *	(0.005) *
Cohabitation with a woman	0.050	0.084
	(0.049)	(0.044) **
Marriage	0.034	0.116
	(0.060)	(0.050) *
Any children	0.073	0.143
	(0.063)	(0.057) *
Oral sex with a woman, performed	0.122	0.077
	(0.046) *	(0.050)
Oral sex with a woman, received	0.136	0.110
	(0.040) *	(0.039) *
Divorce	0.077	0.089
	(0.078)	(0.079)
Number of children	0.254	0.464
	(0.218)	(0.194) *
Illegitimate birth	0.091	0.058
	(0.075)	(0.066)
Anal sex with a woman	0.186	0.163
	(0.068) *	(0.073) *
For female respondents		
Syphilis	-0.008	-0.009
	(0.002) *	(0.003) *
Divorce	0.033	0.016
	(0.062)	(0.064)
Illegitimate birth	0.081	0.013
	(0.059)	(0.051)

NOTE. Numbers in parentheses are robust standard errors. An asterisk indicates significance at the 5% level. A double asterisk indicates significance at the 10% level. Controls include age and dummies for education, income, ethnicity, childhood region, childhood religious affiliation, and family structure. The maximum possible sample size is 1,511 for male respondents and 1,921 for female respondents. The actual sample size varies somewhat depending on the variables included in the regression. See Table 5 for more information about the sample size associated with each of the dependent variables. Data source: NHSLS.

Table 11
Comparing sexual behavior in the pre- and post-AIDS eras

	% with zero or one partner			% with same-gender partner		
Period	pre-AIDS		post-AIDS	pre-AIDS		post-AIDS
For male respondents						
A. Between age 18 and first cohab/marriage	41.92		45.90	2.56		1.39
B. During first cohab/marriage	81.00		85.04	1.44	**	0.29
C. Between first and second cohab/marriage	55.97	*	65.03	2.59		1.36
D. During second cohab/marriage	81.36	*	95.95	3.05	*	0.45
For female respondents						
A. Between age 18 and first cohab/marriage	72.11		61.14	1.05		0.00
B. During first cohab/marriage	94.35		97.04	0.65		0.22
C. Between first and second cohab/marriage	75.80	**	80.77	1.61		0.50
D. During second cohab/marriage	92.74		94.44	1.44		1.72

NOTE. The pre-AIDS era is that before August 1982 when the disease was named AIDS, and the post-AIDS era is that after February 1983 when the New York Times began to publish articles about AIDS. The column label pre-AIDS designates those respondents who experience the entire period in the pre-AIDS era, and post-AIDS designates those respondents who experience the entire period in the post-AIDS era. Figure 3, a sample lifetime sexual history, illustrates the four periods that the table examines. For the periods during cohabitation/marriage, i.e. periods B and D, the two measures refer to sexual partners other than the partner with whom the respondent cohabits or to whom the respondent is married. An asterisk indicates significant difference in proportions at the 10% level, and a double asterisk indicates significance at the 15% level (Fisher's Exact Test that the % with zero or one partner is larger, % with male same-gender partner is smaller, and % with female same-gender partner is larger in the post-AIDS era). Data source: NHSLS.