ESSPRI Working Paper Series Paper #20161

The Effect of State Mandated Sex Education on Teenage Sexual Behaviors and Health

Economic Self-Sufficiency Policy Research Institute

Brittany Bass
University of California, Irvine

11-27-2016

The Effect of State Mandated Sex Education on Teenage Sexual Behaviors and Health

Brittany Bass

November 27, 2016

1 Introduction

The debate over school based sex education in the United States is centered on two major questions: do schools have a responsibility to teach students about issues related to sex, and if schools do teach sex education, what type of information should be presented? In the mid-1980s, once it was recognized that AIDS could be spread via sexual intercourse, Surgeon General Everett Koop called for increased sex education in schools beginning as early as third grade. Using data from multiple sources, including the Youth Risk Behavioral Surveys, National Vital Statistics, and the CDC's Wonder statistics on STDs, this study presents the first examination of the effect of state-level sex education mandates on teenage sexual behavior, STDs, and birth rates.

The primary goal of school based sex education is to help young people build a foundation to mature into sexually healthy adults by assisting them in understanding a positive view of sexuality, providing them with information and skills for taking care of their sexual health, and promoting youth to make sound decisions now and in the future (Bridges

and Hauser, 2014). Sex education programs are viewed as an informational policy tool intended to reduce the future costs of sexually transmitted diseases and teen pregnancy (Sabia, 2006).

Sexually transmitted diseases (STDs) are a severe public health problem in the United States. STDs cause harmful, often irreversible, and costly complications, especially among females (Nations, 1995). There are approximately 20 million new STD infections each year. Nearly half of these infections are among young people ages 15 to 24, who represent only twenty-five percent of the sexually active population. The estimated cost to the US health care system from these new infections is $16 billion annually, including HIV and HPV (human papillomavirus) diagnoses (of STD Prevention, 2014). Among the non-viral STDs, chlamydia is the most common and costly infection, estimated at almost $517 million in annual health care costs (Owusu-Edusei Jr et al., 2013).

The economic costs of teenage childbearing are sizable, especially for taxpayers and society as a whole. Several studies have found that teen childbearing is associated with declines in human capital attainment or future earnings for the teen mother (Angrist and Evans, 1999; Bronars and Grogger, 1994). However, the causal link remains unclear. By exploiting a 'natural experiment' associated with human reproduction, i.e. a miscarriage, Hotz et al. (1997) find little evidence that teenage childbearing harms teen mother's socioeconomic outcomes. Their results fail to rule out the possibility that early childbearing adversely affects the fathers of children born to teen mothers, and the children themselves. Evidence suggests that men who father children of teen mothers would have had substantially higher incomes had they delayed childbearing. Additionally, children of teenage mothers tend to fare poorly compared to children born to older mothers (Hoffman and Maynard, 2008).

As the level of concern over teenage pregnancy and STDs as an economic, and public

health issue has increased over time, states implemented and encouraged the teaching of sex education. Currently, 24 states and Washington DC mandate school based sex education, albeit with considerable heterogeneity in the timing and comprehensiveness of the mandates adopted. While some states' sex education programs are comprehensive in nature, including information on adolescent development, conception and pregnancy, abstinence and contraception effectiveness, others are solely abstinence-based. By exploiting within-state variation in sex education mandates from 1991-2013, difference-in-difference results suggest that the typical state sex education mandate increases teenage condom use by 3%, and decreases teenage chlamydia rates by 8%. A back-of-the-envelope calculation suggests that the 8% decrease in chlamydia rates results in $43 million in savings for annual STD care costs. Exploring the policy heterogeneity with respect to abstinence-only and comprehensive requirements within a states' sex education law, the results generally point to no differential effect of abstinence-only and comprehensive teaching on teenage sexual behavior.

2 Background

Support for sex education began in the late 1800s when mass public campaigns promoted the 'regulation of sexuality' and emphasized risk-reduction practices and health care prevention in response to cholera and syphilis epidemics (for Youth, 2008). Momentum continued throughout the early and mid-1900s, until opposition towards sex education began to be organized by the John Birch Society, Christian Crusade, Parents Opposed to Sex and Sensitivity Education, among others. By the early 1970s, twenty states had voted to restrict or abolish sexuality education. Then, beginning in the 1980s, concerns over teen pregnancy and HIV/AIDS motivated widespread public support for sex education in

schools (Guttmacher Institute, Sex and HIV Education, 2016). As a response, the Reagan administration began federal funding for abstinence-only-until-marriage programs, which gained momentum during the 1990s and early 2000s. Since 1997, Congress has funneled over $1.5 billion into abstinence-only programs.

Federal funds for such programs began easing after a report by Mathematica Policy Research was released in 2007 that found abstinence-only programs had no effect on sexual behavior outcomes (Trenholm et al., 2007). In 2014, at the request of the Obama administration, Congress provided $185 million for medically accurate and age-appropriate sex education programs. In his proposed federal budget for 2017, President Obama removed all funding for abstinence-only education. Although the federal government has provided funding for sex education programs, there is no federal law or policy that requires sex education to be taught in schools. Rather, the decision to mandate school based sex education is left up to the state and local school districts.

According to the National Sexuality Education Standards (NSES), a representative school based sex education mandate should include information on seven key components: anatomy and physiology, puberty and adolescent development, identity, pregnancy and reproduction, sexually transmitted diseases and HIV, healthy relationships, and personal safety. However, the general requirements for school based sex education courses vary significantly across states. Some states require abstinence-based sex education, which stresses or covers the importance of abstinence from sexual intercourse until marriage and includes no information on contraceptives, while other states are comprehensive in nature providing information that is closely aligned with NSES's seven components (refer to Table 1).

How might school based sex education affect teenage sexual behavior? Rational individuals become sexually active at the first age at which the perceived benefits from sexual intercourse surpass the perceived costs (Oettinger, 1999). If sex education teaches

teenagers about the costs associated with pregnancy and sexually transmitted diseases, including mental, physical, and monetary costs, their expected costs and benefits of engaging in sexual behaviors may be altered. However, sex education should only affect teens' perceptions about sex, and their sexual behaviors, to the extent that it presents new information. This new information could be presented in multiple ways. School based sex education typically takes one of two forms: abstinence-based or comprehensive.

