THE RELATIONSHIP BETWEEN SUBSTANCE USE AND RISKY SEXUAL BEHAVIOR AMONG ADOLESCENTS AND YOUNG ADULTS

by

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ABSTRACT

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A positive relationship between the use of such substances as alcohol, marijuana, and cocaine alcohol and risky sexual behavior by adolescents and young adults has been widely documented. While it often is assumed that substance use causes risky sex, this has not been established. The observed relationship may reflect causality in both directions and may also reflect the influence of an omitted "third variable" such as a "thrill-seeking personality." By using data from the National Education Longitudinal Study, I attempt to establish whether substance use does in fact cause risky sex. In the first essay, I employ a two-pronged research strategy. First, I control for a very rich set of individual-characteristics. Second, I use substance use state-level substance control policies as instruments for substance use in a two-stage least squares estimation methodology. In the second paper, two novel classes of identifying variables: a set of school level substance policies and the first difference of the 12^{th} grade substance use; are used to predict the consumption of alcohol and marijuana in a two-stage least squares estimation strategy. My findings suggest that substance uses in both the 10th and 12th

grades are associated with risky sexual behavior when respondents are in their very early twenties. While there is some evidence that the substance use effect is causal, the results are somewhat sensitive to the specific set of instruments employed.

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CHAPTER I

1 Introduction and Literature Review

It has been widely documented in the social science and health science literature[1] that among adolescent and young adults the use of substance such as alcohol, marijuana and cocaine is positively associated with risky sexual behavior, which is broadly defined as the early initiation of sexual intercourse, multiple sexual partners, and engaging in sexual intercourse without contraceptive use.

While it is often assumed that substance use causes risky sex, this causal link has not been established yet. The well observed relationship may reflect causality in both directions and may also reflect the influence of an omitted "third variable" such as a thrill-seeking personality. In recent studies, a number of researches have tried to establish the causality by using event-level data and in-depth examination.

Chesson et al. 2000 attempt to establish the causality from alcohol use to risky sex by examining the direct relationship between alcohol tax and STD rates. Using a panel data over 15 year period from 1981 through 1995, the authors find that higher state beer or liquor taxs reduce the rates of gonorrhea and syphilis for individuals of all ages, young adults and male teenagers. They also show that the gonorrhea rate falls as the minimum legal drinking age rises for youth age 15-19. They conclude that the use of alcohol leads

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[1] See Harvey and Beckman (1986); Yamaguchi and Kandel (1987); Mott and Haurin (1988); Elliot and Morse (1989); Kandel (1989); Biglan et al. (1990); Ensminger (1990); Hingson et al. (1990); Leigh (1990); Rosenbaum and Kandel (1990); Gold et al. (1991); Gold et al. (1992); Gold and Skinner (1992); Orr, Beiter, and Ingersoll (1991); Shafer and Boyer (1991); Mensch and Kandel (1992); Strunin and Hingson (1992); Leigh (1993); Leigh and Stall (1993); Shafer et al. (1993); Cooper, Peirce, and Huselid (1994); Laumann et al. (1994); Lowrey et al. (1994); Senf and Price (1994); Donovan and McEwan (1995); de Gaston, Jensen, and Weed (1995); Graves and Leigh (1995); Harvey and Spigner (1995); Fergusson and Lynskey (1996); Fortenberry et al. (1997); Jakobsten et al. (1997); Kaestner (1997, 1998); Kowaleski-Jones and Mott (1998)*; and Santelli et al. (1998)*. This list excludes studies that describe sexual behavior among specific groups of substance abusers such as alcoholics and intravenous drug users.

to risky sex, which in turn cause the contraction of STDs, because there is no reason to conclude that alcohol price or state policy, is a determinant of risky sexual behavior holding consumption constant.

