THE ECONOMICS OF SEXUALITY: THE EFFECT OF HIV/AIDS ON HOMOSEXUAL BEHAVIOR IN THE UNITED STATES

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Abstract

In this paper, I test a simple microeconomic theory of sexuality. 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 AIDS on male and female homosexual behavior. To do so, 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 number of individual background characteristics. I present evidence that AIDS causes some men to shift from homosexual to heterosexual behavior, whereas AIDS causes some women to shift from heterosexual to homosexual behavior. Thus, sexual behavior may respond to incentives. I consider alternative hypotheses, including biological theories of sexual orientation and stigma-related survey bias, and argue that they are unlikely to explain the results.

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1. INTRODUCTION

Many researchers have examined the effect of the AIDS epidemic on sexual behavior. In studies of the gay community in the US, work has focused primarily on changes in the number of sexual partners and condom use (Catania et al., 1991; Martin, 1987; McKusick et al., 1985a, 1985b; Stall et al., 1988). Likewise, work in Sub-Saharan Africa has focused on changes in promiscuity and condom usage, as well as use of commercial sex workers (Allen et al., 1992a, 1992b; Asiimwe-Okiror et al., 1997; Ghys et al., 2002; Gregson et al., 1998; Nzila et al., 1991). This paper explores another possible response to the epidemic: movements along the heterosexual-homosexual margin, i.e. changes in the gender of sexual partners. Using nationally representative data from the US, I find that AIDS causes some men to shift from homosexual to heterosexual behavior, whereas AIDS causes some women to shift from heterosexual to homosexual behavior.

In what follows, I introduce a simple microeconomic theory of sexuality. The basic result is that as the cost of one sexual activity rises relative to the cost of the other, consumption of the first activity decreases and consumption of the second increases. For people who are at the margin, changes in the cost of sexual activities may affect the trade-off between heterosexual and homosexual behavior. To test the theory, I examine the HIV/AIDS epidemic in the US, since AIDS dramatically altered the cost of sexual activities. I estimate that it is thousands of times more likely that a man would get HIV having sex with another man than having sex with a woman. 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. For a woman, having sex with a man is also more risky. Over six times more men than women have HIV, and vaginal sex is considerably more risky than oral sex.

One potential empirical strategy is to analyze the change in sexual behavior across time. However, distinguishing the impact of HIV and time trends is difficult. Instead, I use the fact that people who have a relative with AIDS are more affected by the epidemic. I contend that people who have a relative with AIDS have more knowledge, awareness, and fear of AIDS than those who do not. Men who have a relative with AIDS have more correct answers to questions about HIV prevention methods, which may imply that they have more HIV knowledge. Empirically, this variable is uncorrelated with a number of individual background characteristics, including gender, age, education, income, marital status, number of brothers, number of sisters, childhood family structure, religious affiliation, religious attendance, opinion of homosexuality, incarceration, and country of birth.

Both with and without controls, having a relative with AIDS is negatively related to homosexuality in males. In contrast, having a relative with AIDS is positively related to homosexuality in females. This evidence is consistent with the notion that AIDS causes some men to shift from homosexual to heterosexual behavior, and AIDS causes women to shift from heterosexual to homosexual behavior. In addition, men and women who have a relative with AIDS are 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. For both men and women, having a relative with AIDS is negatively related to the HIV risk index, a summary measure of sexual risk behavior incorporating condom usage and the number and gender of partners.

It is possible that other factors, unrelated to HIV, may explain why men who have a relative with AIDS are less likely to report homosexual behavior, while women with a relative are more likely. As a robustness check, I look for differences in having ever done anything

sexual with someone of the same gender. For both men and women, there are no significant differences, which implies that prior to learning that their relative came down with AIDS, they engaged in comparable sexual behavior. Furthermore, biological theories of sexual orientation are unlikely to account for the sexual differences between people who have a relative with AIDS and those who do not. 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 (see Section 5.2). Another alternative hypothesis is that people who have a relative with AIDS are especially stigmatized and, thereby, more likely to underreport homosexuality. However, if stigma operates similarly on men and women, the female results imply that stigma is a minor or nonexistent issue.

This paper contributes to several literatures. Investigating a behavioral margin rarely considered, it complements the aforementioned research on the response to the AIDS epidemic. Providing further support for the economic approach to sexuality, it contributes to the economic literature on the effect of price and risk on sexual behavior (Ahituv et al., 1996; Chesson et al., 2000; Gertler et al., 2005; Johnson and Raphael, 2006; Kremer, 1996; Lakdawalla et al., 2006; Oster, 2005, 2007; Philipson and Posner, 1993; Posner, 1992). It also adds to research on sexual orientation (Bailey and Pillard, 1991; Ehrhardt et al., 1985; Gladue et al., 1984; Hamer et al., 1993; LeVay, 1991; Pillard and Weinrich, 1986; Swaab and Hofman, 1990). The findings in this paper illustrate that, while biology may play a crucial role, sexual behavior may respond to incentives.