Courses that are primarily focused on abstinence typically stress that students should abstain from sexual activity until after marriage, abstinence from sex is the only 100% effective way to avoid unwanted pregnancy, STDs and HIV, conceiving a child out of wedlock is likely to have harmful consequences for the child, the child's parents and society, and failure rates associated with condom use (Alford, 2001). Abstinence-based sex education should have no effect on the sexual behavior of teens who wish to remain abstinent. For teens who prefer sexual activity but wish to avoid a pregnancy, abstinence-based education should decrease the level of sexual activity and reduce the risk of pregnancy, due to possible declines in the frequency of sexual activity. For teens who want to incur a pregnancy, abstinence-based sex education should have no effect on the current level of sexual activity or risk of pregnancy. Prior studies have found that abstinence-based sex education is not associated with a reduction in the likelihood of having sexual intercourse, and is associated with an increase in pregnancy rates among teens (Haffner, 1997; Kirby, 2008; Kohler et al., 2008; Stanger-Hall and Hall, 2011).

Comprehensive sex education courses tend to be age-appropriate, and include medically accurate information on topics like human development, relationships, decision making, abstinence, contraception, and disease prevention (Alford, 2001). Again, for teens who prefer to remain abstinent, comprehensive education should have no effect on their sexual behavior. For teens who prefer sexual activity but want to avoid a pregnancy, comprehensive sex

education should decrease the risk of pregnancy or STDs for any level of sexual activity, by, for example, increasing contraception use. For teens who desire a pregnancy, comprehensive sex education should increase the risk of pregnancy for any given level of sexual activity, and increase the fraction of teens who choose to be sexually active. The previous literature examining the effect of comprehensive sex education on teenage sexual behaviors finds that condom and contraception use increases, teen pregnancy decreases, and the initiation of sexual intercourse decreases (Kirby, 2008; Kohler et al., 2008; Stanger-Hall and Hall, 2011; Starkman and Rajani, 2002).

Recall that sex education should only affect teens sexual behaviors to the extent that it presents new information. Sex education should have a greater impact on teens who gain a lot of new information, such as teens without low-cost alternative sources of sexual information (Oettinger, 1999). Older teenagers, those 16 and up, are more likely to have a drivers license, a job, and better access to media, all of which can provide more opportunities to engage in sexual activity. Additionally, teens with older siblings and higher levels of peer interaction are likely to have more information about sex than those without such low-cost sources. Therefore, younger teenagers, those without older siblings, and those with less peer interactions are more likely to be affected by new information provided by sex education.

Does this new information provided by sex education affect teenagers knowledge of sex? If so, does this increase in knowledge affect their sexual behaviors? Several studies have shown that sex education programs have increased teenagers' knowledge about sexual health issues (Eisen and Zellman, 1986; Kim et al., 1997; Reichelt and Werley, 1975; Sanderson, 2000). Kim et al. (1997) and Dupas (2011) connect the dots and find that sex education programs not only increase teens' knowledge about sex, but also effects their sexual behaviors.

The empirical work on sex education is extensive, and has attempted to provide a clearer understanding of the potential tradeoff in sexual education. However, the results of the studies discussed above should be interpreted with caution. A causal interpretation of the results regarding abstinence-based versus comprehensive sex education is hindered by the cross-sectional nature of the studies (Haffner, 1997; Kohler et al., 2008; Stanger-Hall and Hall, 2011; Starkman and Rajani, 2002), or the lack of external validity associated with the randomized control trials targeted toward at-risk populations (Dupas, 2011; Kim et al., 1997; Kirby, 2008; Kirby et al., 2007)[1].

This study contributes to the existing literature in several ways. First, I exploit the within-state variation in state sex education mandates to estimate their effect on teenage sexual behaviors – an identification strategy superior to the cross-sectional identification employed in prior studies. Importantly, I attempt to assess the credibility of the common trends assumption of my identification strategy through an event-study like exercise, which the previous literature fails to address. Second, my primary analysis uses data drawn from repeated cross-sections of both the National and State Youth Risk Behavior Surveys (YRBS) from 1991 to 2013, a dataset yet to be used to examine the effect of sex education on teen sexual behaviors. The use of individual-level data allows me to estimate the effect of sex education on finer measures of teenage sexual behaviors, such as sexual activity, condom use or contraception use at last sex, and the age at which a student exits out of virginity status. Finally, this study is the first to explore whether the effect of school based sex education extends to teenage STD rates.

[1]Kirby (2008) conducted an exhaustive review of 56 studies that assessed the impact of abstinence-based and comprehensive sex and HIV education on adolescent sexual behavior

3 Data and Measures

3.1 Data

My primary analysis will use data drawn from two sources. First, I use repeated cross-sections of both the National and State Youth Risk Behavior Surveys (YRBS) from 1991 to 2013. The National YRBS is conducted biennially by the Centers for Disease Control and Prevention (CDC) and, when weighted, is representative of the population of U.S. high school students. The State YRBS surveys are also administered to high school students and contain most of the questions in the NYRBS. While the state surveys are coordinated by the CDC, they are usually conducted by state education and health agencies. The augmentation of national with state YRBS data has been employed in a number of recent studies examining the effects of many state-level public policies - cigarette taxes (Hansen et al., 2013), medical marijuana laws (Anderson et al., 2015), and parental involvement laws for abortion (Sabia and Anderson, 2014) - on risky behaviors. The YRBS is well suited for this study because it contains data on several measures of student sexual behaviors, including initiation of sex, condom and contraception use, and number of sexual partners. Second, I use state-level chlamydia and birth rates for 15 to 19 year olds were obtained from the CDC's Wonder statistics on STDs, and I supplement with data from the National Vital Statistics, respectively, to estimate the effect of sex education mandates on teenage STD and birth rates.

3.2 YRBS Survey Outcome Measures

Using the YRBS data, I identify four key measures of teenage sexual activity. First, I measure whether or not a student has ever had sex using answers to the following survey

item:

Have you ever had sex?

I generate a binary variable, *HadSex*, set equal to 1 if the student indicated they had ever had sex, and zero otherwise. I find that 48 percent of the sample indicated they have had sexual intercourse (see Table 2).

Next, respondents were asked about condom and contraception use the last time they had sexual intercourse. Specifically, they answered the following questions:

The last time you had sexual intercourse, did you or your partner use a condom?

The last time you had sexual intercourse, what one method did you or your partner use to prevent pregnancy?

Binary variables were created to measure condom and contraception use, *CondomUse*, *ContraceptionUse*, and *FDAMethod*. *CondomUse* was coded equal to 1 if the respondent indicated they had used a condom at last sex, and zero otherwise. *ContraceptionUse* was coded equal to 1 if the respondent indicated they had used any kind of birth control method at last sex, including a condom, and zero otherwise. Specifically, they could select among the following options: no method, birth control pills, condoms, an IUD or shot, patch, or birth control ring, and withdrawal or some other method. Finally, *FDAMethod* was set equal to 1 if the respondent indicated they had used any kind of FDA-approved contraception (birth control pills, an IUD or shot, patch, or birth control ring), excluding condoms. All condom and contraception use variables are conditional on having had sexual intercourse. According to the sample, 52 percent of students indicated using a condom at last sex, while 71 percent indicated using a method of birth control at last sex, and 18 percent used an FDA-approved contraception method. Figure 1, panel (a) shows national trends for each of the above outcomes during the 1991-2013 period indicating that teenage sexual

activity has decreased, while contraception use has somewhat increased during the time states were enacting sex education mandates.

