American Law and Economics Review Advance Access published January 16, 2013

The Long-run Effect of Abortion on Sexually Transmitted Infections

Christopher Cornwell, *University of Georgia,* and Scott Cunningham, *Baylor University*

Send correspondence to: Scott Cunningham, Department of Economics, Baylor University, One Bear Place #98003, Waco, TX 76798-8003, USA; Tel: 254-710-4753; Fax: 254-710-6142; E-mail: scott_cunningham@baylor.edu

There is a growing literature on the effects of abortion legalization on a range of fertility outcomes. The now-famous paper by Donohue and Levitt [2001. "The Impact of Legalized Abortion on Crime," 116 *Quarterly Journal of Economics* 379–420], linking abortion to the decline in crime in the 1990s, has shifted the focus to non-fertility outcomes. We focus on STIs, specifically gonorrhea, exploiting the states that legalized abortion prior to *Roe v. Wade* as a quasi-experiment. Using data from the CDC, we present difference-in-difference estimates showing gonorrhea incidence fell among 15–19-year-olds in early-repeal states 15–19 years after legalization. The effects are most pronounced and precisely estimated for Black women. The basic findings hold up under triple-differencing with an untreated older cohort that was not *in utero* during abortion repeal.

1. Introduction

Social scientists have convincingly documented the effect of abortion legalization on a range of fertility outcomes, including birth rates, pregnancies, abortion utilization, and contraception use (Levine, 2004). More recently, however, attention has been shifted to non-fertility outcomes. The most prominent example of this shift is that of Donohue and Levitt (2001) (DL01), who link abortion legalization in the early 1970s to the decline in crime in the 1990s. Their argument is simple: abortion reduces unwanted

American Law and Economics Review
doi:10.1093/aler/ahs019

births and unwanted children, who are more likely to engage in criminal activity. As summarized by Levitt (2004), the evidence suggests that abortion accounts for about 10% of the drop in homicide, violent crime, and property crime between 1991 and 2001.

The DL01 evidence has been disputed, most notably by Joyce (2004, 2009) and Foote and Goetz (2008). Donohue and Levitt (2004, 2008) claim in response that appropriate revisions of their original study preserve the qualitative findings, albeit at smaller magnitudes. The lack of robustness in the evidence surrounding the abortion–crime hypothesis encourages additional scrutiny. One strategy has been to examine abortion legalization's effect on other life outcomes associated with crime. As argued by Joyce (2009):

> If abortion lowers homicide rates by 20–30%, then it is likely to have affected an entire spectrum of outcomes associated with well-being: infant health, child development, schooling, earnings and marital status. Similarly, the policy implications are broader than abortion. Other interventions that affect fertility control and that lead to fewer unwanted births — contraception or sexual abstinence — have huge potential payoffs. In short, a causal relationship between legalized abortion and crime has such significant ramifications for social policy and at the same time is so controversial, that further assessment of the identifying assumptions and their robustness to alternative strategies is warranted.

This paper addresses one of those outcomes: sexually transmitted infections (STIs). The characteristics of the marginal (unborn) child could explain risky sexual behavior that leads to disease transmission. For example, Gruber et al. (1999) show that the child who would have been born had abortion remained outlawed was 60% more likely to live in a single-parent household. Being raised by a single parent is a strong predictor of earlier sexual activity and unprotected sex, evidenced by the higher rates of teenage pregnancy among the poor (Santelli et al., 2000; Sionean et al., 2001). Levine et al. (1999) find that the legalization of abortion caused teen childbearing to fall by 12%, and insofar as teenage childbearing is a function of contraception use *and* correlated intergenerationally, rising abortion rates during the 1970s would have caused contraceptive use for teens to increase among the treated group (Newcomer and Udry, 1984). Charles and Stephens (2006) report that children exposed *in utero* to a legalized abortion regime were less likely to use illegal substances. Studies such as

	CDC Surveillance Data in Calendar Year															
Age in calendar year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
15	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
16	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
17	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
18	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
19	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
20	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
21	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
22	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
23	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77
24	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
25	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
26	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
27	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73
28	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
29	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Number of cohorts (age 15-19) exposed, reforms in 71, 74: Repeal (1)	0	1	2	3	4	5	5	5	5	5	5	5	5	5	5	5
No Repeal (2)	0	0	0	0	1	2	3	4	5	5	5	5	5	5	5	5
Difference (3)	0	1	2	3	3	3	2	1	0	0	0	0	0	0	0	0

Figure 1. Period–cohort diagram.

Grossman et al. (2004) and Chesson et al. (2000) have argued that substance abuse, including alcohol consumption, can increase risky sexual behavior and thereby facilitate disease transmission.

In our analysis, we focus on gonorrhea because its symptoms appear soon after infection making the disease closely contemporaneous with sexual activity. We propose using the states that legalized abortion prior to *Roe v. Wade* (the "early repeal states") as a quasi-experiment to identify the effect of legal abortion on gonorrhea incidence in the affected birth cohort 15–19 years later. Klick and Stratmann (2003) employ a similar strategy to estimate the effect of abortion legalization on gonorrhea rates immediately after the pre-*Roe* actions. However, this is the first study to examine abortion's effect on STIs in the birth cohort exposed to the repeal of abortion bans.

Applying the abortion-legalization argument to gonorrhea leads to two predictions. First, we should observe lower incidence among 15–19-year-olds in the repeal states during the 1986–1992 period relative to their *Roe* state counterparts. Second, the treatment effect should be nonlinear, because the treated cohorts in the repeal states do not fully come of age until 1988, just when the first 15-year-olds born under *Roe* enter the sample. Figure 1 depicts how birth cohorts move through the sample window, indicating the U-shaped pattern the treatment effect should follow.

Using Gonorrhea Surveillance data from the Centers for Disease Control (CDC), we first estimate difference-in-differences (DD) regressions that compare gonorrhea incidence in states that repealed abortion restrictions prior to *Roe v. Wade* with incidence in the other 45 states for which *Roe* was the action that liberalized abortion law. The DD evidence supports both predictions for Blacks, particularly for Black females. We find that gonorrhea incidence among Black females was 15% lower in repeal states in 1986, 43% lower in 1989 (when the estimated treatment effect peaks), and 30% lower in 1991; by 1992, the estimated treatment effect is no longer statistically significant. The estimated treatment effects for Black males are smaller magnitude, but follow the same basic pattern. For Whites, the evidence is somewhat weaker.

The results for Blacks generally hold up when we estimate triple-difference (DDD) regressions that introduce a comparison with 25–29-year-olds who would not have been affected by the effects of early repeal. Again, the estimated treatment effects are u-shaped, with the largest magnitudes appearing in the middle of the treatment window. In the peak year, Black female gonorrhea incidence among 15–19-year-olds is 38% lower relative to the older cohort, whereas Black male incidence is 27% lower.

2. Implications of Abortion Legalization

With the *Roe v. Wade* decision in 1973, a right to legal abortion was established in US law. However, prior to *Roe*, a number of states enacted abortion reforms of their own. The most notable and expansive of these state actions occurred in Alaska, California, Hawaii, New York, and Washington (see Levine, 2004 for a review). By 1970, each of these states had either repealed their abortion ban or had it revoked through a judicial decision.

Expanded access to legal abortion affects a birth cohort in two important ways that could influence outcomes as the cohort ages. First, legal abortion mechanically reduces cohort size. Levine et al. (1999) find abortion legalization lowered overall birth rates about 4.1%, with teenagers and non-White women experiencing the largest effects. Birth rates fell about 12% among 15–19-year-olds and non-White women. Insofar as cohort size influences the size and density of the cohort's sexual network, then it may alter the dynamics of STI transmission.[1] Second, depending on the characteristics of the marginal aborted child, abortion access changes the composition of the cohort. In addition to having a higher probability of growing up in a single parent household, Gruber et al. (1999) estimate that the marginal child would have been 50% more likely to live in poverty and 45% more likely to be a welfare recipient.