The remainder of the paper is organized as follows. Section 2 discusses an economic theory of sexuality and makes predictions about the impact of AIDS. Sections 3 and 4 describe the data and empirical strategy. Section 5 presents the empirical results. Section 6 concludes.

2. THEORY AND BACKGROUND

In this section, I discuss a simple microeconomic theory of sexuality that is consistent with this literature. Then, I describe the ways in which the HIV/AIDS epidemic changed the cost of sexual activities. Applying the theory, I make predictions about the effect of AIDS on sexuality.

2.1 AN ECONOMIC THEORY OF SEXUAL BEHAVIOR

I propose a simple economic theory of sexuality in which an individual chooses between sexual activities. The two activities may be vaginal and oral sex; protected and unprotected sex; promiscuity and monogamy; or heterosexual and homosexual sex. Preferences over the activities are assumed to be biologically determined. I also assume that both goods are normal, and that an individual is endowed with limited resources, capturing the notion that time, money, and physical capacity are scarce. Each sexual 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 optimally allocates resources between sexual activities so as to maximize his or her utility. The basic result is that as the cost of one sexual activity rises relative to the cost of the other, consumption of the first activity decreases, and consumption of the second increases, which is simply the law of demand.

The theory elucidates the potential trade-off between heterosexual and homosexual behavior. Nationally representative surveys of sexual behavior suggest that 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 margin, the substitutability between having male and female sexual partners is greater than zero. Table 1 contains estimates of the

sexual continuum, which is a characterization of preferences according to the degree to which heterosexual and homosexual activities are substitutes. Based on three data sources, the table displays the percentage of people who report that they are strictly heterosexual, in the middle, and strictly homosexual. The estimates imply that the percentage of people in the middle of the continuum is several times greater than the percentage of strict homosexuals. Not only does the heterosexual-homosexual margin exist, but it is sizable.

In short, the key notion is that—taking the biological and other exogenous determinants of sexual preferences as given—social, cultural, and economic variables may affect the sexual behavior of individuals at the margin. Not only does this general idea underlie theoretical work on sexual behavior in economics but also empirical work (Ahituv et al., 1996; Boozer and Philipson, 2000; Chesson et al., 2000; Johnson and Raphael, 2006; Lakdawalla et al., 2006; Oettinger, 1999). It is worth noting that the economics of sexuality contrasts with other theories which assume that sexual behavior is purely 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 childhood influences (Bearman and Brückner, 2002; Bieber et al., 1962; Freud, 1953; Nevid et al., 1995).

2.2 HIV/AIDS

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 likelihood of HIV transmission varies widely across sexual activities (Royce et al., 1997). Figure 1 depicts the per-contact probability of HIV transmission by sexual activity. This is the likelihood of getting HIV from having unprotected

sex once with an HIV-infected person. Anal receptive sex is the most dangerous (Kingsley et al., 1987; Winkelstein et al., 1987). The per-contact probability of transmission is 0.82%. For anal insertive sex, the likelihood 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 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 HIV is transmitted through oral sex, although there are some reported cases (Rothenberg et al., 1998).

Table 2 calculates the expected cost of AIDS to a male in the early 1990s. Not only are men considerably more likely to have HIV than women, but anal receptive sex is riskier than vaginal sex. I estimate that it is 3,500 times more likely that a man would get HIV having anal receptive sex with another man than having vaginal sex with a woman. In terms of AIDS-related mortality, the expected cost of having unprotected anal receptive sex once with a man is almost $2,000, whereas the expected cost of having unprotected vaginal sex once with a woman is less than a dollar. While using a condom reduces the likelihood of transmission, the expected cost of having protected anal receptive sex once with a man is about $200. Having unprotected anal insertive sex with a man is about $140. Note that among homosexual relationships, nearly all male respondents report participating in both receptive and insertive anal sex. Having unprotected anal sex with a woman is slightly more risky than vaginal sex, as its expected cost is about a dollar, although sex with a woman is almost always vaginal not anal. Oral sex is relatively safe, but, among adults, it is rarely the only sexual activity that occurs.

Taking into account the various changes in the cost of sexual activities, I apply the economic theory 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 generally, but I also predict that people may respond along the heterosexual-homosexual margin. I hypothesize that AIDS causes some men to shift from homosexual to heterosexual behavior. In contrast, I hypothesize that AIDS causes some women to shift from heterosexual to homosexual behavior. Women are less likely to have HIV than men, and oral sex is much safer than vaginal receptive sex. It is almost impossible for a woman to get HIV having sex with another woman. These theoretical predictions are consistent with those that other economists have made (Philipson and Posner, 1993; Posner, 1992).