3.3 Health Outcomes

Though the YRBS is rich with individual level sexual behavior data, the surveys fail to ask students questions regarding sexually transmitted diseases. According to the CDC's Division of STD Prevention, young people ages 15 to 24 are at a higher risk of acquiring an STD, especially chlamydia. Since many chlamydia infections go unnoticed and undiagnosed, the result of such a disease can be severe, specifically for a woman's reproductive health (Newsroom). State-level chlamydia rates for 15-19 year olds, per 1,000, for 1996-2014 were obtained from the CDC's STD Surveillance Data[2]. This data are derived from information from the official statistics for the reported occurrence of nationally notifiable STDs in the United States, test positivity and prevalence data from numerous prevalence monitoring initiatives, sentinel surveillance, and national health care services surveys (CDC, 2015). Additionally, data on pregnancies and the outcome of such pregnancies is not available in the YRBS. Thus, I obtain state-level birth rates for 15 to 19 year old females for the years 1991-2013 from the National Vital Statistics. Figure 1, panel (b) shows national trends for teenage chlamydia and birth rates from 1995-2013 and 1991-2013, respectively, reflecting a decline in teenage birth rates, and an increase in teenage chlamydia rates.

3.4 Sex Education Mandates

I begin by generating a binary sex education variable, *SexEd*, that measures whether a state had enacted and was enforcing a sex education mandate. Information about sex

[2]These data can be found at http://wonder.cdc.gov/std-race-age.html. Prior to 1996, STD rates were not available by age brackets

education effective dates was obtained from multiple sources. Policy information from 1991 to 2000 for each state was retrieved from numerous volumes of the SIECUS (Sexuality Information and Education Council of the United States) Report. The SIECUS Report was published from 1972 to 2005, and includes scholarly articles, opinion pieces, policy information, and other works regarding sexuality information and education (SIECUS). Sex education mandates from 2001 to 2013 were collected from the Guttmacher Institute State Policies in Brief: Sex and HIV Education publications, which contain detailed sex education policy information at the state level. Throughout the sample period, 20 states mandated sex education (refer to Table 1).

Given the substantial heterogeneity in the type of sex education mandate enacted by each state, SIECUS Reports and the Guttmacher Institute (GI) categorize these mandates by their comprehensiveness and requirements. Given the debate about what type of sex education should be offered in schools among policymakers, identifying the most effective type of sex education, whether it be abstinence-based or more comprehensive in nature, is critical. I use the SIECUS and GI reports from 1995-2013[3] to indicate whether a state mandating sex education requires abstinence-based education, or comprehensive sex education. I generate a binary indicator, *Abstinence*, and *Comprehensive*, that measures whether a state already enacting a sex education mandate requires the teaching of abstinence-based education or comprehensive education. Ten states that mandate sex education include abstinence-based education, while 11 states mandating sex education require a comprehensive curriculum (refer to Table 1).

[3]Information regarding the components of a state's sex education mandate was not available prior to 1995

4 Empirical Approach

My econometric approach will estimate a reduced form difference-in-difference model that takes the form:

$$Y_{ist} = \alpha + \beta SexEd_{st} + \delta' X_{ist} + \gamma' Z_{st} + \theta_s + \tau_t + \epsilon_{ist} \quad (1)$$

where i indexes the individual, s indexes the respondent's state, and t indexes the survey year. Y_{ist} is a measure of individual teenage sexual behavior, including ever had sexual intercourse, condom use during last sex, and contraceptive use during last sex[4]. $SexEd_{st}$ is an indicator for whether a sex education mandate was in effect in state s at year t. The vector X includes individual level controls, including age, race, gender, and grade level; the vector Z includes state level economic and policy controls, including the unemployment rate, per capita income, beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Finally, θ_s and τ_t are state and year fixed effects.

Identification of the variable of interest, β, comes from within-state variation in sex education mandates during the 1991-2013 sample period (see Table 1). To produce unbiased estimates of β in the equation above, the parallel trends assumption of difference-in-difference models must be satisfied. This may be violated if, for example, states enact sex education mandates in response to unfavorable teenage sexual behaviors, STD or birth rate trends, or if there are time-varying state characteristics not captured in state-specify time-varying economic and policy controls that are associated with both the adoption of sex education mandates and with the outcomes under study. To address the potential policy endogeneity, I test whether sex education mandates were implemented in response

[4]Chlamydia rates are obtained at the state level, thus Equation 1 can be modified as: $Y_{st} = \alpha + \beta SexEd_{st} + \gamma' Z_{st} + \theta_s + \tau_t + \epsilon_{st}$

to pre-existing teenage sexual behavior trends with the following event study specification:

$$Y_{ist} = \mu + \sum_{\tau=\leq -4}^{\geq 7} \sigma_\tau I(t - t_0 = \tau)_{st} + \delta' X_{ist} + \gamma' Z_{st} + \theta_s + \tau_t + \epsilon_{ist}, \tag{2}$$

where $I(t - t_0 = \tau)$ is an indicator equal to 1 if the observation is τ years away from the implementation of the sex education mandate, and zero otherwise[5].

The coefficient β in Equation 1 gives the average effect of a sex education mandate on the outcomes under study. Using only this treatment variable, heterogeneity across states' sex education mandates is omitted. The type of sex education offered is important, especially from a policy perspective. Therefore, I re-estimate Equation 1 above by including the policy variable *Abstinence*, or *Comprehensive* which indicates whether a states' sex education mandate requires the teaching of abstinence-based education or comprehensive education. Identification of ϕ comes from within-state variation in states' mandates that require abstinence-based or comprehensive sex education from 1995-2013[6].

$$Y_{ist} = \alpha + \beta SexEd_{st} + \phi EducRequirement_{st} + \delta' X_{ist} + \gamma' Z_{st} + \theta_s + \tau_t + \epsilon_{ist} \tag{3}$$

where *EducRequirement* indicates either abstinence-based or comprehensive education. It may be the case that states begin requiring schools to teach about abstinence versus contraception in response to trends in teenage STD rates, pregnancy rates, and other risky sexual behaviors. If this is so, the estimated effect of the education requirements on teenage sexual behaviors will be biased. Therefore, the type of sex education provided should be

[5]Equation 2 can be modified to account for state-level STD data:

$$Y_{st} = \mu + \sum_{\tau=\leq -4}^{\geq 7} \sigma_\tau I(t - t_0 = \tau)_{st} + \gamma' Z_{st} + \theta_s + \tau_t + \epsilon_{ist}$$

.