The compositional effect is central to the DL01 argument concerning abortion and crime, and abortion and any other bad teenage or adult outcome. Other than crime, only three outcomes have been studied empirically. Angrist and Evans (1999) examine teen and out-of-wedlock childbearing and find that abortion reform significantly reduced teen fertility and childbearing and increased schooling and employment rates among Black women. Donohue et al. (2009) and Ozbeklik (2006) show that abortion legalization reduced teenage pregnancy among the individuals who were *in utero* when the bans were repealed. Finally, Charles and Stephens (2006) report legal access to abortion decreased alcohol and drug use in the birth cohort.

Taken together, these previous findings suggest a role for abortion legalization in determining STI rates of affected cohorts. There are several potential mechanisms for abortion's influence. First, if abortion legalization caused women to invest in more human capital, then abortion policies may have led to improved health outcomes for their children (Angrist and Evans, 1999; Currie and Moretti, 2003).[2] Second, STI rates may be affected by changing household structure through its shaping of adolescent sexual behavior. Examining data from the 1992 National Health and Social Life Survey, we found that individuals whose biological or adoptive parents were unmarried at age 14 were statistically more likely to have had gonorrhea at least once in their lifetime.[3] Third, STI and drug-use rates are highly correlated. The crack epidemic was associated with the dramatic rise in gonorrhea and syphilis incidence during the 1980s, partly fueled by increased female prostitution and the practice of exchanging sex for drugs or money

1. Network size directly alters the structure of social networks and in turn may affect the choices of individuals embedded in that network (Ballester et al., 2006).

2. The effects on education and health outcomes may also be directed through the change in cohort size insofar as the marginal child is on average of higher birth order (Black et al., 2005).

3. These results are available from the authors upon request.

to purchase drugs (Edlin et al., 1994; Jones et al., 1998). Others (Chesson et al., 2000; Carpenter, 2005; Grossman et al., 2004) have found gonorrhea rates, and risky sexual behavior more generally, to be responsive to limits on alcohol consumption, suggesting that curbing substance abuse may also reduce risky sex and gonorrhea.

3. Data and Methodology

3.1. Gonorrhea and Abortion

Gonorrhea is an exclusively bacterial STI that can grow and multiply in the reproductive tract and urethra, as well as in the mouth and throat (Holmes et al., 1999). Among STIs, gonorrhea is ideal for our study. First, its very short incubation period makes awareness of symptoms highly correlated with contemporaneous sexual behavior. Second, although gonorrhea can lead to serious health problems, such as infertility if left untreated, it is easily cured with clinical dosages of antibiotics. Third, these characteristics in combination with relatively high prevalence in the population, have produced consistent state-level records of gonorrhea incidence since the early 1980s. Finally, during the sample period, gonorrhea was much more common among Blacks, making it more likely that the marginal aborted child would have a disruptive effect on gonorrhea transmission in the Black sexual network.[4]

Now, if the abortion-legalization hypothesis is true, what patterns should we expect to find in the gonorrhea incidence data? To sort this out, we borrow from Angrist and Evans (1999) and construct the period-cohort diagram in Figure 1. The top panel depicts birth-cohort aging over the sample period, highlighting 15–19-, 20–24-, and 25–29-year-old age groups. The

4. At this point, one might reasonably ask why we do not include syphilis in our analysis. In our judgment, syphilis is inappropriate for this study for at least two reasons. Syphilis is rare, making it far less likely that the marginal aborted child would have been centrally important in disease transmission. Data from the CDC's syphilis surveillance program put the syphilis rates for Black and White 15–49-year-olds over our sample period at 29 and 3, respectively. By contrast, the corresponding gonorrhea rates were 2,109 and 82, which are greater by factors of about 70 and 30. In addition, syphilis is disproportionately concentrated among gay males, for whom there is no theoretical link to the marginal aborted child in the early 1970s.

bottom panel tracks cohort exposure to abortion legalization, distinguishing *Roe* states from the early-repeal states in each calendar year. Like Angrist and Evans (1999), we mark the beginning of each cohort's treatment with abortion legalization at 1971 for repeal and 1974 for *Roe* to accommodate a 9-month fetal gestation.

The differences in exposure between the *Roe* and early-repeal states suggest two testable predictions. First, from 1986 to 1992, repeal states should have witnessed lower gonorrhea incidence among 15–19-year-olds than the *Roe* states. Lower gonorrhea incidence in the early repeal states should only be temporary, because the exposed *Roe* state cohort moves through the sample frame and erases the difference. Second, the treatment effect should be u-shaped, because the distinction between the *Roe* and early-repeal states initially sharpens, as the treated cohorts in the early-repeal states come of age, and then weakens, when the first 15-year-olds born under *Roe* enter the sample. These predictions are evident in the bottom panel of Figure 1.

Data on new gonorrhea cases were acquired from the CDC Division for STD Prevention, which collects its information from state health departments. Starting in 1981, the data were available by race, age, gender, state, and year, although there is some measurement error in the tabulations for 1981–84 due to incomplete records and poorly recorded race and age identifiers. Following the suggestion of health researchers at the CDC, we therefore conduct our analysis without the 1981–84 data.[5]

Figures 2 and 3 plot gonorrhea incidence for 15–19-year-old Blacks and Whites by gender over the 1985–2000 period. In each case, the basic difference in differences should be apparent, as the shaded area highlights the years 1986–92 when the *in utero* treatment group entered the sample frame (see Figure 1). Figure 2 shows that Black gonorrhea incidence in the *Roe* and early-repeal states follows the patterns predicted by the abortion-legalization hypothesis. Gonorrhea incidence fell in the repeal states relative to the *Roe* states from 1986 to 1992, with the difference in incidence peaking in the middle of this period. However, as indicated in Figure 3, gonorrhea incidence among Whites does not exhibit the same patterns.

5. Private correspondence with Harrell Chesson at the CDC.

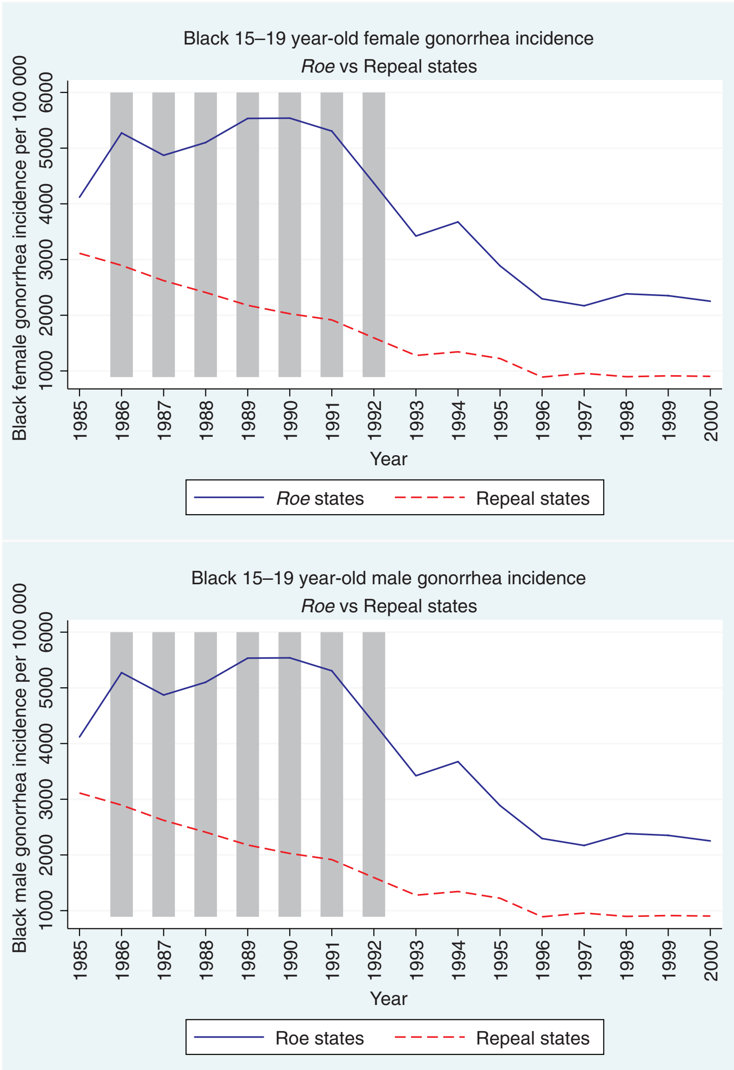

Figure 2. Gonorrhea incidence among 15–19-year-old Blacks in *Roe* and early-repeal states by gender, 1985–2000.