3. DATA

I use the National Health and Social Life Survey (NHSLS), a nationally representative dataset on sexual behavior conducted in 1992 by the University of Chicago and National Opinion Research Center (Laumann et al., 1994, 1995). It covers the US population aged 18-59, and the sample size is almost 3,500. At about 80%, the NHSLS response rate was relatively 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. 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. Since all personal identifying information 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. In 1992, the principal exposure category was men who have sex with men (CDC, 1993). Effective drugs to sustain the

lives of those with AIDS were not yet available.[1] During the years prior to 1992, both the annual number of AIDS cases and deaths in the US were growing rapidly. Figure 2 plots annual HIV incidence, AIDS incidence, and AIDS deaths (Brookmeyer, 1991; CDC, 1993-2004). Both the annual number of AIDS cases and deaths more than tripled between 1986 and 1991. 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 infection. As the figure shows, estimated annual HIV incidence peaks in the mid-1980s (Brookmeyer, 1991).

I construct a number of variables to measure homosexual behavior: same gender partner in the last five years, appeal of sex with the same gender, attraction to not only the opposite gender, homosexual or bisexual identity, and anything sexual with the same gender since puberty. Other outcome variables relate to syphilis, marriage, children, as well as oral and anal sex with the opposite gender. I also create a summary measure of the total riskiness of a respondent's sexual activities, the HIV risk index. It is the estimated probability that a respondent became infected with HIV during the last year based on information about the number and gender of partners, the frequency of sex, and condom use.[2] Table 3 defines the dependent variables. Table 4 displays summary statistics.

4. EMPIRICAL STRATEGY

[1] The AIDS cocktail, which greatly extended life, was first approved by the FDA in the mid-1990s. Figure 2 illustrates the impact that the cocktail had on the annual number of AIDS deaths.

[2] I estimate the number of times that each respondent had unprotected/protected vaginal sex, unprotected/protected anal sex with a woman (male respondents only), and unprotected/protected anal sex with a man in the past year. I also estimate the probability of getting HIV by sexual activity (Table 2 and analogous calculations). To construct the HIV risk index, I assume that the transmission probability is proportional to the number of sexual events and is additive across sexual activities.

In principle, one could examine the change in sexual behavior across time, but it is challenging to disentangle the impact of HIV from time trends. Alternatively, I estimate the effect of having a relative with AIDS on sexual behavior.[3] 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. Several empirical studies report 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). Having a relative with AIDS may increase knowledge about HIV transmission and prevention; may make AIDS salient and raise consciousness; and may involve some graphic and shocking experiences that intensify fear. Indeed, based on the number of correct answers to several questions about the effectiveness of methods to prevent HIV transmission, men who have a relative with AIDS have more HIV knowledge. The difference is modest but statistically significant in regressions with and without controls. Of course, knowledge, awareness, and fear of AIDS are intertwined and other related causal pathways may also play a role.

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. 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.[4] 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

[3] The essential idea is that while people may choose their friends, acquaintances, and co-workers, they do not, for the most part, choose their family. Not surprisingly, people who have a friend, etc., with AIDS are more likely to be homosexual due to positive assortative matching in social groups.

[4] 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 is 35 years old. As of the survey year, about half of all AIDS cases were diagnosed by 1988.

nearly matches the percentage of male 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.

Table 5 compares the background characteristics of respondents who have and do not have a relative with AIDS. Having a relative with AIDS is mostly 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, and country of birth. Having a relative with AIDS is correlated with ethnicity and childhood region.[5] 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 North Central or East South Central regions at age 14. This is because ethnicity and childhood region are family-related, and HIV prevalence varies along ethnic and regional lines.[6][7] In the empirical work, I control for ethnicity and childhood region, along with other characteristics.

Moreover, potential biological effects run counter to the effects of HIV/AIDS that I identify. Based on genetic theories of sexual orientation, having a male homosexual relative raises the likelihood that a male respondent is homosexual.[8] Based on hormonal theories of

[5] 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).

[6] There are few racial differences in homosexuality. The only significant difference in male homosexuality (p-value 0.092) is homosexual or bisexual identity between whites and Hispanics (3.2% and 6.0%, respectively). The only significant difference in female homosexuality (p-value 0.034) is attraction to not only men between whites and blacks (5.1% and 2.6%, respectively). Note that in both cases the potential bias is in the opposite direction of the findings.