[6]See Table 1

uncorrelated with pre-treatment trends in the outcomes. This assumption can be tested using a similar event study specification as discussed above[7].

Main estimation results are shown in Tables 3 through 7. All models present effects from linear probability models, and standard errors are clustered at the state level.

5 Results

Table 3 presents the results from Equation 1 for the effect of any state sex education (*SexEd*) mandate on measures of teenage sexual behavior. Difference-in-difference estimates indicate that the typical state sex education mandate increases the probability of condom use by about 3 percent (0.016/0.524), and increases the probability of contraception use by 2.3 percent (0.016/0.707). Sex education mandates appear to have no effect on FDA-approved contraception methods, suggesting that condom use is driving the contraception use result. Additionally, sex education mandates have no statistically significant effect on the probability of engaging in sexual intercourse. The precision of the estimate is such that I can rule out, with 95 percent confidence, the probability of sexual activity decreasing by more than 1.8 percent, and increasing by more than 4.7 percent. The estimates imply that teens are not engaging in any more sexual activity, but are increasing their use of contraceptives, specifically condoms.

A causal interpretation of the effect of state mandated sex education on teenage sexual behaviors can be supported by the event study figures presented in Figure 2. Panels a-f show the estimates of α from Equation 2 on all individual-level outcomes from the YRBS, and teen chlamydia and birth rates. The points in the plots give the estimate of α, while

[7]Modification of Equation 3 to account for state-level STD data is: $Y_{st} = \alpha + \beta SexEd_{st} + \phi EducRequirement_{st} + \gamma' Z_{st} + \theta_s + \tau_t + \epsilon_{ist}$

the lines extending from them represent 95% confidence bounds that are calculated using standard errors clustered at the state level. There exists no evidence of pre-treatment trends in any of the outcome measures, except for sexual activity and teen birth rates. In order to control for the pre-treatment trends in sexual activity and birth rates, a state-specific linear time trend is added to Equation 2 to account for unmeasured state trends unfolding linearly. Figure 3, panels (a) and (b) show the estimates of α from Equation 2 on sexual activity and teen birth rates. Once the state-specific time trend is included, the pre-trends are no longer statistically significant at the 95 percent level.

To assess the robustness of the results in Table 3, Appendix Table 1 adds a state-specific time trend to Equation 1. The results suggest that state-level sex education mandates have no significant impact on teenage sexual behaviors. However, the precision of the estimates on sexual activity, condom use and contraception use is such that I can rule out, with 95 percent confidence, the probability of sexual activity, and teenage condom or contraception use decreasing by more than 1.7 percent, and increasing by more than 4 percent.

Table 4 presents the results for the effect of sex education by age, since it may be the case that younger teenagers (12-14 years old) respond more to school based sex education due to a higher degree of new information being obtained. However, the estimates in Table 4 fail to confirm that hypothesis, and indicate that older teens, those 15 to 18 respond more to sex education. Condom use and contraception use increase by 3.1 percent and 2.1 percent, respectively. Recall, however, that condom use, contraception use, and FDA-approved contraception use are all conditional on having had sexual intercourse. According to a national sex study done by researchers at Indiana University, younger teens engage in oral sex significantly more than vaginal intercourse (Herbenick et al., 2010). Thus, it is not surprising that sex education does not significantly affect condom and/or contraception use for younger teens.

Additionally, it may be the case that length of exposure to school based sex education affects teenage sexual behaviors. Those who have been exposed to sexual health information for longer periods of time may be affected more than those most recently exposed. This effect may only exist if the education being provided is new, and teens are updating their sexual health information. Since younger teens could have only been in high school at most one or two years, this analysis is focused on teens ages 16 to 18. The results for length of exposure to sex education are presented in Appendix Table 4. Older teens exposed to sex education for more than 1 year significantly increase their condom and contraception use. The improved sexual behavior effects for older teens may take time to unfold due to teens potentially gaining new information, updating their knowledge, and eventually changing their behavior.

Given the significant effect of the typical sex education mandate's effect on teenage condom and contraception use at last intercourse, it is useful to explore whether this effect translates to teenage STD and birth rates. Table 5 presents the results for any sex education mandate on chlamydia and birth rates, per 1,000, for teenagers ages 15-19 for 1996-2013 and 1991-2013, respectively. The estimates suggest that school based sex education mandates decreases chlamydia rates by 8.4 percent, and has no significant effect on the teenage birth rate. Falsification tests on chlamydia rates for older young adults ages 20-24 for the years 1996-2013 are presented in Appendix Table 3. There is no evidence that school based sex education mandates effect chlamydia rates for young adults who should be unaffected by the passing of such laws. The significant decrease in chlamydia rates is substantial, given that the estimated direct medical costs for treating young people with sexually transmitted diseases is $16 billion annually, excluding costs associated with HIV/AIDS (CDC, 2013). Furthermore, among the non-viral STDs, chlamydia is the most common and costly infection, estimated at almost $517 million in annual health care costs

(Owusu-Edusei Jr et al., 2013). A back-of-the-envelope calculation estimates that the annual savings associated with an 8.4 percent decrease in chlamydia rates is roughly $43 million.

While the average school based state sex education mandate appears to have a significant positive effect on teenage condom and contraception use, and chlamydia rates, I next explore whether there may be heterogeneity in the effect of sex education by type of law implemented. Tables 6 and 7 present the results from Equation 3 for abstinence-based and comprehensive sex education on teenage sexual behaviors, and teen STD and birth rates, respectively. The results imply that there is no significant differential effect of abstinence-based or comprehensive sex education to the typical school based sex education mandate. This may suggest that the type of school based sex education does not differentially affect teenage sexual activities, but simply being exposed to *any* information regarding sexual health alters teens' behaviors[8].

6 Conclusion

Given the intense policy debate over school based sex education, credible estimates of the causal link between sex education and teenage sexual behaviors are needed. Despite the exhaustive literature examining the effect of sex education on adolescent sexual behaviors, the effect of state-level sex education mandates on sexual behavior has not been studied in a way that allows for a causal interpretation of the results. This study presents the first examination of the relationship between school based sex education and teenage sexual behavior using within-state variation in sex education mandates from 1991-2013. Difference-in-difference results suggest that the typical state sex education mandate in-

[8]Event study figures for comprehensive and abstinence-based sex education are presented in Figures 4 and 5 in the Appendix, respectively.

creases the probability of condom use and contraception use by 3 percent and 2.3 percent, respectively, and decreases the chlamydia rate among teens ages 15 to 19 by 8 percent. A causal interpretation of the results is supported by the event study exercise that indicates no pre-trends were present before the implementation of a sex education mandate, and the falsification test on chlamydia rates of older young adults, for whom school based sex education mandates do not bind. When heterogenous types of sex education are analyzed, I find that abstinence-based and comprehensive sex education have no differential effect on teenage sexual behaviors.