Figures 4 and 5 add data on 25–29-year-olds to the race-specific incidence trends presented in Figures 2 and 3, introducing a comparison with an older cohort that was not exposed to legalized abortion. We use

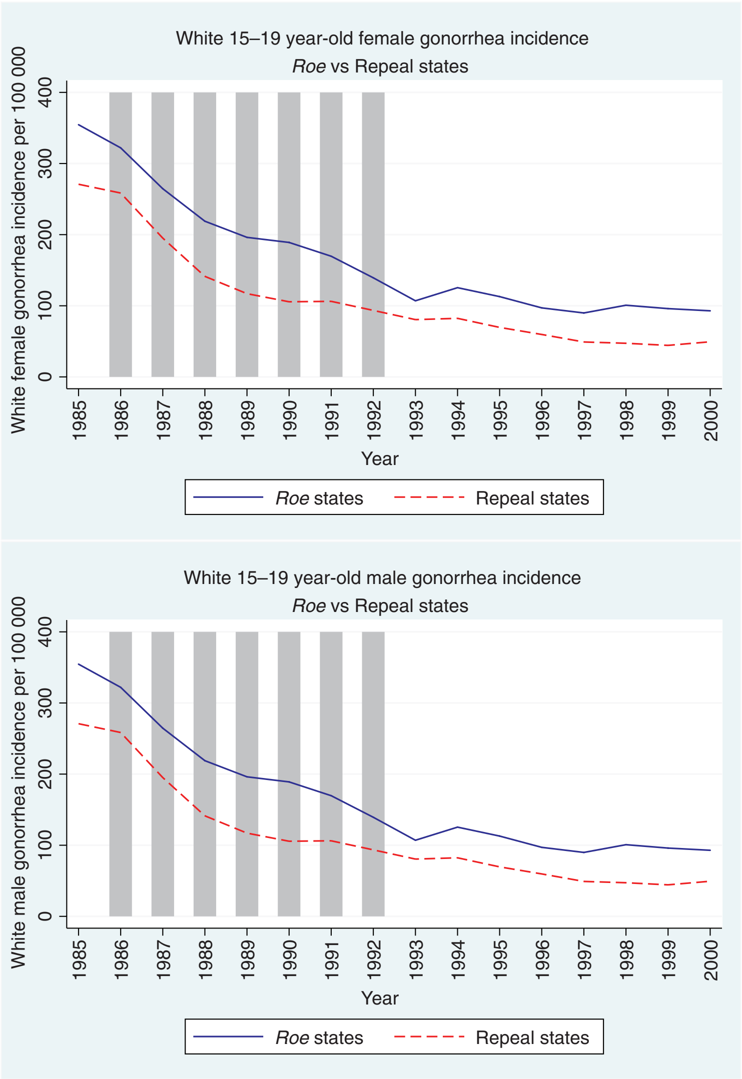

Figure 3. Gonorrhea incidence among 15–19-year-old Whites in *Roe* and early-repeal states by gender, 1985–2000.

25–29-year-olds as the older cohort because they are close enough in terms of behavior, but far enough from the 15- to 19-year-olds in age to limit the possibility that they are matching with the teenage cohort during the

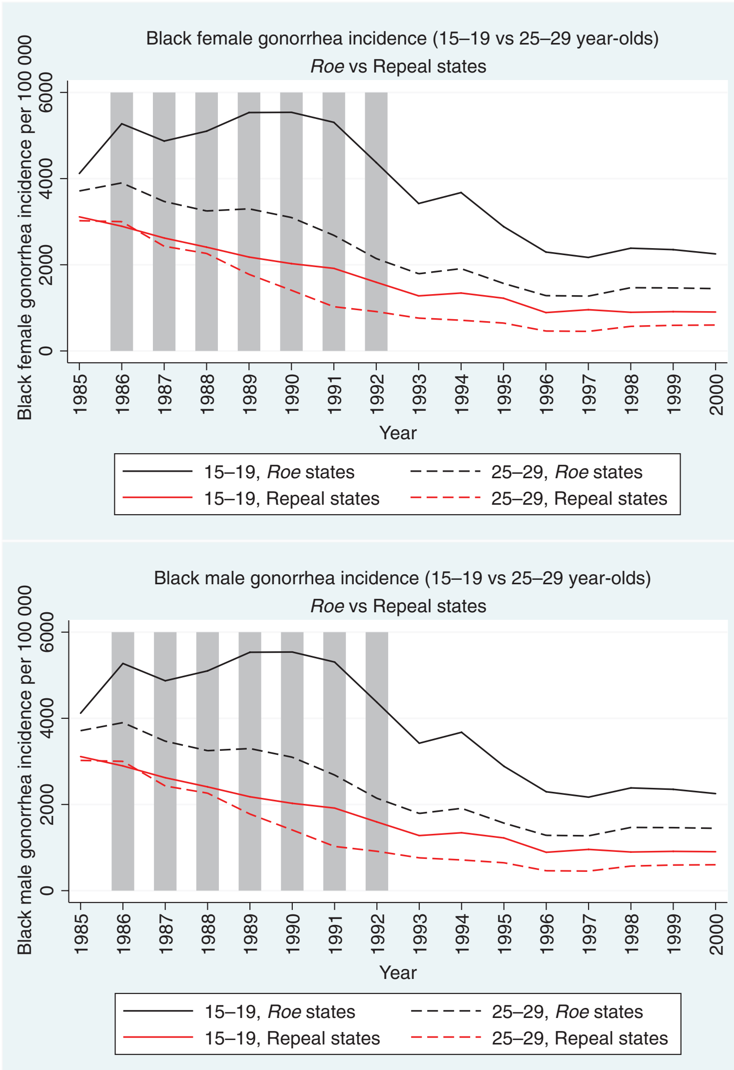

Figure 4. Gonorrhea incidence among 15–19- and 25–29-year-old Blacks in *Roe* and early-repeal states by gender, 1985–2000.

treatment window. The DDD represented in Figure 4 also suggest the abortion-legalization hypothesis may apply to Blacks. Figure 5 reveals no similar pattern for Whites. The *Roe* and early-repeal gonorrhea series for 25–29-year-olds are much more similar to those of the younger cohort.

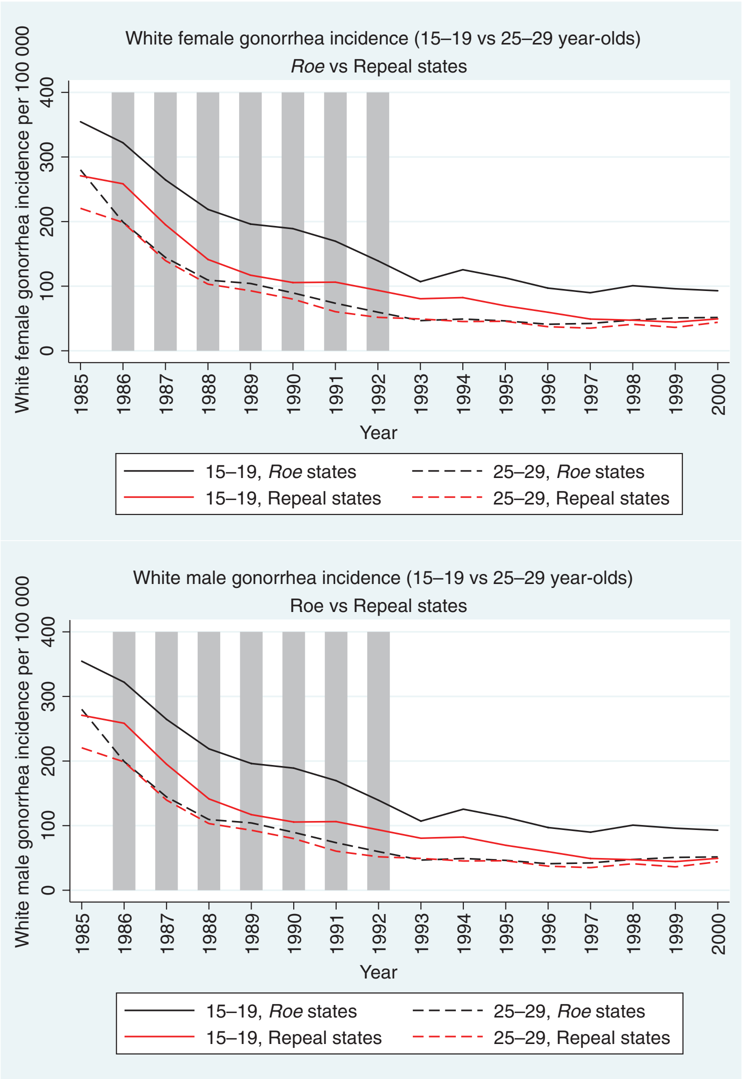

Figure 5. Gonorrhea incidence among 15–19- and 25–29-year-old Whites in *Roe* and early-repeal states by gender, 1985–2000.