[7] It is possible 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. Nevertheless, most regions are uncorrelated with having a relative with AIDS; the regression estimates are robust to the addition of region controls; and, if anything, high prevalence is positively associated with male homosexuality, which runs counter to the male findings.

[8] 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

sexual orientation, having a male homosexual relative raises the likelihood that a male respondent is homosexual but lowers the likelihood that a female respondent is homosexual, because prenatal hormone levels have opposite effects on men and women. For this reason, I report a secondary hypothesis test, which takes into account possible biological effects, when I analyze differences between respondents who have a relative with AIDS and those who do not. In addition, potential unobservable social effects on sexual orientation raise the likelihood that a male or female respondent is homosexual. This runs counter to the male findings but in the same direction as the female findings, leaving open the possibility that the effect of having a relative with AIDS on women is attributable to knowledge, awareness, and fear of AIDS, an unobservable social effect, or both.

5. RESULTS AND DISCUSSION

In this section, I explore the empirical relationship between having a relative with AIDS and homosexual behavior. I then discuss robustness and consider two alternative hypotheses, biological theories of sexual orientation and stigma-related survey bias.

5.1 MAIN RESULTS

Table 6 compares respondents who have a relative with AIDS and those who do not. Taken together, the evidence is consistent with the idea that, at the margin, AIDS causes men to shift from homosexual to heterosexual behavior, whereas AIDS causes women to shift from heterosexual to homosexual behavior. Having a relative with AIDS is negatively related to homosexuality in males. For example, 1.7% and 6.9% of male respondents who have and do not

homosexual than the general population (6.2% homosexuality in brothers, uncles, and cousins of homosexual subjects compared with 2.0% in the population).

have a relative with AIDS, respectively, say they are not only sexually attracted to women. Under the null hypothesis that the true proportions are equal, a difference in proportions this or more extreme is 8.1% likely to occur by chance alone. 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 (p-value 0.062). In contrast, having a relative with AIDS is positively related to homosexuality in females. 10.0% and 4.1% of female respondents who have and do not have a relative with AIDS, respectively, say they are not only sexually attracted to men. Under the null hypothesis that the true proportions are equal, a difference in proportions this or more extreme is 1.6% likely to occur by chance alone. 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 (p-value 0.011).

Recall that studies of the genetic basis of sexual orientation find that the rate of homosexuality is greater among men who have a male homosexual relative. If it is true that men who have a male homosexual relative are 3.1 times more likely to be homosexual (see footnote 8), 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 as the general population. The last column in Table 6 reports the p-values under the null hypothesis that the proportion in column (2) is twice that of column (1). For every variable, a difference in male homosexuality as or more extreme than that actually observed is less than 5% likely to occur by chance alone if the genetic model were true. In this way, the biological theories complement or strengthen the empirical evidence in favor of the economic theory.

Using a linear probability model, I regress homosexual behavior on having a relative with AIDS and a number of controls.[9] Table 7 displays the results. Both with and without controls, men who have a relative with AIDS are significantly less likely to have had a male sexual partner in the last five years; rate same gender sex as appealing; 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 4.8 percentage points less likely to say they are not only sexually attracted to women. For women, the effect goes the other way. Both with and without controls, women who have a relative with AIDS are significantly more likely to rate same gender sex as appealing and 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.

I examine the effect of having a relative with AIDS on other sexual activities and the HIV risk index, a summary measure of sexual risk behavior including condom usage and the number and gender of partners. Table 8 displays the regressions. Both men and women who have a relative with AIDS are less likely to have syphilis than those who do not have a relative with AIDS, indicating that AIDS inspired people to practice safer sex. While I do not find any significant effects for women, men who have a relative with AIDS are more likely to have ever married a woman and have had children, which both suggest that AIDS increased monogamy. They are also more likely to have ever received oral sex from a woman, which reveals that AIDS may have spurred a rise in oral sex, as it is one of the safest sexual practices. Interestingly, men who have a relative with AIDS are more likely to have ever engaged in anal sex with a woman. Together with the findings on the heterosexual-homosexual margin, this may imply that AIDS causes some men who would have had anal sex with men to have anal sex with women. For men,

[9] Controls include age and dummies for education, income, ethnicity, childhood region, childhood religious affiliation, and family structure.

having a relative with AIDS is negatively related to the HIV risk index. The coefficient is significant both in the full sample and in the restricted sample excluding men who were married (and not cheating) or did not have any sexual partners in the past year. For women, having a relative with AIDS is negatively related to the HIV risk index only in the restricted sample. This evidence is broadly consistent with previous empirical studies that report that people adopted safer sexual practices due to AIDS.