Is school-based sex education cost effective? The typical cost for a school-based sex education curriculum is roughly $200 (NARAL, 2009). In 2012, there were approximately 27,000 US public secondary schools (NCES, 2012). If each of these schools implemented a sex education curriculum, it would cost around $5.4 million annually to educate teens about sex. Given the $43 million in annual STD savings, clearly the benefits of implementing sex education outweigh the costs.

References

Alford, S. (2001). Sex education programs: Definitions and point-by-point comparison. Technical report, Advocates for Youth.

Anderson, D. M., Hansen, B., and Rees, D. I. (2015). Medical marijuana laws and teen marijuana use. *American Law and Economics Review*, 17(2):495–528.

Angrist, J. D. and Evans, W. N. (1999). Schooling and labor market consequences of the 1970 state abortion reforms. *Research in labor economics*, 18:75–113.

Bridges, E. and Hauser, D. (2014). Youth health and rights in sex education.

Bronars, S. G. and Grogger, J. (1994). The economic consequences of unwed motherhood: Using twin births as a natural experiment. *The American Economic Review*, pages 1141–1156.

CDC (2013). Incidence, prevalence, and cost of sexually transmitted infections in the united states. Online.

CDC (2015). Interpreting std surveillance data.

Dupas, P. (2011). Do teenagers respond to hiv risk information? evidence from a field experiment in kenya. *American Economic Journal: Applied Economics*, 3(1):1–34.

Eisen, M. and Zellman, G. L. (1986). The role of health belief attitudes, sex education, and demographics in predicting adolescents' sexuality knowledge. *Health Education & Behavior*, 13(1):9–22.

for Youth, A. (2008). History of sex ed.

Haffner, D. W. (1997). Whats wrong with abstinence-only sexuality education programs? *SIECUS report*, 25(4):9–13.

Hansen, B., Rees, D. I., and Sabia, J. J. (2013). Cigarette taxes and how youth obtain cigarettes. *National Tax Journal*, 66(2):371–394.

Herbenick, D., Reece, M., Schick, V., Sanders, S. A., Dodge, B., and Fortenberry, J. D. (2010). Sexual behavior in the united states: results from a national probability sample of men and women ages 14–94. *The journal of sexual medicine*, 7(s5):255–265.

Hoffman, S. D. and Maynard, R. A. (2008). *Kids having kids: Economic costs & social consequences of teen pregnancy*. The Urban Insitute.

Hotz, V. J., McElroy, S. W., and Sanders, S. G. (1997). The impacts of teenage childbearing on the mothers and the consequences of those impacts for government. *Kids having kids: Economic costs and social consequences of teen pregnancy*, pages 55–94.

Kim, N., Stanton, B., Li, X., Dickersin, K., and Galbraith, J. (1997). Effectiveness of the 40 adolescent aids-risk reduction interventions: a quantitative review. *Journal of Adolescent Health*, 20(3):204–215.

Kirby, D. B. (2008). The impact of abstinence and comprehensive sex and std/hiv education programs on adolescent sexual behavior. *Sexuality Research & Social Policy*, 5(3):18–27.

Kirby, D. B., Laris, B., and Rolleri, L. A. (2007). Sex and hiv education programs: their impact on sexual behaviors of young people throughout the world. *Journal of Adolescent Health*, 40(3):206–217.

Kohler, P. K., Manhart, L. E., and Lafferty, W. E. (2008). Abstinence-only and comprehensive sex education and the initiation of sexual activity and teen pregnancy. *Journal of Adolescent Health*, 42(4):344–351.

NARAL (2009). The healthy youth act - comprehensive sex education for wisconsin's youth.

Nations, U. (1995). Report of the international conference on population and development. Technical report, United Nations.

NCES (2012). Number of educational institutions, by level and control of institution: Selected years, 1980-81 through 2011-12. Technical report, Institute of Education Sciences.

Newsroom, N. Reported cases of stds on the rise in the u.s.

Oettinger, G. S. (1999). The effects of sex education on teen sexual activity and teen pregnancy. *Journal of Political Economy*, 107(3):606–644.

of STD Prevention, D. (2014). Sexually transmitted disease surveillance 2014. Technical report, Centers for Disease Control and Prevention.

Owusu-Edusei Jr, K., Chesson, H. W., Gift, T. L., Tao, G., Mahajan, R., Ocfemia, M. C. B., and Kent, C. K. (2013). The estimated direct medical cost of selected sexually transmitted infections in the united states, 2008. *Sexually transmitted diseases*, 40(3):197–201.

Reichelt, P. A. and Werley, H. H. (1975). Contraception, abortion and venereal disease: Teenagers' knowledge and the effect of education. *Family Planning Perspectives*, pages 83–88.

Sabia, J. J. (2006). Does sex education affect adolescent sexual behaviors and health? *Journal of Policy Analysis and Management*, 25(4):783–802.

Sabia, J. J. and Anderson, D. M. (2014). Parental involvement laws, birth control, and mental health: New evidence from the yrbs. Technical report, Working Paper, San Diego State University.

Sanderson, C. A. (2000). The effectiveness of a sexuality education newsletter in influencing teenagers' knowledge and attitudes about sexual involvement and drug use. *Journal of Adolescent Research*, 15(6):674–681.

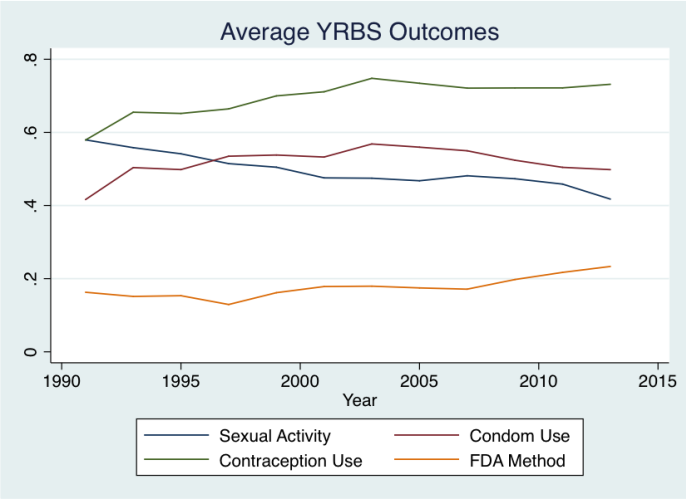
SIECUS, . Siecus report.

Stanger-Hall, K. F. and Hall, D. W. (2011). Abstinence-only education and teen pregnancy rates: why we need comprehensive sex education in the us. *PLoS One*, 6(10):e24658.