Of course, the observed patterns in the incidence data could merely reflect other factors that may have affected gonorrhea incidence, whose timing corresponds to abortion-law changes. Two potential confounding events during the 1986–1992 period are the crack and AIDS epidemics which likely influenced sexual behavior and may have varied by repeal status. Several studies have shown that crack users were far more likely to be infected with HIV and AIDS than non-users (Edlin et al., 1994). Some evidence suggests that because of its highly addictive nature, regular users engage in criminal activity, including commercial sex work, to support their habits (Jones et al., 1998; Grogger and Willis, 2000). Ethnographers reported an increase in drugs-for-sex exchanges among urban Blacks, attributing much of the explosion in Black STIs during this period to the increased prostitution activity (Rolfs et al., 1990; Ratner, 1993). As the problem of HIV/AIDS grew to prominence in the mid-1980s, it was understood to be concentrated among gay and bisexual men. At the time, two of the early repeal states—California and New York—had large homosexual and bisexual male populations. If worries about AIDS reduced risky sex, as some studies suggest (Ahituv et al., 1996; Chesson et al., 2003; Francis, 2008), then declines in gonorrhea in the early repeal states may be due to a combination of increased condom use or higher mortality among centrally important individuals in the sexual network. We include proxies for crack and AIDS mortality in all of our models.

3.2. Data

As described above, our data on gonorrhea come from the CDC Division for STD Prevention, which collects the information from state health departments. We use the Fryer et al. (2013) crack index as a proxy for crack use. Their index covers the 1980–2000 period and varies by state and year. It is the product of a factor analysis involving cocaine-related arrests, cocaine-related and crack-related drug seizures, and cocaine-related deaths. We control for AIDS awareness by including cumulative AIDS mortality over the current and preceding three years. This variable is constructed from information on AIDS deaths provided by the AIDS Public Information Data.

In addition, we follow Chesson et al. (2000, 2003) and control for a range of economic and demographic factors. The economic variables include a state's population share living in poverty, unemployment rate, and real per capita income. Finally, we include measures of per capita alcohol consumption and the male incarceration rate (defined as the number of

Table 1. Covariate Summary Statistics

Variable name	Obs.	Mean	Std. Dev.	Min	Max
		White male case			
AIDS mortality	802	34.722	36.097	0	405.760
Alcohol consumption per capita	802	2.277	0.411	1.2	5.05
Crack index	802	1.7801	1.198	−1.166	7.313
White male incarceration rate 10,000	802	95.390	29.521	0	262.778
Poverty rate	802	13.165	3.499	2.9	27.2
Real income per capita	802	$21,173.15	5242.35	$9,892	$41,489
State unemployment rate	802	5.709	1.678	2.258	13.441
		White female case			
AIDS mortality	808	34.644	35.991	0	454.303
Alcohol consumption per capita	808	2.277	0.410	1.2	5.05
Crack index	808	1.778	1.198	−1.166	7.313
White male incarceration rate 10,000	808	95.378	29.540	0	262.778
Poverty rate	808	13.161	3.497	2.9	27.2
Real income per capita	808	$21,175.45	5239.05	$9,892	$41,489
State unemployment rate	808	5.707	1.677	2.258	13.442
		Black male case			
AIDS mortality	754	44.707	45.183	0	454.303
Alcohol consumption per capita	754	2.275	0.374	1.2	5.05
Crack index	754	1.686	0.997	−1.166	7.313
Black male incarceration rate 10,000	754	415.008	154.199	0	3798.45
Poverty rate	754	14.300	3.917	2.9	27.2
Real income per capita	754	$21,280.05	5410.425	$9892	$41,489
State unemployment rate	754	5.842	1.69	2.258	13.44
		Black female case			
AIDS mortality	736	44.712	45.184	0	454.303
Alcohol consumption per capita	736	2.276	0.374	1.2	5.05
Crack index	736	1.686	0.997	−1.166	7.313
Black male incarceration rate 10,000	736	414.948	153.773	0	3798.45
Poverty rate	736	14.300	3.917	2.9	27.2
Real income per capita	736	$21,280.45	5410.287	$9,892	$41,489
State unemployment rate	736	5.842	1.692	2.258	13.442

institutionalized males per 10,000 in of the age–race population in a given state).

Table 1 presents summary statistics for the covariates by race and gender, corresponding to the estimation cases we outline below. Because we are estimating the effect of abortion legalization on the log of gonorrhea incidence, we provide descriptive statistics for only those states which have non-zero incidence.[6] Although the mean values of the covariates are similar for males and females of a given race, we present the statistics by gender to be clear about the differences in the samples used in estimation.

3.3. Empirical Models

We first estimate the DD in (log) gonorrhea incidence between early-repeal and *Roe* states using regression models of the form:

$$\ln \mathrm{GON}_{st} = \beta_1 \,\mathrm{Repeal}_s + \beta_2 DT_t + \beta_{3t} \,\mathrm{Repeal}_s \cdot DT_t + X_{st}\xi + \alpha_{1s} DS_s + \gamma_1 t + \gamma_{2s} DS_s \cdot t + \epsilon_{st}, \tag{1}$$

where GON is the number of new gonorrhea cases for 15–19-year-olds (per 100,000 of the population) in state s and year t; $\mathrm{Repeal}_s = 1$ if state s legalized abortion prior to *Roe*; DT_t is a year indicator; DS_s is a state indicator; t is a time trend; X_{st} is a vector of covariates; and ϵ is an error term. The parameters of interest are the β_{3t}, which capture the effects of the early repeal of abortion bans on gonorrhea incidence in the treated birth cohort 15–19 years later. We estimate the model separately for Blacks and Whites by gender, weighting the observations in each case by the race–age–state–year population share. Standard errors are clustered at the state level.[7]

If the abortion legalization hypothesis is correct, then the $\hat{\beta}_{3t}$ should be negative and statistically significant in 1986–92, rising in magnitude through the middle of this period and falling thereafter, as indicated in Figure 1. However, because early repeal applies exclusively to the 15–19-year-old cohort, we should not find a policy response in older cohorts.

6. This is an issue in states with few Blacks (e.g., South Dakota), because in a given year there may no reported incidence of gonorrhea.

7. We also used the procedure of Cameron, Gelbach, and Miller (CGM) (2010) to incorporate clustering at the state and year levels into the estimation of the covariance matrix. Two-way clustering generally produces smaller standard errors, leading to more confident rejections of the null of no abortion effect. However, we are skeptical of these results for two reasons. First, the asymptotic justification for two-way clustering is made in terms of the smaller number of clusters, which is just 16 in our case. Second, in most instances the "raw" estimated covariance matrix is not positive definite, requiring a correction that involves a spectral decomposition of the covariance matrix and replacing negative eigenvalues with zeroes (see CGM, p. 241).