Rees et al. 2001 investigate the effects of marijuana use and drinking on the sexual behavior of high school students in the United States, by taking data from the National Longitudinal Study of Adolescent Health. To correct for the biases in substance use resulted from the unobserved elements, the following instrument variables are employed in both 2SLS method and bivariate probit model, which include: whether the state of residence required schools to offer alcohol and drug prevention education; per capita local and state expenditures on police protection; the number of arrests per violent crime in the county of residence; and the number of total arrests per crime in the county of residence Their findings indicate a much weaker causal link between substance use and sexual activity than previous researchers suggested. Estimates only pertaining to male may reflect causation, which both marijuana and heavy drinking increase the probability of engaging in sex intercourse without contraceptive use.

Sen, 2002 makes use of the first wave of the National Longitudinal Study of Youth, 1997 (NLSY97) to study alcohol use towards the probabilities of having sex and unprotected sex by gender. A slightly different set of instrument variables employed to predict the alcohol use are: per gallon beer tax in state of residence; per pack cigarette tax in state of residence; the year I which the state of residence increased the legal drinking age to 21; per capita spending on police protection in state of residence; arrest rates for juvenile drunk driving in county of residence; and per capita alcohol consumption by adults in state of residence. Results from both bivariate probit and 2SLS estimation

indicate that light drinking has significant causal effect on the probability of engaging in sex and non-contracepted intercourse for both genders. However, heavy drinking has no effect on sex activity for both genders, which is consistent with the findings from Ree et al.

Grossman and Markowitz, forthcoming gauge the relationship between substance use and risky sexual behavior accounting for gender difference by using data from the Youth Risk Behavior Surveys. Results from two-stage least squares and reduced form models suggest that binge drinking does not increase the probability of having sex or the number of partners, while it does reduce the likelihood of using of birth control and condoms among sexually active teenagers.

Rashad and Kaestner, 2004 assess the work done by Rees et al. (2001) and Sen (2002) using the first wave of both the National Longitudinal Survey of Adolescent Health and the 1997 National Longitudinal Survey of Youth. By testing the efficacy of identification strategy, they address the weak instrument problem associated with the estimation, and therefore question the validity of findings and conclusions in the two papers. In addition, to examine the casuation of cigarette on sexual behavior in bivariate probit model, the following instrument variables included to predict the smoking are: state per pack cigarette tax; whether tobacco marketing prohibited on billboards within 500 feet of schools and/or churches in state of residence; full time equivalent staff on tobacco control per 1,000,000 population in state of residence; and total funds in millions of dollars for tobacco control per 100,000 population in state of residence. Estimates again reveal the difficulty to establish the causality between cigarette use and risky sexual behavior.

This paper uses data from National Educational Longitudinal Study to gauge the link between high school substance use and two outcomes: the probability of having sex as well as the probability of engaging risky sex. I employ a two-pronged research methodology to address and control for the potential endogenous substance use caused by the third unobserved element. First, I control for a very rich set of individual-characteristics. Second, I use state-level substance control policies as instruments for substance use in a two-stage least squares estimation methodology.

My findings suggest that alcohol, marijuana and cocaine use in both the 10^{th} and 12^{th} grade are positively associated with risky sexual activity in their very early twenties. While there is some evidence that the substance use effect is causal, the results are somewhat sensitive to the specific set of instruments employed and the model of specification.

2 Empirical Model

The goal of the analysis is to gauge the causal impact of substance use such as alcohol, marijuana and cocaine on risky sexual activities among adolescence and young adults. This issue becomes complicated because the common unobserved factor such as a thrill-seeking personality generates a spurious correlation between these two problem behaviors. Therefore, the objective of empirical research is designed to address and test for this problem through the following two approaches. First, the paper uses a multivariate equation to control for a very rich set of individual characteristics. The second is using a two-stage least squared estimation methodology. Both methods are

tested by male and female separately to consider the gender differences in the association between these two deviant outcomes.