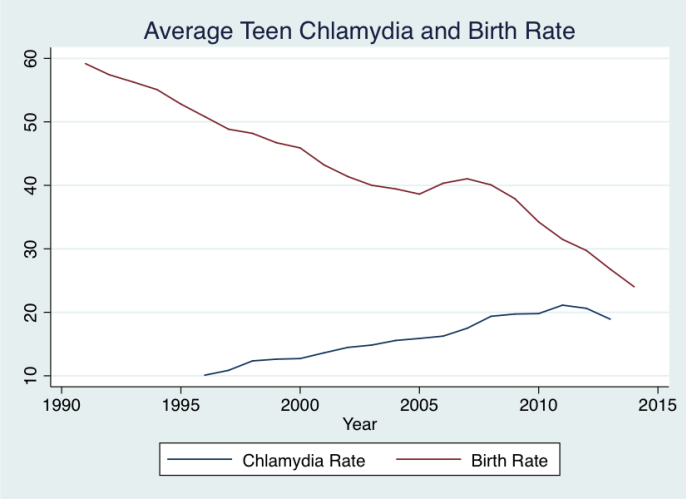
Starkman, N. and Rajani, N. (2002). The case for comprehensive sex education. *AIDS patient care and STDs*, 16(7):313–318.

Trenholm, C., Devaney, B., Fortson, K., Quay, K., Wheeler, J., and Clark, M. (2007). Impacts of four title v, section 510 abstinence education programs. final report. *Mathematica Policy Research, Inc.*

Figure 1: National Trends in Main Outcomes

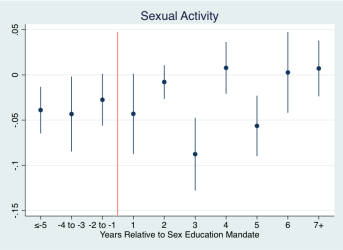


(a)

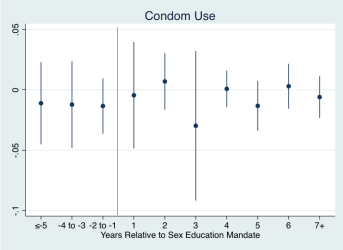


(b)

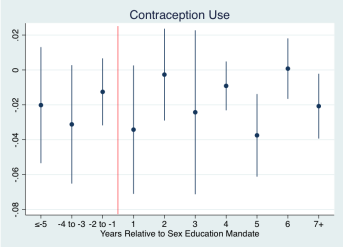
Figure 2: Event Study Estimates of the Effect of Sex Education Mandates on Teenage Sexual Behaviors



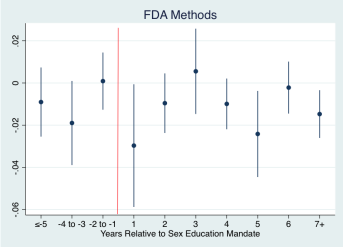
(a)



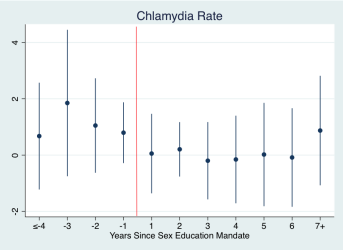
(b)



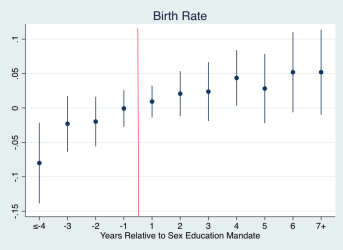
(c)



(d)



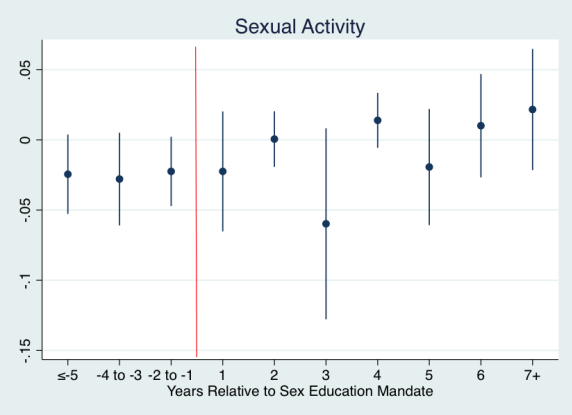
(e)



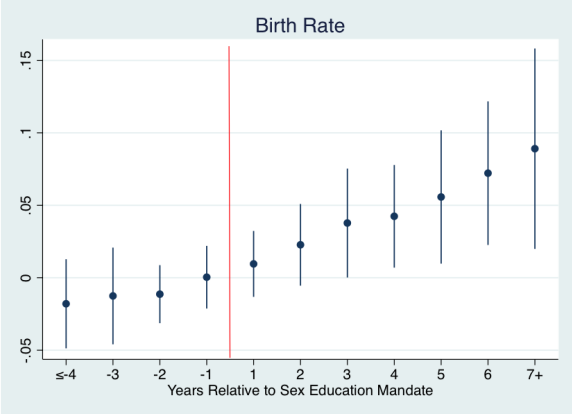
(f)

Notes: Estimates of Equation 2 described in the text. All estimates include individual controls (when applicable), state-level controls, and state and year fixed effects. 95 percent confidence intervals are shown extending from each point. All estimates are relative to year 0.

Figure 3: Event Study Estimates of the Effect of Sex Education on Teenage Sexual Activity and Birth Rates, with Time Trends



(a)



(b)

Notes: Estimates of Equation 2 described in the text. All estimates include individual controls (when applicable), state-level controls, and state and year fixed effects, and state-specific time trends. 95 percent confidence intervals are shown extending from each point. All estimates are relative to year 0.

Table 1: State-level Sex Education Mandates, 1991-2013

Sex Education		**Abstinence-Based**		**Comprehensive**	
Alabama	1993	Florida	2001	Washington DC	2004
Alaska	2001	Georgia	2004	Hawaii	1997
Arizona	1994	Kentucky	1999	Illinois	2004
Florida	1992	Minnesota	2011	Maine	2003
Hawaii	1995	Montana	2007	Maryland	2001
Illinois	1994	New Jersey	2004	New Jersey	1997
Kentucky	1999	North Carolina	2004	New Mexico	2009
Maine	2001	North Dakota	2012	North Carolina	1995
Minnesota	1995	Ohio	2011	Oregon	2008
Montana	2007	Tennessee	2001	Tennessee	1995
Mississippi	2012	West Virginia	1997		
New Mexico	2009				
North Carolina	1995				
North Dakota	2012				
Ohio	2011				
Oregon	2008				
Tennessee	1995				
Texas	1994				
West Virginia	1995				
Wyoming	2001				

Notes: The states contributing to the identifying variation are listed above. States that passed sex education mandates during the 1991-2013 period, and states that implemented abstinence-based versus comprehensive sex education from 1995-2013. New Jersey and North Carolina switched from comprehensive to abstinence-based in 2004, and Tennessee switched from comprehensive to abstinence-based in 2001. Washington DC and Georgia already had sex education mandates implemented before the 1991 period, but the type of sex education wasn't enacted until the dates listed above.