Therefore, as a further test of the abortion legalization hypothesis, we estimate DDD regressions, comparing the effects of early repeal on 15–19-year-olds with its effects on 25–29-year-olds. The DDD regressions add age-cohort terms to (1), which allow us to separate out contemporaneous shocks during 1986–92 in repeal states from the cohort effect itself. The DDD regressions take on the form:

$$\begin{aligned}\ln \mathrm{GON}_{ast} = {} & \beta_1 \,\mathrm{Repeal}_s + \beta_2 DT_t + \beta_{3t} \,\mathrm{Repeal}_s \cdot DT_t + \delta_1 DA \\ & + \delta_2 \,\mathrm{Repeal}_s \cdot DA + \delta_{3t} DA \cdot DT_t + \delta_{4t} \,\mathrm{Repeal}_s \cdot DA \cdot DT_t \\ & + X_{st}\xi + \alpha_{1s} DS_s + \alpha_{2s} DS_s \cdot DA + \gamma_1 t + \gamma_{2s} DS_s \cdot t \\ & + \gamma_3 DA \cdot t + \gamma_{4s} DS_s \cdot DA \cdot t + \epsilon_{ast}, \end{aligned} \tag{2}$$

where $DA = 1$ for 15–19-year-olds. In these cases, the coefficients of interest are the δ_{4t}, and we will look for the same patterns among their estimated values predicted for the DD coefficients in (1).

Finally, we should point out that our tests of the abortion legalization hypothesis do not rule out the possibility that the early-repeal states attracted individuals from *Roe* states who wanted access to legal abortion (before 1973). However, insofar as this occurred, it should bias the estimated treatment effects towards zero. Individuals making such choices would receive the early-repeal treatment and return to their home *Roe* (control-group) state, thus attenuating the differences between the two groups.

3.4. Difference-in-Difference Results

Table 2 reports the estimated coefficients of the repeal-year interactions ($\hat{\beta}_{3t}$) and the covariates in Equation (1) for Blacks and Whites by gender. To gauge the sensitivity of the results to omitted state trends in gonorrhea, we present estimates first dropping the trend terms from (1) and then including them.

Focus first on the results for Black females. The specification without state trends (column a) produces estimated DD coefficients that are negative and statistically significant at the 1% level over the 1986–92 period, increasing in magnitude from 0.26 in 1986 to 0.79 in 1989 before falling to 0.44 in 1992. After 1992, the $\hat{\beta}_{3t}$ fall sharply in magnitude, and, with the exception of 1993, become statistically insignificant. The data for

Table 2. Diff-in-Diff Baseline: Panel Fixed Effects Regressions of Early Repeal of Abortion on In Utero Cohort Log of 15–19 Year-Old Gonorrhea Incidence Rates by Race/Gender, 1985–2000, State Clustering

	Black female		Black male		White female		White male	
Covariates	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Repeal × 1986	−0.259***	−0.162**	−0.302***	−0.189	−0.096	−0.035	−0.310	−0.277
	(0.063)	(0.074)	(0.104)	(0.154)	(0.105)	(0.147)	(0.224)	(0.264)
Repeal × 1987	−0.342**	−0.194	−0.570***	−0.389	−0.152	−0.059	−0.384*	−0.345
	(0.168)	(0.209)	(0.207)	(0.281)	(0.139)	(0.152)	(0.215)	(0.255)
Repeal × 1988	−0.611***	−0.411	−0.687***	−0.469	−0.663	−0.525	−0.623	−0.572
	(0.203)	(0.264)	(0.250)	(0.325)	(0.436)	(0.522)	(0.385)	(0.450)
Repeal × 1989	−0.785***	−0.555*	−0.688***	−0.468*	−0.220	−0.044	−0.400*	−0.331
	(0.237)	(0.309)	(0.192)	(0.271)	(0.241)	(0.130)	(0.230)	(0.226)
Repeal × 1990	−0.632***	−0.397**	−0.447	−0.262	0.018	0.195	−0.240	−0.196
	(0.176)	(0.180)	(0.273)	(0.157)	(0.541)	(0.316)	(0.342)	(0.203)
Repeal × 1991	−0.553***	−0.353**	−0.361**	−0.258	0.180	0.298	−0.013	−0.006
	(0.139)	(0.173)	(0.178)	(0.158)	(0.417)	(0.192)	(0.313)	(0.193)
Repeal × 1992	−0.442***	−0.235	−0.344	−0.220	0.082	0.284*	0.001	0.064
	(0.160)	(0.205)	(0.238)	(0.183)	(0.452)	(0.158)	(0.369)	(0.245)
Repeal × 1993	−0.306*	−0.178	−0.238	−0.220	0.213	0.262	0.298	0.277
	(0.181)	(0.176)	(0.215)	(0.175)	(0.516)	(0.168)	(0.390)	(0.270)
Repeal × 1994	−0.118	−0.033	−0.038	−0.044	0.276	0.248	0.341	0.282
	(0.207)	(0.177)	(0.306)	(0.175)	(0.637)	(0.243)	(0.536)	(0.271)
Repeal × 1995	0.021	0.119	0.177	0.207	0.247	0.206	0.246	0.161
	(0.223)	(0.203)	(0.353)	(0.206)	(0.567)	(0.169)	(0.515)	(0.251)

Repeal × 1996	−0.124	−0.056	0.098	0.091	0.316	0.156	0.190	0.027
	(0.207)	(0.144)	(0.415)	(0.184)	(0.618)	(0.139)	(0.521)	(0.216)
Repeal × 1997	0.021	0.051	0.295	0.252*	0.331	0.038	0.303	0.043
	(0.264)	(0.127)	(0.414)	(0.130)	(0.688)	(0.139)	(0.511)	(0.186)
Repeal × 1998	−0.036	−0.071	0.176	0.041	0.411	−0.079	0.491	0.096
	(0.347)	(0.118)	(0.505)	(0.147)	(0.749)	(0.108)	(0.529)	(0.121)
Repeal × 1999	0.015	−0.046	0.178	0.019	0.545	−0.095**	0.310	−0.186**
	(0.357)	(0.059)	(0.502)	(0.082)	(0.847)	(0.038)	(0.584)	(0.082)
AIDS mortality per capita	0.003**	0.000	0.003	0.000	0.012**	0.003	0.008*	0.003
	(0.001)	(0.002)	(0.002)	(0.002)	(0.005)	(0.003)	(0.005)	(0.003)
Incarceration per capita	0.000	−0.000	0.001*	−0.000	0.003	−0.002	0.001	−0.003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.004)	(0.003)	(0.004)
Parental involvement law	−0.039	−0.015	−0.029	−0.000	−0.053	−0.081	−0.057	−0.021
	(0.066)	(0.053)	(0.071)	(0.042)	(0.118)	(0.062)	(0.135)	(0.080)
Alcohol consumption per capita	0.447	−0.063	1.020**	−0.077	1.097	0.062	1.232*	0.596
	(0.328)	(0.256)	(0.433)	(0.244)	(0.655)	(0.348)	(0.647)	(0.468)
Crack index	0.053	0.024	0.042	−0.008	0.067	0.051*	0.069*	0.035
	(0.035)	(0.033)	(0.037)	(0.028)	(0.043)	(0.030)	(0.035)	(0.033)
Poverty per capita	−0.003	−0.002	−0.013	−0.008	−0.003	0.001	−0.003	0.001
	(0.014)	(0.016)	(0.014)	(0.015)	(0.015)	(0.013)	(0.017)	(0.015)
Real income per capita	0.000	−0.000	0.000	0.000	0.000	−0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
State unemployment rate	−0.028	−0.044	−0.042	−0.036	0.027	−0.032	0.034	−0.007
	(0.036)	(0.044)	(0.034)	(0.030)	(0.078)	(0.048)	(0.093)	(0.057)
F-test p-value coeff 1986–92	0.000	0.001	0.029	0.414	0.015	0.004	0.043	0.056
R-squared	0.857	0.911	0.893	0.947	0.809	0.924	0.852	0.917
N	736	736	754	754	808	808	802	802

The dependent variable in each model is the log of new gonorrhea cases per 100,000. Standard errors clustered at state-level reported in parenthesis. Column (a) includes state fixed effects and year fixed effects; column (b) includes state-specific time trends as well. All models use race population as analytical weights. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Black females clearly support the two basic predictions of the abortion-legalization hypothesis. These estimates imply that abortion legalization decreased gonorrhea incidence among 15–19-year-old Black females in early-repeal states relative to the rest of the country by 23–55%, as this group came of age and (later) the effects of *Roe* were realized. Adding state trends (column b) reduces magnitudes and precision, but the essential story is unaffected. The estimated DD coefficients remain negative and (with two exceptions) statistically significant at the 10% level over the treatment period, and follow the same u-shaped pattern. Based on these findings, we would conclude that abortion-legalization caused gonorrhea incidence to drop 15–43% among 15–19-year-old Black females as the intensity of the treatment rose then fell in the early-repeal states.