Formally, the main framework in this paper is based on a linear specification of the structural demand function for risky sexual behavior (S), and the reduced form demand equation for substance use (D):

$$(1) \qquad S = \alpha_1 D_1 + \alpha_2 X + \alpha_3 \mu + \varepsilon$$

$$(2) \qquad D = \beta_1 X + \beta_2 Y + \beta_3 \mu + \eta$$

Equation (1) stands for the demand function for risky sexual activity in which substance use (D) is the main determinant. X is a vector of observed personal and demographic characteristics such as gender and race, μ is unmeasured individual traits such as a thrill-seeking personality. Equation (2) specifies the demand function for substance use (D), which is influenced by exogenous factors X, the same set of observed individual-level effects towards risky sexual behavior. The vector Y is comprised of state-level prices and control policies that only affect the consumption of alcohol and illicit drug by youths. μ is a vector of common personal variables which determine the substance use available and risky sexual activities as well. ε and η are random disturbance terms. Intercepts are suppressed for convenience.

The parameter of interest is α_1, which measures the effect of substance use on adolescent risky sexual behavior. However, estimating equation (1) by simple OLS can lead to biased and inconsistent estimates if the common unobserved personal traits are correlated with risky sexual behavior and substance use ($\alpha_3 \neq 0, \beta_3 \neq 0$). In this case, alcohol and illicit drug use will be correlated with error term $\alpha_3 \mu + \varepsilon$ in equation (1),

thus estimating the coefficients by a standard OLS model would violate a central requirement underlying the OLS framework, which is that the right hand side variables should be orthogonal to the error term.

With this regard, the first method is to gradually add several additional sets of observed variables to equation (1), then estimated using an OLS regression model, in order to achieve the extensive proxy of μ as full as possible by accounting for a very rich set of individual characteristics, and meanwhile to access the sensitivity of selection on observed characteristics[2]. The detailed estimation is in the following procedure. First, equation (1) is regressed without any control variables, referred to Model 1. In Model2, the estimation includes a basic set of personal and demographic variables that have been linked to adolescent risky sexual behavior in previous studies. To demonstrate the degree of selection on observed personal and family background characteristics, the estimated coefficient on substance use in Model 2 should be attenuated substantially compared to the estimates in Model 1. In the same manner, Model 3 is then regressed by adding a set of student and high school variables since substance use is known to be correlated with other concurrent problem behaviors. The magnitude of estimates is expected to decline once these variables are included. Finally, Model 4 includes a set of 8^{th} grade individual characteristics highly proxy risky personality. If high school substance use is a cause of risky sexual behavior, the coefficients on substance use should not decrease appreciably.

Notwithstanding the effort to fully explore the proxy of μ, the immeasurable factors still exist in the error term in equation (1) that may correlate to the use of substance also towards risky sexual behavior. Thus, in order to avoid spurious correlation

[2] This methology comes from the work of Painter & Levine (2000), who use NELS to examine the impact of family structure on youths' outcomes.

estimated by OLS regression, the risky sexual activity model is then regressed by a two-stage least squares method[3]. Two models of specification are implemented in the analysis of two-stage least squares estimation. The first specification contains only a set of exogenous covariates to the youth's perspective such as personal and demographic characteristics. The second is formed from a full set of covariates including an additional set of variables, for instance, smoking and other problem behavior. Both these two models of specification are instrumented by a set of state-level substance prices and control policies. To test the sensitivity of identifying variables to the state time-invariant factor, then the estimation is carried on by adding several state sentiment variables, which may confound the association between high school substance use and risky sexual activity. All models are estimated using robust standard errors that account for clustering of observation at state level of residents. The eligibility of instrument variables can be showed in the first stage F-statistics. The endogeneity of substance use is tested using the Durbin-Wu-Hausman test and the validity of the over-identifying restrictions is assessed by using Sargan statistics as well.

A reduced form equation can be derived by substituting equation (2) into equation (1):

$$(3) \qquad S = \gamma_1 X + \gamma_2 Y + \gamma_3 \mu + \varepsilon + \eta$$

The reduced form demand function for risky sexual activity displays the changes of state level substance price and control policy in reducing risky sexual behavior directly. A statistically significant result implies that risky sexual behavior is a result of the consumption of alcohol and illicit drugs since the only way for state alcohol and drug

[3] Heckman and MaCurdy [1985] and Angrist [2001] show the validity of using linear probability models for estimating simultaneous equations with dichotomous endogenous variables.

price and control policy to affect risky sex behavior is through the reduction in demand. Therefore, the employment of reduced form equation serves as an alternative estimation strategy in the analysis of the validity of instrument variables method[4].