5.2 ROBUSTNESS

Since the data are cross-sectional, it is particularly 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. As a robustness check, I look 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 comparison. 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. 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. Neither of these differences are statistically significant. In a regression with controls, the coefficient on having a relative with AIDS is also insignificant for both male and female respondents. Thus, prior to learning that their relative

came down with AIDS, people who have a relative with AIDS exhibited comparable sexual behavior.

Neither genetic nor hormonal theories of sexual orientation are likely to explain the sexual differences between people who have a relative with AIDS and those who do not. Studying twins, relatives, or chromosomes, some researchers argue that male homosexuality has a genetic basis and is, hence, positively correlated within families (Bailey and Pillard, 1991; Hamer et al., 1993; Pillard and Weinrich, 1986; Whitam et al., 1993). There is no evidence of a genetic link between male and female homosexuality. Studying sexual behavior in animals, other researchers argue that prenatal hormone levels have opposite effects on men and women in that a prenatal excess of androgen in females and a prenatal deficit of androgen in males are related to homosexuality (Ehrhardt et al., 1968, 1985; Ellis and Ames, 1987; Gladue et al., 1984; Meyer-Bahlburg, 1984). Thus, 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. It is important to emphasize, however, that evidence that sexual behavior responds to incentives does not rule out a primary role for biology in determining sexual orientation.

Another potential alternative hypothesis is stigma-related survey bias. We may never really know whether respondents are being fully honest and how respondents truly feel, which are potential problems with any survey, especially one about sexuality. It is possible that people who have a relative with AIDS are especially stigmatized and, thereby, more likely to underreport homosexuality. Nevertheless, there are reasons to believe that the findings are not simply an artifact of stigma-related survey bias. Namely, if stigma operates similarly on men and women who have a relative with AIDS, the female results imply that stigma is a minor or

nonexistent issue. Social stigma would have to operate differently on men and women to explain the results.

6. CONCLUSION

In this paper, I test an economic theory of sexuality. I present evidence that changes in the cost of sexual activities due to the AIDS epidemic have caused people in the middle of the sexual continuum to shift from male to female sexual partners. That is, some men move toward heterosexual behavior, while some women move toward homosexual behavior.