The results for Black males are qualitatively and quantitatively very similar. With state trends, for the years 1986–92, the $\hat{\beta}_{3t}$ are negative, statistically significant at the 10% level (or better) and u-shaped relative magnitudes as predicted by the abortion-legalization hypothesis. As for women, including state trends causes magnitudes to fall and standard errors to rise—enough so that the individual $\hat{\beta}_{3t}$ are no longer significant at the 10% level. Nevertheless, the estimates from the state-trend specification suggest that abortion legalization decreased gonorrhea incidence 17–38% among 15–19 year-old Black males relative to their counterparts in the *Roe* states. At their peak in 1989, the percentage reductions in gonorrhea incidence translate into roughly 1824 (1355) fewer female (male) gonorrhea cases per 100,000, relative to mean incidence in 1985.[8]

Now turn to the results for Whites. Here, the evidence for the abortion-legalization hypothesis represented in the signs and magnitudes of the individual $\hat{\beta}_{3t}$ is weaker. In the White female regressions, the repeal-year interactions are negative and rising in magnitude through 1988, but never statistically significant at even the 10% level, whether or not state trends are included. For White males, the effects of the repeal-year interactions are a little more precisely estimated, though still not significant at the usual levels, and follow those of their Black counterparts more closely.

In sum, on the basis of temporal pattern and statistical significance of the individual $\hat{\beta}_{3t}$, it has been concluded that abortion has affected

8. The mean gonorrhea rate for 15–19-year-old Black males in 1985 was 3,565 cases per 100,000; for Black females, it was 4,241 cases per 100,000.

gonorrhea incidence in a manner consistent with DL01, especially for Black females. However, we might also appeal to the joint significance of the $\hat{\beta}_{3t}$. The relevant F statistics are reported at the bottom of Table 2. For both Black and White females, with or without state trends included, the null over the 1986–92 treatment window is rejected at the 5% level.[9] For males, the same is true when state trends are omitted, but not otherwise (although the p value for Whites is close to the 5% standard in the state-trend specification). In addition, it is worth asking whether the temporal pattern evidenced in the $\hat{\beta}_{3t}$ represents statistically significant differences from year to year. So, we conduct (one-sided) tests of the equality of $\hat{\beta}_{3,1989}$ and $\hat{\beta}_{3,1992}$ with the peak-year $\hat{\beta}_{3t}$. Using the state-trend specification, we are able to reject the null at the 10% level in each case, with the sharpest rejections occurring for Blacks. These tests provide additional support for the abortion-legalization hypothesis and suggest that abortion's effect on gonorrhea may have extended beyond Black females.

Finally, we note that the covariates add little to the explanatory power of the regressions reported in Table 2. Three exceptions are AIDS mortality, crack, and alcohol consumption, each of which are shown to increase gonorrhea incidence when state trends are omitted. The finding for alcohol and crack are intuitive, but the result for AIDS mortality is not. Knowledge about the consequences of HIV/AIDS should reduce risky behavior (Ahituv et al., 1996) and slow disease transmission. One explanation for the counterintuitive result is that AIDS mortality may simply be capturing the fact that places where AIDS was more pronounced, risky sexual practices were more widespread. This could explain why its impact disappears when state trends are included. The estimated effect of alcohol consumption also does not survive the inclusion of state trends, though the effect for crack is mixed.

3.5. Triple-Difference Results

If the abortion legalization hypothesis applies to gonorrhea incidence, its effect should be apparent in a comparison of incidence among 15–19-year-olds in the early repeal states with older cohorts that were not exposed to the treatment. As explained earlier, we take 25–29-year-olds as the older cohort

9. The F statistics on the joint significance of the 1986–1992 coefficients may be less useful for White females, though, since 3 of the 7 coefficients are positive.

on the grounds that they are not too dissimilar from 15- to 19-year-olds in terms of behavior and are far enough apart in age so that matching across groups is not a great concern. Table 3 reports the estimated coefficients of the repeal–cohort–year interactions ($\hat{\delta}_{4t}$) and the covariates in Equation (2) for Blacks and Whites by gender. The first column in each case omits state–age trends from (2); the second column reflects the full specification.

Again, we start with the results for Black females. Whether or not state–age trends are included, the DDD coefficient estimates are negative, rising in absolute value, and statistically significant at the 5% level through the mid-point of the treatment window. In addition, their magnitudes over this period are roughly on par with the DD estimates given in the second column of Table 2 (which are conditional on state trends). From 1990 to 1992, their absolute values and precision diminish considerably. After 1992, the $\hat{\delta}_{4t}$ are generally not statistically significant.[10] So, the strong support of the abortion-legalization hypothesis for Black females shown in Table 2 holds up when the older-cohort contrast is added. In both timing and temporal pattern, the DDD coefficient estimates are consistent with the two fundamental predictions. Using the estimates from the full, state–age–trend specification, we would conclude that early repeal decreased gonorrhea incidence among 15–19 year-old Black females relative to 25–29-year-olds by 32–38% from 1986 to 1989.[11]

For Black males, the DDD results are also largely consistent with the abortion-legalization hypothesis. The best evidence comes from the full,

10. One conspicuous exception, which appears in the Black male results as well, is the estimated coefficient of the 1997 repeal–cohort–year interaction. This counterintuitive increase in gonorrhea incidence apparent in the DDD estimator may be a reflection of the movement of the treatment cohort into the control group in 1996. Figure 1 shows that the treated cohort was 25–26-years-old by 1997.

11. We replicated this analysis with the 20–24-year-olds as the comparison group and find that the DDD support for the abortion-legalization hypothesis is not as strong, but some evidence for abortion's impact among Black females remains survives. The estimated effects of early repeal relative to 20–24-year-olds are negative and statistically significant at the 5% level in 1986 and 1987, with magnitudes of 12–17% range. The 1988 and 1989 coefficient estimates are also negative, although smaller in magnitude and not statistically significant at the usual levels. The weaker case for the abortion-legalization hypothesis with the younger comparison cohort should not be surprising. For the 20–24-year-olds to be a legitimate control group, their sexual networks should not overlap with those of 15–19-year-olds. Insofar as they do, the early repeal treatment applied to the latter will spill over into the former.

Table 3. Diff-in-Diff-in-Diff: Panel fixed effects regressions of early repeal of abortion on in utero cohort log of 15–19 year-old gonorrhea incidence rates by race/gender, 25–29 comparison, state and age linear trends, 1985–2000, state clustering