3 Data Sources and Variables

The principle data source for this paper comes from the National Educational Longitudinal Study of 1988 (hereafter NELS88), a nationally representative survey conducted by the U.S Department of Education. NELS88 was designed to collect information about students' educational experiences, family background, attitudes and social behaviors including substance uses and sexual behaviors along with information provided by parents, teachers and school administrator regarding social activities of American eighth graders, the family, teaching practices and the school. The detailed description of sampling method and survey techniques is documented elsewhere.[5] In short, the first wave survey was initiated in the year of 1988, when approximately 25,000 eighth graders from more than 1,000 public and private schools were interviewed. Students were reinterviewed in 1990, 1992, 1994 and 2000, allowing researchers to track students' transition from 8th grade to high school. Students who dropped out of high school were followed, and interviews in 1994 took place whether or not the subject was attending college. In addition, the survey was refreshed with some new respondents in 1990 and 1992 to guarantee nationally representative cross sectional analysis of 10th and 12th graders.

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[4] See Grossman and Markowitz forthcoming
[5] See Bartot and Taylor (1998).

Two sets of sub-sampling data, used in the paper of analysis, are 10th grade and 12th grade samples respectively. They are both taken from the fifth wave of NELS in 2000, which included 12,144 respondents from the four previous surveys. The 10th grade sample consists of 6,147 students who were still in school by 1990, two years after the first wave survey and who had information on student, parent and school questionnaires available. It is used to explore the probability of 10th grade alcohol and illicit drug use on the probability of selection into risky sexual behavior among students who were still in school but not necessarily at 10th grade level. The 10th grade sample excludes 437 members dropout during 8th and 10th grade, because it is possible that these members are dropout before receiving 10th grade questionnaire. It also excludes 1,098 respondents who married by 1994 and 163 members of any missing information on risky sexual behavior in 1994. There were 1,131 respondents also excluded in the 10th grade data set for any missing information on substance use and 1,329 members dropped because of missing information on school drug policies in 10th grade. Any moderate missing information regarding other right hand side variables were imputed by sample means.

The 12th grade data set is a subset of 10th grade sample, containing 4,483 students who completed 10th grade questionnaire and were still in school by 1992. The data set is used to examine the probability of 12th grade illicit drug and alcohol use on the probability of selection into risky sexual behavior among students who were still in school but not necessarily at 12th grade level. The number of 12th graders who failed to complete their questionnaire and were excluded is 31. There were 785 respondents excluded for missing information on 12th grade substance use and 848 members also dropped because of missing information on 12th grade school policies.

To examine the causal relationship between substance use and risky sexual behavior, the explanatory variables of interest are alcohol, marijuana and cocaine use. There is a great deal of information available on students' substance use in the second and third wave questionnaires, when most students were in 10^{th} and 12^{th} grade. Respondents reported the number of occasions they had alcoholic beverages to drink in the past 30 days, in the past year and in lifetime. Respondents were also asked about how many times they used marijuana and how many times they used cocaine in the past 30 days, in the past year and in lifetime.

Dummy variables are employed to measure alcohol and illicit drug use in 10^{th} and 12^{th} grade. The first is to indicate whether or not the respondent had consumed at least one drink of alcohol in the past thirty days; the second indicator is to measure whether or not the respondent used marijuana at least once in the past thirty days; the third explanatory variables is to indicate whether or not the respondent used cocaine at least one occasion in the past 12 months. The exceptional timing of cocaine use measure is the past twelve months rather than the past thirty days in that only a small number of respondents reported any cocaine use in the past thirty days. The specific models presented in the paper include each substance use measure separately in order to avoid multicollinearity between the measures of substance use.

Information regarding sexual behaviors appears only on the fourth wave in 1994, when most respondents are 20 years old. Respondents were asked how often they had intercourse in the past month, three or more times, two times, once or not at all; and whether they had any type of birth control to prevent pregnancy or sexually transmitted disease at last sex intercourse.