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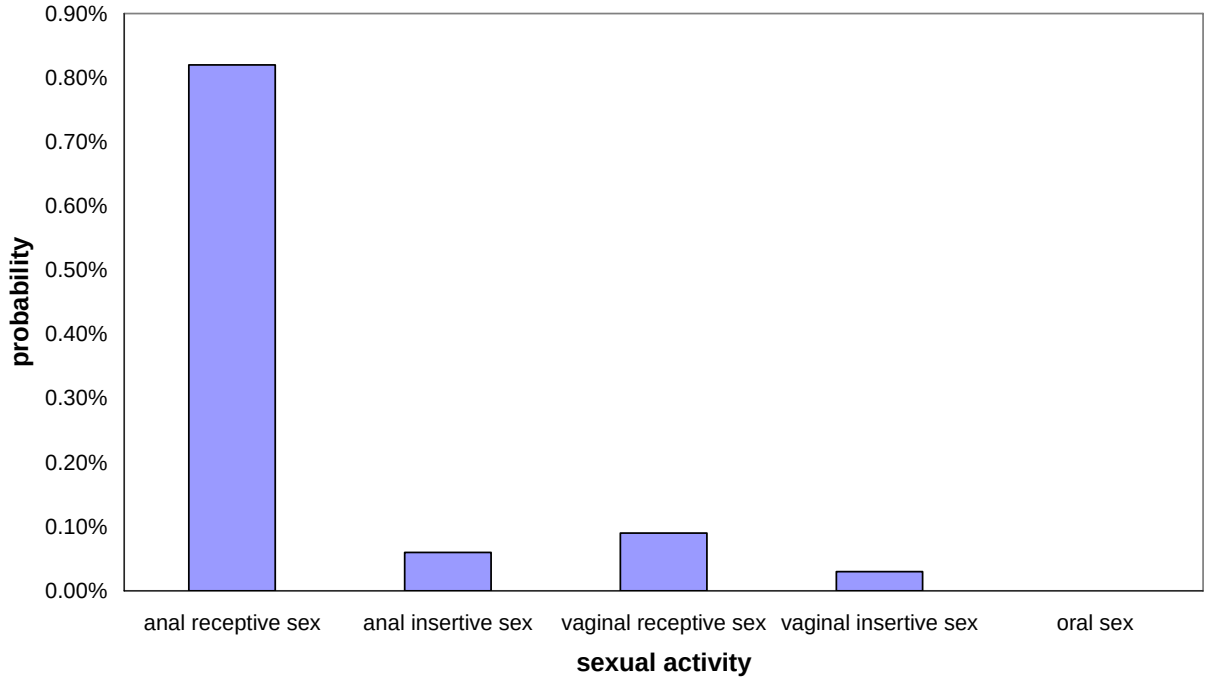
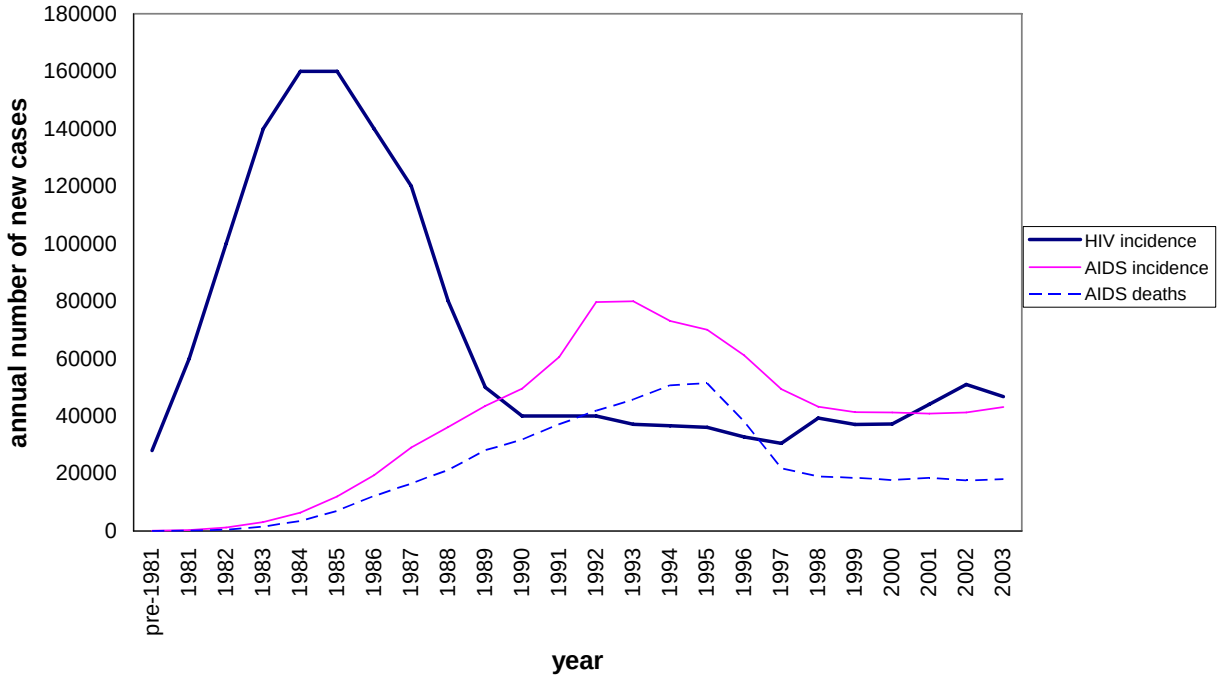
Figure 1
Per-contact probability of HIV transmission by sexual activity



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 after 1990 is based on calculations using annual CDC reports (1993-2003) and US Census estimates. Annual AIDS incidence and deaths come from CDC reports (2002-2004).

Table 1
Estimates of the sexual continuum

	Men			Women		
	Strict Hetero-sexuality	In the Middle	Strict Homo-sexuality	Strict Hetero-sexuality	In the Middle	Strict Homo-sexuality
NHSLS						
Measure I (attraction) [a]	93.3%	4.2%	2.5%	95.5%	4.1%	0.4%
Measure II (identity) [b]	90.9%	7.2%	1.9%	95.9%	3.5%	0.7%
Add Health						
Wave I (attraction) [c]	91.7%	7.2%	1.0%	94.0%	4.4%	1.6%
Wave II (attraction) [c]	94.2%	4.0%	1.8%	94.2%	4.5%	1.3%
Wave III (attraction) [c]	94.2%	4.6%	1.2%	87.0%	12.4%	0.6%
Wave III (desire/identity) [d]	94.3%	4.5%	1.3%	86.2%	13.2%	0.5%
NATSAL						
Wave I (attraction) [e]	94.3%	5.2%	0.5%	95.4%	4.3%	0.3%
Wave II (attraction) [e]	90.9%	8.1%	1.0%	88.2%	11.5%	0.3%

NOTE. "In the middle" is the percentage who (a) are not only attracted to the opposite gender minus the percentage who are only attracted to the same gender, (b) have done something sexual with someone of the same gender but do not think of themselves as homosexual, (c) have been romantically attracted to both genders, (d) are mostly heterosexual, but somewhat attracted to the same gender, attracted to men and women equally, or mostly homosexual, but somewhat attracted to the opposite gender, (e) have been sexually attracted to both genders. Data sources: NHSLS (US; 1992; ages 18-59), Add Health (US; panel 1995, 1996, 2001; ages 21-24 in 2001; Udry, 2003), NATSAL (UK; repeated cross-section 1990/1991, 2000/2001; ages 16-59; National Centre for Social Research et al., 2005).