Table 2: Descriptive Statistics of Analysis Variables

	N	Mean	SD	Min	Max
Demographics					
Grade	1,178,736	10.378	1.102	9	12
Age	1,183,001	15.99	1.237	12	18
Male	1,186,880	0.491	0.500	0	1
White	1,193,759	0.548	0.498	0	1
Black	1,193,759	0.151	0.358	0	1
Hispanic	1,193,759	0.151	0.358	0	1
Outcome Measures					
Sexual Activity	919,775	0.481	0.499	0	1
Condom Use	411,315	0.523	0.499	0	1
Contraception Use	411,315	0.706	0.456	0	1
FDA Method	411,315	0.183	0.386	0	1
Chlamydia Rate	865	15.918	7.696	2.92	66.25
Birth Rate	1,122	42.893	15.541	2.2	112.8
Treatment Measures					
Sex Education	1,189,637	0.468	0.499	0	1
Abstinence-Based	1,074,319	0.130	0.336	0	1
Comprehensive	1,074,319	0.278	0.448	0	1

Notes: Data on treatment measures come from the SIECUS Reports from 1991-2000, and the Guttmacher Institute State Policies in Brief: State Sex and HIV Education, 2001-2013. Data on individual-level outcome measures and demographics come from the State and National YRBS from 1991-2013. Data on state-level STD rates for 15-19 year olds come from CDC WONDER Online Database for the years 1996-2014, and data on female birth rates for 15 to 19 year olds come from the National Vital Statistics from 1991-2013. Condom use, contraception use, and FDA methods are all conditional on having had sex.

Table 3: The Effect of Sex Education on Teenage Sexual Behaviors

	Had Sex	Condom Use	Contraception Use	FDA Method
SexEd	0.007	0.016***	0.016**	-0.0002
	(0.008)	(0.006)	(0.006)	(0.004)
Observations	899,724	401,166	401,166	401,166
Outcome Means	0.479	0.524	0.707	0.182
State-level controls	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: Unweighted linear probability model estimates are obtained using data from the 1991-2013 YRBS. Individual controls include age, grade, and race. State-level controls include the unemployment rate, real income per capita, state-level beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: The Effect of Sex Education on Teenage Sexual Behaviors, by Age

	Had Sex	Condom Use	Contraception Use	FDA Method
Panel I: 12 to 14 year olds				
SexEd	0.009	0.018	0.019	0.001
	(0.008)	(0.013)	(0.015)	(0.007)
Observations	100,213	23,252	23,252	23,252
Outcome Means	0.249	0.586	0.674	0.087
Panel II: 15 to 18 year olds				
SexEd	0.006	0.016**	0.015**	-0.0002
	(0.008)	(0.006)	(0.007)	(0.004)
Observations	799,511	377,914	377,914	377,914
Outcome Means	0.508	0.521	0.709	0.189

Notes: Unweighted linear probability model estimates are obtained using data from the 1991-2013 YRBS. Regressions include individual-level and state-level controls, and state and year fixed effects. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: The Effect of Sex Education on Teenage STD and Birth Rates

	Chlamydia	Birth Rate
SexEd	-1.321**	0.018
	(0.631)	(0.015)
Observations	865	1,122
Outcome Means	15.640	3.730
State-level controls	Yes	Yes
State FE	Yes	Yes
Year FE	Yes	Yes

Notes: Unweighted linear probability model estimates are obtained using data on STD rates for 15-19 year olds from CDC WONDER Online Database for the years 1996-2013. Birth rates for females ages 15 to 19 were obtained from the National Vital Statistics for the years 1991-2013. All regressions include state-level controls, and state and year fixed effects. State-level controls include the unemployment rate, real income per capita, state-level beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: The Effect of Sex Ed Components on Teen Sexual Behaviors

	Had Sex	Condom Use	Contraception Use	FDA Method
Panel I: Abstinence-Based Sex Education				
SexEd	0.006	0.019**	0.015*	-0.003
	(0.008)	(0.008)	(0.009)	(0.006)
Abstinence	0.003	-0.005	0.002	0.007
	(0.010)	(0.011)	(0.010)	(0.006)
Observations	822,618	359,610	359,610	359,610
Panel II: Comprehensive Sex Education				
SexEd	0.011	0.015*	0.015*	0.001
	(0.009)	(0.008)	(0.008)	(0.005)
Comprehensive	-0.017	0.007	0.004	-0.003
	(0.011)	(0.008)	(0.008)	(0.006)
Observations	822,618	359,610	359,610	359,610
Outcome Means	0.471	0.530	0.717	0.186

Notes: Unweighted linear probability model estimates are obtained using data from the 1995-2013 YRBS. Regressions include individual-level and state-level controls, and state and year fixed effects. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

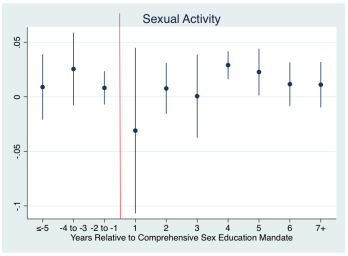
Table 7: The Effect of Sex Ed Components on Teenage STD and Birth Rates

	Chlamydia	**Birth Rate**
Panel I: Abstinence-Based Sex Education		
SexEd	-1.253*	0.017
	(0.703)	(0.015)
Abstinence	-0.170	0.014
	(0.541)	(0.018)
Observations	865	918
Panel II: Comprehensive Sex Education		
SexEd	-1.770**	0.019
	(0.748)	(0.014)
Comprehensive	1.493	-0.016
	(0.914)	(0.020)
Observations	865	918
Outcome Means	15.640	3.670

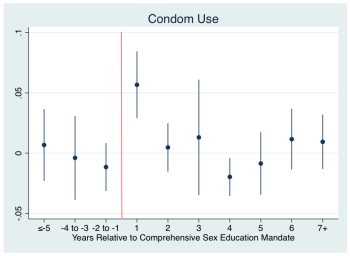
Notes: Unweighted linear probability model estimates are obtained using data on STD and birth rates for 15 to 19 year olds. All regressions are for the years 1995-2013, since information on Abstinence-based versus Comprehensive sex education was only available for those years. All regressions include state-level controls, and state and year fixed effects. State-level controls include the unemployment rate, real income per capita, state-level beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7 Appendix