	Black female		Black male		White female		White male	
Covariates	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Repeal × 15-year-old × 1986	−0.337***	−0.389***	−0.244**	−0.274*	−0.123	−0.146**	−0.219***	−0.210*
	(0.115)	(0.126)	(0.110)	(0.137)	(0.084)	(0.061)	(0.080)	(0.125)
Repeal × 15-year-old × 1987	−0.389**	−0.451**	−0.215**	−0.259*	−0.152	−0.197*	0.037	0.057
	(0.155)	(0.189)	(0.092)	(0.131)	(0.180)	(0.116)	(0.277)	(0.195)
Repeal × 15-year-old × 1988	−0.382**	−0.472**	−0.232**	−0.308**	−0.344***	−0.415**	−0.160	−0.140
	(0.143)	(0.182)	(0.098)	(0.143)	(0.077)	(0.182)	(0.209)	(0.100)
Repeal × 15-year-old × 1989	−0.277*	−0.380*	0.048	−0.043	0.135	0.041	−0.080	−0.049
	(0.138)	(0.191)	(0.212)	(0.142)	(0.375)	(0.238)	(0.327)	(0.155)
Repeal × 15-year-old × 1990	−0.046	−0.163	0.202	0.090	0.223	0.108	−0.126	−0.083
	(0.146)	(0.169)	(0.247)	(0.150)	(0.486)	(0.320)	(0.450)	(0.233)
Repeal × 15-year-old × 1991	0.079	−0.039	0.308	0.196	0.341	0.210	0.045	0.097
	(0.148)	(0.216)	(0.214)	(0.118)	(0.326)	(0.157)	(0.366)	(0.120)
Repeal × 15-year-old × 1992	0.122	0.005	0.183	0.071	0.272	0.129	0.173	0.236*
	(0.140)	(0.144)	(0.301)	(0.163)	(0.384)	(0.180)	(0.417)	(0.135)
Repeal × 15-year-old × 1993	−0.168	−0.261	−0.123	−0.213	0.095	−0.054	0.034	0.119
	(0.360)	(0.328)	(0.414)	(0.311)	(0.474)	(0.250)	(0.525)	(0.256)
Repeal × 15-year-old × 1994	0.239*	0.112	0.231	0.112	0.120	−0.055	0.188	0.261
	(0.124)	(0.104)	(0.421)	(0.240)	(0.505)	(0.250)	(0.628)	(0.232)
Repeal × 15-year-old × 1995	0.151	0.060	0.295	0.207	0.094	−0.082	−0.019	0.084
	(0.142)	(0.096)	(0.459)	(0.255)	(0.515)	(0.225)	(0.685)	(0.248)
Repeal × 15-year-old × 1996	0.183	0.095	0.311	0.222	0.311	0.125	−0.130	−0.013
	(0.114)	(0.115)	(0.415)	(0.195)	(0.338)	(0.103)	(0.695)	(0.239)
Repeal × 15-year-old × 1997	0.357***	0.269***	0.435	0.346**	0.231	0.030	−0.113	0.025
	(0.114)	(0.098)	(0.379)	(0.146)	(0.411)	(0.107)	(0.711)	(0.172)

(continued)

Table 3. Continued

	Black female		Black male		White female		White male	
Covariates	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Repeal × 15-year-old × 1998	0.096	0.009	0.151	0.063	0.175	−0.035	−0.219	−0.068
	(0.105)	(0.069)	(0.321)	(0.080)	(0.450)	(0.098)	(0.575)	(0.142)
Repeal × 15-year-old × 1999	0.097	0.011	0.089	0.002	0.253	0.030	−0.252	−0.089
	(0.122)	(0.100)	(0.212)	(0.072)	(0.322)	(0.108)	(0.580)	(0.175)
AIDS mortality per capita	−0.001	−0.001	−0.002	−0.002	0.002	0.002	−0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Parental involvement law	−0.024	−0.024	−0.016	−0.007	−0.044	−0.088	0.008	−0.036
	(0.047)	(0.052)	(0.043)	(0.045)	(0.058)	(0.058)	(0.086)	(0.083)
Incarceration per capita	−0.000	−0.001	−0.000	−0.001	0.001	−0.002	−0.002*	−0.001
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Alcohol consumption per capita	−0.024	−0.059	−0.116	−0.143	0.185	0.169	0.392	0.400
	(0.179)	(0.197)	(0.160)	(0.170)	(0.322)	(0.338)	(0.374)	(0.386)
Crack index	0.042	0.039	0.004	0.003	0.051*	0.051*	0.043	0.041
	(0.037)	(0.037)	(0.032)	(0.033)	(0.027)	(0.028)	(0.028)	(0.029)
Poverty per capita	0.018	0.017	0.014	0.013	0.014	0.013	0.007	0.006
	(0.028)	(0.028)	(0.025)	(0.024)	(0.017)	(0.017)	(0.017)	(0.017)
Real income per capita	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
State unemployment rate	−0.043	−0.036	−0.049*	−0.044	0.002	0.002	0.042	0.039
	(0.038)	(0.038)	(0.027)	(0.027)	(0.034)	(0.035)	(0.038)	(0.040)
R-squared	0.915	0.927	0.911	0.923	0.920	0.931	0.897	0.920
N	1,437	1,437	1,504	1,504	1,603	1,603	1,606	1,606

The dependent variable in each model is the log of new gonorrhea cases per 100,000. Standard errors clustered at state-level reported in parenthesis. Columns (a) include state-specific and age-specific time trends, and column (b) includes a state-age interaction with state-age specific time trends. All models use race population as analytical weights. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

state–age–trends specification (column 4), where the estimated coefficients of the repeal–cohort–year interactions are negative, relatively large in magnitude and statistically significant at the 10% level through 1988. The DDD coefficient estimates suggest early repeal caused gonorrhea incidence to fall between 24 and 27% over the first half of the treatment window. From 1989 to 1992, the DDD coefficient estimates are generally positive, smaller in magnitude and not statistically significant.

Similarly to the findings in Table 2, the DDD support for the abortion-legalization hypothesis, as depicted in the individual $\hat{\delta}_{4t}$, is weaker for Whites than Blacks. However, in contrast to the DD findings, the clearer case appears for White females. Focusing on the full state-age-trend specification (column 6), we find a pattern of DDD coefficient estimates that matches up qualitatively with those Black females. Through 1988, $\hat{\delta}_{4t}$ are negative, increasing in magnitude, and statistically significant at the 10% level (or better), suggesting treatment effects between 14 and 34%. After 1988, the signs reverse and statistical significance erodes. For White males, the estimated effects of the repeal–year interactions are negative in most years of the treatment window, but their magnitudes do not follow the pattern predicted by the abortion-legalization hypothesis and are typically smaller than the corresponding standard errors.

3.6. Racial Differences in Abortion's Effect

The racial disparity in abortion's effect on gonorrhea incidence may reflect differences between Blacks and Whites in the response to the early repeal of abortion laws. Some of the disparity may be accounted for by the migration of higher income whites from *Roe* to states where abortion had been legalized. Insofar as individuals in *Roe* states traveled to repeal states during 1970–1973 period because of its unavailability in the residence state, our DD estimates are biased toward zero.[12] At the same time, Blacks were more likely to initiate elective abortions in the 1970s following abortion repeal (Gruber et al., 1999). Another possible explanation is that the marginal aborted child was far more likely to have been centrally important in the Black STI network (see Ballester et al., 2006). In 1990, gonorrhea

12. Joyce et al. (2009) shows that prior to *Roe v. Wade*, a large number of pregnant women traveled to New York for elective abortions.

incidence among 15–19 year-old Black females was 5,072 per 100,000, but only 267 per 100,000 for White females of the same age, a difference of almost 20-fold. Thus, the probability that a child aborted in the early 1970s might have been a "key player" in the spread of gonorrhea is considerably higher for Black females.

4. Conclusion

There is a growing literature on the effects of abortion legalization on a range of fertility outcomes. The now-famous paper by Donohue and Levitt (2001) (DL01), linking abortion to the decline in crime in the 1990s, has shifted the focus to non-fertility outcomes. The shift is not without controversy. The DL01 story has been questioned by a number of recent examinations of their work. The most prominent critique has come from Joyce (2009), who argues if Donohue and Levitt are right, the abortion legalization hypothesis should be confirmed for many other "bad" cohort outcomes.

Our contribution is to test the abortion-legalization hypothesis on STIs. Whatever characteristics of the marginal (unborn) child make him more susceptible to crime, could also make him more likely to engage in risky sexual behavior that leads to disease transmission. We focus on gonorrhea in this paper because its symptoms appear soon after infection making the disease closely contemporaneous with sexual activity.

Exploiting the states that legalized abortion prior to *Roe* as a quasi-experiment, we estimate the effect of abortion on gonorrhea incidence in the treated birth cohort 15–19 years later. We argue that the abortion's effect on gonorrhea should show up in two ways. First, there should be lower incidence among 15–19-year-olds in the repeal states during the 1986–1992 period relative to their *Roe* state counterparts. Second, the treatment effect should be u-shaped, rising in magnitude as the treated cohorts in the repeal states come of age fully in 1988, and then falling as the first 15-year-olds born under *Roe* enter the sample. Using gonorrhea data from the CDC, we find strong support for this argument among Blacks, especially Black women. The evidence is weaker for Whites. For Blacks, our DD results suggest that abortion reduced gonorrhea incidence in the early-repeal states in a manner consistent with the predicted u-shaped pattern. For example, in the

Black female case, we report statistically significant estimated treatment effects of 15% at the beginning of the treatment window, rising to 43% in 1989 and falling to 30% in 1991. Our findings generally stand up to a comparison with 25–29-year-olds who would not have been affected by effects of early repeal. The estimated treatment effects from the DDD analysis are u-shaped, with the largest magnitudes appearing in the middle of the treatment window. In the peak year, Black female gonorrhea incidence among 15–19-year-olds is 38% lower relative to the older cohort.