Two sets of dependent variables are constructed in line with the timing of past month, similar to the designation of outcome variables by Rees (2001). The first measure sexual behavior is a dummy variable to indicate whether the respondent had sex intercourse in the past month, which is set to 1 if the person had at least one occasion of sex intercourse and 0 otherwise. Nevertheless, as for the second indicator, we could not reproduce the timing of past month since we have no information on when the last sex intercourse take place, whether is before or after 10^{th} grade or 12^{th} grade substance use. Instead, by applying measures of the frequency of sex and contraceptive use corresponding to 1 month prior to interview, we defined a new measure of risky sex, which is equal to one if the respondent had his/her last sex in the past month and failed to use any type of birth control at that time. For those respondents who didn't have sex, the risky sex indicator is set to zero. There are approximately 7% of the respondents who had sex in the past month also engaging in risky sex by definition in the 10^{th} grade sub-sample data set.

One of the primary advantages of the NELS88 is the wealth of variables representing personal and family characteristics. Two models of specification are used in both 10^{th} and 12^{th} grade regression. The first specification includes only a set of exogenous covariates: gender, race/ethnicity dummy variables, region of residence, whether or not the school is located in a suburban (as baseline), rural or urban area, religion indicator variables, a dummy variable to indicate whether or not the respondent spent time on religion activities, indicator of whether or not spent time on working hobbies, mother's and father's education levels (high school graduate as the baseline, high school dropout, some college and college graduate), 8^{th} grade family structure (both

parents as the baseline, step family and single family), family income quartiles and number of siblings. The second model contains a full set of covariates by adding a set of additional variables: dummy variable to indicate whether or not the respondent smoked in the current school year, dummy variables for school environment associated with drug use and school's policy regarding drug and alcohol possession at school (indicator of whether or not the respondent was offered drugs in the current school year, a dummy variable of whether or not the punishment for the first occurrence of drug or alcohol possession is expulsion, whether or not drugs or alcohol are problem at his/her high school), several dummy variables to control for preexisting personal characteristics in 8^{th} grade that may affect both substance use and risky sexual behavior (whether or not respondent smoked daily in 8^{th} grade, a dummy indicator of whether or not school called student's parents about behavior, a dummy variable of whether or not respondent was offered drug in 8^{th} grade). To control for the potential confound elements, we compare the estimates from two models of specification by including observed effects. If the association between substance use and risky sexual behavior is not affected substantially by adding additional set of variables, it is reasonable to conclude that both behaviors are less selected either on observed or unobserved elements. Otherwise, it is compelling to believe that both substance use and risky sexual activity are predisposed by the third common unmeasured factor confounding the magnitude of the correlation between these two behaviors.

Six state-level substance use policies and prices are employed in the models as instrument variables to predict the consumption of illicit drugs and alcohol but not sexual behavior. These variables, regarded as high proxies for the full price of substance use, are:

the midpoint of the minimum and maximum jail terms for marijuana possession in the state, the midpoint of the minimum and maximum fine for marijuana possession in the state, possession arrest of marijuana in 1,000 capita, the real money price of cocaine[6], possession arrest of cocaine in 1,000 capita and real state excise tax on beer per gallon.

Finally, because policy variables may be correlated with unmeasured state sentiment variables, each model of specification are also tested including the following variables: 1) the state religion composition (percentage of state that is protestant, Southern Baptist, Catholic and Mormon; 2) real income in state; 3) state unemployment rate.

4 Results

4.1 Descriptive Analysis

Table 1 present the descriptive measure of sample mean. Among both 10th and 12th grade respondents, approximately 50 percent had sex intercourse in the past month, while only 6 to 7 percent engaged in risky sex. Compared to 6.3 percent 10th grade students used marijuana in the past 30 days, the percentage of marijuana use in 12th grade is 3 percent somewhat higher. The rate of alcohol use shares the same pattern. Almost half of 12th grade respondents used alcohol in the past 30 days, while 10 percent less among 10th graders. Cocaine use in the past year is around 2 percent in both 10th and 12th grade.