Table 2
Estimating the risk and expected cost of AIDS to 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, anal receptive sex [e]	0.82%
HIV transmission probability, anal insertive sex [e]	0.06%
HIV transmission probability, vaginal insertive sex [e]	0.03%
Condom effectiveness [f]	90%
Value of life [g]	$2,000,000
Number of sexual encounters	1
Estimates	
Probability a homosexual male partner HIV positive [h]	11.73%
Overall probability of getting HIV from anal receptive sex with a man	0.096188%
Overall probability of getting HIV from anal insertive sex with a man	0.007038%
Probability a female partner HIV positive	0.09%
Overall probability of getting HIV from vaginal sex with a woman	0.000027%
Overall probability of getting HIV from anal sex with a woman	0.000055%
Analysis	
Ratio of probability of getting HIV (anal receptive / vaginal)	3,500
Expected cost of having sex with a man	
unprotected anal receptive sex	$1,923.75
unprotected anal insertive sex	$140.76
protected anal receptive sex	$192.38
protected anal insertive sex	$14.08
Expected cost of having sex with a woman	
unprotected vaginal insertive sex	$0.55
unprotected anal insertive sex	$1.10
protected vaginal insertive sex	$0.05
protected anal insertive sex	$0.11

NOTE. I assume that the percentages of HIV infected people who are male homosexual and female are the same as those for AIDS cases in 1992, and that sexual partners are randomly selected. 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, (b) the number of HIV infected minus the number of AIDS cases cumulative through 1991 (Brookmeyer, 1991; CDC, 2002), (c) CDC estimates (CDC, 1993), (d) the percentage of men who had a male partner in the last year (NHSLS), (e) Figure 1, (f) Pinkerton and Abramson (1997), Saracco et al. (1993), (g) Viscusi (1993). (h) My estimate is comparable to other estimates of HIV prevalence among men who have sex with men (Catania et al., 2001, 17%; Hays et al., 1997, 18.7%).

Table 3
Definition of dependent variables

Same gender partner last five years	equals one if the respondent had at least one same gender partner in the last five years; zero if op. gender only
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
Attraction to not only op. gender	equals one if the 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 the 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 the respondent has ever done anything sexual with someone of the same gender since puberty; zero otherwise
Syphilis	equals one if the respondent has ever been told by a doctor he or she had syphilis; zero otherwise
Marriage	equals one if the respondent has ever married someone of the opposite gender; zero otherwise
Any children	equals one if the respondent has ever had at least one child; zero otherwise
Oral sex with opposite gender	equals one if someone of the opposite gender has ever performed oral sex on the respondent; zero otherwise
Anal sex with opposite gender	equals one if the respondent has ever had anal sex with someone of the opposite gender; zero otherwise
HIV risk index	equals the estimated probability that the respondent became infected with HIV during the last year based on the estimated number of times he or she had unprotected and protected vaginal and/or anal sex with female and/or male sexual partners

Table 4
Summary statistics

	M/F	N	Mean	Min	Max
Relative with AIDS	both	3,432	0.044	0	1
Male partner last five years	male	1,427	0.042	0	1
Appeal of sex with same gender	male	1,505	0.045	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
Female partner last five years	female	1,783	0.024	0	1
Appeal of sex with same gender	female	1,914	0.056	0	1
Attraction to not only men	female	1,901	0.044	0	1
Homosexual or bisexual identity	female	1,897	0.018	0	1
Anything sexual with a woman	female	1,790	0.041	0	1
Syphilis	both	3,423	0.008	0	1
Marriage	both	3,432	0.716	0	1
Any children	both	3,413	0.665	0	1
Oral sex with opposite gender	male	1,410	0.780	0	1
Anal sex with opposite gender	male	1,399	0.257	0	1
HIV risk index (percentage points)	male	1,511	0.110	0	23.28
Oral sex with opposite gender	female	1,826	0.715	0	1
Anal sex with opposite gender	female	1,824	0.198	0	1
HIV risk index (percentage points)	female	1,921	0.004	0	0.05

NOTE. M/F indicates whether the summary statistics are calculated for male respondents, female respondents, or both. The standard deviation of the HIV risk index for men and women is 1.005 and 0.007, respectively. Data source: NHSLS.