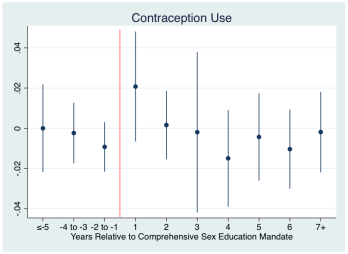
Figure 4: Event Study Estimates of the Effect of Comprehensive Sex Education Mandates on Teenage Sexual Behaviors



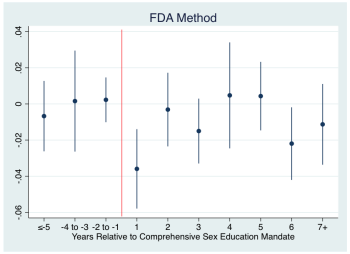
(a)



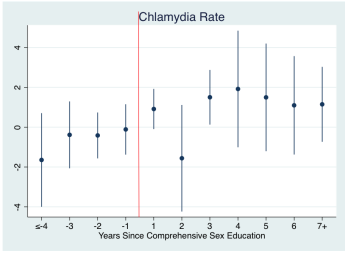
(b)



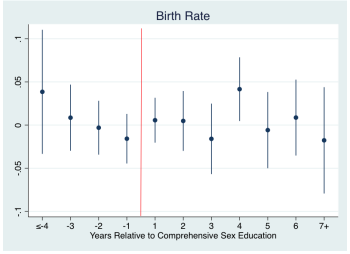
(c)



(d)



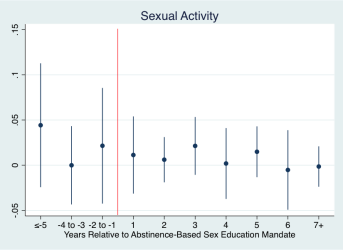
(e)



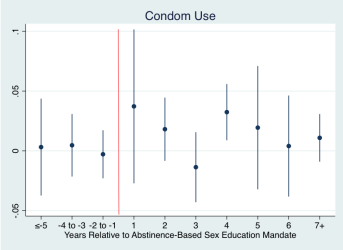
(f)

Notes: Estimates of Equation 2 described in the text. All estimates include individual controls (when applicable), state-level controls, and state and year fixed effects. 95 percent confidence intervals are shown extending from each point. All estimates are relative to year 0.

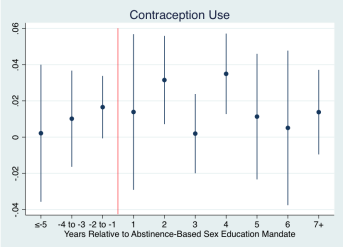
Figure 5: Event Study Estimates of the Effect of Abstinence-Based Sex Education Mandates on Teenage Sexual Behaviors



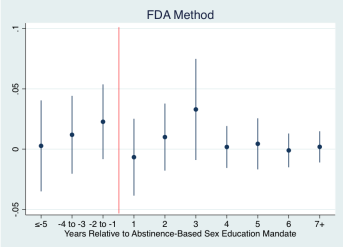
(a)



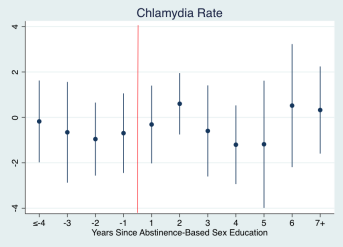
(b)



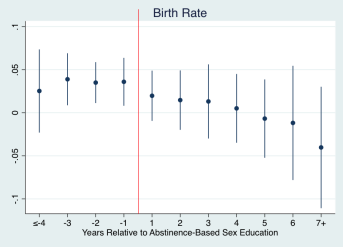
(c)



(d)



(e)



(f)

Notes: Estimates of Equation 2 described in the text. All estimates include individual controls (when applicable), state-level controls, and state and year fixed effects. 95 percent confidence intervals are shown extending from each point. All estimates are relative to year 0. Sexual activity, FDA Method, and Birth Rates include a state-specific time trend to control for pre-trends associated with the adoption of abstinence-based sex education.

Table 1: The Effect of Sex Education on Teenage Sexual Behaviors

	Had Sex	**Condom Use**	**Contraception Use**	**FDA Method**
	(1)	(2)	(3)	(4)
SexEd	0.006	0.007	0.005	-0.002
	(0.007)	(0.007)	(0.007)	(0.004)
Observations	899,724	401,166	401,166	401,166
State-level controls	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
State time trend	Yes	Yes	Yes	Yes

Notes: Unweighted linear probability model estimates are obtained using data from the 1991-2013 YRBS. Individual controls include age, grade, and race. State-level controls include the unemployment rate, real income per capita, state-level beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2: The Effect of Sex Education on Teenage STD and Birth Rates

	Chlamydia	**Birth Rate**
SexEd	-0.502	0.002
	(0.663)	(0.007)
Observations	865	1,122
State-level controls	Yes	Yes
State FE	Yes	Yes
Year FE	Yes	Yes
State time trend	Yes	Yes

Notes: Unweighted linear probability model estimates are obtained using data on STD rates for 15-19 year olds from CDC WONDER Online Database for the years 1996-2013. Birth rates for females ages 15 to 19 were obtained from the National Vital Statistics for the years 1991-2013. All regressions include state-level controls, and state and year fixed effects. State-level controls include the unemployment rate, real income per capita, state-level beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Falsification Tests on Older Young Adult Chlamydia Rates

	Chlamydia
SexEd	-0.514
	(0.682)
Observations	865
State-level controls	Yes
State FE	Yes
Year FE	Yes

Notes: Unweighted linear probability model estimates are obtained using data on STD rates for 20-24 year olds from CDC WONDER Online Database for the years 1996-2013. State-level controls include the unemployment rate, real income per capita, state-level beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Years Exposed to a Sex Education Mandate for 16 to 18 year olds

	Had Sex	Condom Use	Contraception Use	FDA Method
1 year exposed	0.026	-0.003	-0.003	-0.0001
	(0.018)	(0.011)	(0.009)	(0.009)
2 years exposed	-0.018	0.014**	0.011	-0.004
	(0.011)	(0.007)	(0.006)	(0.005)
3+ years exposed	-0.002	0.012*	0.012**	-0.0002
	(0.012)	(0.007)	(0.006)	(0.005)
Observations	570,763	302,390	302,390	302,390
State-level controls	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: Unweighted linear probability model estimates are obtained using data from the 1991-2013 YRBS. Individual controls include age, grade, and race. State-level controls include the unemployment rate, real income per capita, state-level beer taxes, blood alcohol content laws, and zero tolerance drunk driving laws. Standard errors clustered at the state level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1