References

Ahituv, Avner V., Joseph Hotz, and Tomas Philipson. 1996. "The Responsiveness of the Demand for Condoms to the Local Prevalence of AIDS," 31 *Journal of Human Resources* 869–897.

Angrist, Joshua D., and William Evans. 1999. *Research in Labor Economics*, vol. 18. Schooling and Labor Market Consequences of the 1970 State Abortion Reforms. Amsterdam: Elsevier, pp. 75–113.

Ballester, Coralio, Antoni Calvo-Armengol, and Yves Zenou. 2006. "Who's Who in Networks. Wanted: The Key Player," Unpublished Manuscript.

Black, Sandra E., Paul J. Devereux, and Kjell G. Salvanes. 2005. "The More the Merrier? The Effect of Family Size and Birth Order on Children's Education," 120 *Quarterly Journal of Economics* 669–700.

Cameron, Colin A., Jonah B. Gelbach, and Douglas L. Miller. 2008. "Bootstrap-Based Improvements for Inference with Clustered Errors," 90 *Review of Economics and Statistics* 414–427.

Carpenter, Christopher. 2005. "Youth Alcohol Use and Risky Sexual Behavior: Evidence from Underage Drunk Driving Laws," 24 *Journal of Health Economics* 613–628.

Charles, Kerwin Kofi, and Melvin Stephens. 2006. "Abortion Legalization and Adolescent Substance Use," 49 *Journal of Law and Economics* 481–505.

Chesson, Harrell W., Paul Harrison, and William J. Kessler. 2000. "Sex Under the Influence: The Effect of Alcohol Policy on Sexually Transmitted Disease Rates in the United States," 43 *Journal of Law and Economics* 215–238.

Chesson, Harrell W., Thomas S. Dee, and Sevgi O. Aral. 2003. "AIDS Mortality May Have Contributed to the Decline in Syphilis Rates in the United States in the 1990s," 30 *Sexually Transmitted Diseases* 419–424.

Currie, Janet, and Enrico Moretti. 2003. "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings," 4 *Quarterly Journal of Economics* 1495–1532.

Donohue, John J., and Steven D. Levitt. 2001. "The Impact of Legalized Abortion on Crime," 116 *Quarterly Journal of Economics* 379–420.

Donohue, John J., and Steven D. Levitt. 2004. "Further Evidence that Legalized Abortion Lowered Crime: A Reply to Joyce," 39 *Journal of Human Resources* 29–49.

Donohue, John J., and Steven D. Levitt. 2008. "Measurement Error, Legalized Abortion, the Decline in Crime: A Response to Foote and Goetz (2005)," 123 *Quarterly Journal of Economics* 425–440.

Donohue, John J., Jeff Grogger, and Steven D. Levitt. 2009. "The Impact of Legalized Abortion on Teen Childbearing," 11 *American Law and Economics Review* 24–46.

Edlin, B. R., K. L. Irwin, S. Faruque, C. B. McCoy, C. Word, Y. Serrano, J. A. Inciardi, B. P. Bowser, R. F. Schilling, and S. D. Holmberg. 1994. "Intersecting Epidemics—Crack Cocaine Use and HIV Infection Among Inner-City Young Adults," 331 *New England Journal of Medicine* 1422–1427.

Foote, Christopher L. and Christopher F. Goetz. 2008. "The Impact of Legalized Abortion on Crime: Comment," 123 *Quarterly Journal of Economics* 407–423.

Francis, Andrew. 2008. "The Economics of Sexuality: The Effect of HIV/AIDS on Homosexual Behavior in the United States," 27 *Journal of Health Economics* 675–689.

Fryer, Roland, Paul Heaton, Steven Levitt, and Kevin Murphy. 2013. "Measuring Crack Cocaine and Its Impact," *Economic Inquiry*, Forthcoming. doi:10.1111/j.1465-7295.2012.00506.x

Grogger, Jeff, and Michael Willis. 2000. "The Emergence of Crack Cocaine and the Rise in Urban Crime Rates," 82 *Review of Economics and Statistics* 519–529.

Grossman, Michael, Sara Markowitz, and Robert Kaestner. 2004. "Get High and Get Stupid: The Effect of Alcohol and Marijuana Use on Teen Sexual Behavior," 2 *Review of the Economics of the Household* 413–441. Review of the Economics of the Household.

Gruber, Jonathan, Phillip B. Levine, and Douglas Staiger. 1999. "Abortion Legalization and Child Living Circumstances: Who is the "Marginal Child"?" 114 *Quarterly Journal of Economics* 263–291.

Holmes, King K., P. Frederich Sparling, Per-Anders Mardh, Stanley M. Lemon, Walter Stamm, Peter Pio, and Judith N. Wasserheit. 1999. *Sexually Transmitted Diseases*. 3rd ed. New York: McGraw-Hill Professional.

Jones, D. L., K. L. Irwin, J. Inciardi, B. Bowser, R. Schilling, C. Word, P. Evans, S. Faruque, H. V. McCoy, and B. R. Edlin. 1998. "The High-Risk Sexual Practices of Crack-Smoking Sex Workers Recruited from the Streets of Three American Cities," 25 *Sexually Transmitted Diseases* 187–193.

Joyce, Ted. 2004. "Did Legalized Abortion Lower Crime?" 39 *Journal of Human Resources* 1–28.

Joyce, Ted. 2009. “A Simple Test of Abortion and Crime,” 91 *Review of Economics and Statistics* 112–123.

Joyce, Ted, Ruoding Tan, and Yuxin Zhang. 2010. “Changes in Teen Fertility Following Access to the Pill and Abortion in the Early 1970s,” Unpublished Manuscript.

Klick, Jonathan, and Thomas Stratmann. 2003. “The Effect of Abortion Legalization on Sexually Transmitted Diseases,” 32 *Journal of Legal Studies* 407–433.

Levine, Phillip B. 2004. *Sex and Consequences: Abortion, Public Policy, and the Economics of Fertility*. 1st ed. Princeton, NJ: Princeton University Press.

Levine, Phillip B., Douglas Staiger, Thomas J. Kane, and David J. Zimmerman. 1999. “Roe v. Wade and American Fertility,” 89 *American Journal of Public Health* 199–203.

Levitt, Steven D. 2004. “Understanding Why Crime Fell in the 1990s: Four Factors that Explain the Decline and Six that Do Not,” 18 *Journal of Economic Perspectives* 163–190.

Newcomer, Susan F., and J. R. Udry. 1984. “Mothers’ Influence on the Sexual Behavior of Their Teenage Children,” 66 *Journal of Marriage and the Family* 477.

Ozbeklik, Serkan. 2006. “The Effect of Abortion Legalization on Teenage Out-of-Wedlock Childbearing in Future Cohorts,” IEPR University of Southern California Working Paper 06.50.

Ratner, Mitchell S. (ed.). 1993. *Crack Pipe as Pimp: An Ethnographic Investigation of Sex-for-Crack Exchanges*. New York: Lexington Books.

Rolfs, Robert T., Martin Goldberg, and Robert G. Sharrar. 1990. “Risk Factors for Syphilis: Cocaine Use and Prostitution,” 80 *American Journal of Public Health* 853–858.

Santelli, John, Richard Lowry, Nancy Brener, and Leah Robin. 2000. “The Association of Sexual Behaviors with Socioeconomic Status, Family Structure, and Race/Ethnicity Among US Adolescents,” 90 *American Journal of Public Health* 1582–1588.

Sionean, Catlainn, Ralph J. Diclemente, Gina M. Wingood, Richard Crosby, Brenda Cobb, Kathy Harrington, Susan Davies, Edward Hook, and Kim Oh. 2001. “Socioeconomic Status and Self-reported Gonorrhea Among African American Female Adolescents,” 28 *Sexually Transmitted Diseases* 236–239.