Table 5
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	Country of birth			
currently married	0.53		0.55	US	0.92		0.94
divorced	0.14		0.12	Another country	0.08		0.06
widowed	0.02		0.01	Ethnicity			
separated	0.02		0.03	white	0.72	**	0.59
Number of brothers				black	0.16	**	0.27
0	0.18		0.21	hispanic	0.09	**	0.14
1	0.31	*	0.26	other	0.03	**	0.00
2+	0.50		0.53	Childhood region			
Number of sisters				new england	0.06		0.05
0	0.23		0.24	middle atlantic	0.15	*	0.21
1	0.30		0.30	east north cent.	0.17	*	0.12
2+	0.47		0.46	west north cent.	0.11		0.09
Childhood family structure				south atlantic	0.17		0.15
both mom & dad	0.72	*	0.66	east south cent.	0.08	**	0.03
dad & stepmom	0.02		0.02	west south cent.	0.09		0.10
mom & stepdad	0.07		0.07	mountain	0.05		0.05
dad & no mom/stepmom	0.02		0.02	pacific	0.11	**	0.18
mom & no dad/stepdad	0.13	**	0.19				
male & female relatives	0.04		0.03				

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 Fisher's Exact Test to assess whether the difference in proportions is significant. A double asterisk indicates significance at the 5% level. A single asterisk indicates significance at the 10% level. Data source: NHSLS.

Table 6
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 p-value [a]		Genetic Model True p-value [b]	
For male respondents						
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	*	0.002	**
Homosexual or bisexual identity	3.5%	0.0%	0.134		0.015	**
	(N=1451)	(N=60)				
For female respondents						
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	*	-	
	(N=1831)	(N=90)				

NOTE. A double asterisk indicates significance at the 5% level. A single asterisk indicates significance at the 10% level. Same gender partner in the last five years is missing a small number of values. (a) 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. (b) Studies of the genetic basis of sexual orientation report that the rate of homosexuality is greater among men who have a male homosexual relative (see text). 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). Data source: NHSLS.

Table 7
The heterosexual-homosexual margin

	Independent variable: Relative with AIDS			
Dependent variable	without controls		with controls	
For male respondents				
Male partner last five years	-0.044		-0.051	
	(0.006)	**	(0.011)	**
Appeal of sex with same gender	-0.046		-0.050	
	(0.006)	**	(0.011)	**
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)	**
For female respondents				
Female partner last five years	0.022		0.024	
	(0.023)		(0.024)	
Appeal of sex with same gender	0.069		0.075	
	(0.035)	**	(0.036)	**
Attraction to not only men	0.059		0.062	
	(0.032)	*	(0.032)	*
Homosexual or bisexual identity	0.027		0.033	
	(0.022)		(0.024)	

NOTE. Numbers in parentheses are robust standard errors. A double asterisk indicates significance at the 5% level. A single 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 4 for more information. Data source: NHSLS.

Table 8
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)	**
Marriage	0.034		0.116	
	(0.060)		(0.050)	**
Any children	0.073		0.143	
	(0.063)		(0.057)	**
Oral sex with a woman	0.136		0.110	
	(0.040)	**	(0.039)	**
Anal sex with a woman	0.186		0.163	
	(0.068)	**	(0.073)	**
HIV risk index	-0.114		-0.106	
	(0.027)	**	(0.039)	**
HIV risk index (excluding married)	-0.267		-0.229	
	(0.063)	**	(0.127)	*
For female respondents				
Syphilis	-0.008		-0.009	
	(0.002)	**	(0.003)	**
Marriage	-0.021		-0.033	
	(0.048)		(0.040)	
Any children	0.025		-0.023	
	(0.047)		(0.039)	
Oral sex with a man	0.055		0.072	
	(0.047)		(0.047)	
Anal sex with a man	0.061		0.051	
	(0.048)		(0.048)	
HIV risk index	-0.000		-0.000	
	(0.001)		(0.001)	
HIV risk index (excluding married)	-0.002		-0.003	
	(0.001)	*	(0.001)	**

NOTE. Numbers in parentheses are robust standard errors. A double asterisk indicates significance at the 5% level. A single 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 4 for more information. Data source: NHSLS.

Table 9
Robustness check: anything sexual with the same gender ever

	Relative with AIDS? No	Yes	Fisher's Exact Test p-value	Independent variable: Relative with AIDS with controls
For male respondents				
Anything sexual with a man	9.1%	7.5%	0.465	-0.018 (0.042)
For female respondents				
Anything sexual with a woman	4.0%	5.9%	0.273	0.029 (0.027)

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. Numbers in parentheses are robust standard errors. A double asterisk indicates significance at the 5% level. A single 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 sample size is 1,326 for male respondents and 1,706 for female respondents. Data source: NHSLS.