In general, the probability of having sex in the past month for substance user is 20 percent higher than that of non-users across all substances, which indicate that the

[7] The methodology for creating the cocaine price series is described in detail in Grossman and Chaloupka (1998)

respondents are more likely to be sexually active if they use substance (Table 2). It is also striking to see the difference in the outcome of risky sex that the likelihood of substance users is almost 2 folded than that of non-users, except for the 10th grade alcohol use, which is 2 percent higher. The rate of cocaine users who also use marijuana is very high about 96.4 percent in 10th grade and 95.2 percent in 12th grade and almost 100 percent using alcohol at mean time. This measure may suggest the relationship of complementary demand among the use of these three substances.

As most empirical studies documented, the personal and family characteristics of high school students are included to measure the impact of the selection into substance use along these observed factors towards sexual activity. For instance, in the 10th grade sample, single parent or step family, smoking daily in 10th grade and having been offered drugs in 10th grade school are considered as risky factors for substance use. Protective factors against the deviant behavior include engaging in religion activity, having parents who are college graduates, Asian or Africa-American ethnicity and studying in a rural school. High school students who report the use of substance had problem behavior in 8th grade. The preexisting characteristics before their entering high school associated with high school substance use have impact on their risky sexual behavior.

Table 3 continues the descriptive analysis capturing the difference in gender. In both 10th grade and 12th grade samples, males who had sex intercourse and risky sexual practice have higher rates than the correspondence of female. Fifty two percent males engaged in sex and 7.2 percent engaged in unsafe sex in 10th grade sample. The corresponding rates for 10th grade females are 48.8 and 6.7 percent. Males also have higher rate than females across all substance uses. For example, 1 percent of males use

cocaine in 10th grade while female has only 0.4 percent. The difference in cocaine use holds for 12th grade respondents.

4.2 OLS Estimates

The estimates from OLS models that examine the association between the use of substance and risky sexual activity are presented in Table 4 and 5. Table 4 displays the results of the impact of substance use on the likelihood of having sex. The results in each column from OLS regression are presented separately by gender. For each of the measures of 10th grade and 12th grade substance use listed in the table, six separate estimates are obtained. The first column in table 4 shows the estimated coefficient on substance use from Model 1 which is regressed without any control variables. With the effort to gauge the sensitivity of selection on observed elements, the following estimates from model 2 through 5 are summarized in the following columns. Results from Model 2 account for a limited set of social and demographic variables. Model 3 in column three also considers student personal and high school covariates. Finally, estimates from Model 4 reveal the correlates to 8th grade problem behaviors. The t-ratios in brackets are computed based on standard errors which are clustered by the state of residence.[7] Using the same format, Table 5 summarizes the estimates of all substance use in 10th and 12th grade on the probability of engaging risky sex.

The OLS results from a regression model without any control variables in column one of both Table 4 and Table 5 show a positive association between substance use and risky sexual behavior. The coefficients on substance use only are overall robust and statistically significant. By adding a limited set of covariates, the magnitudes of OLS

[7] See Huber, 1967.

estimates in column two do not diminish substantially, which indicate that alcohol and illicit drug use are positively associated with having sex and risky sex for both males and females. For example, male respondents who use marijuana in 10^{th} grade are 15 percentage points more likely to engage in sex intercourse in the past month than male respondents who are not 10^{th} grade marijuana users. The similar rate for female high school respondents is 16.7 percentage points. The effects of alcohol and illicit drug use on the likelihood of risky sex are only half the magnitude of those in Table 4. Furthermore, alcohol use in both grades has very small impact on the probability of risky sex than that on having sex. Estimates in general are consistent with numerous researches that show a strong positive relationship between substance use and risky sexual behavior.

Column three in both Tables shows OLS results from an expanded regression model that includes a set of high school student and school covariates. The reduction in the magnitude of coefficients on substance use is almost half to two thirds of the size of those in column two. The substantial attenuation in magnitudes of the estimates implies that there is a considerable selection on observable characteristics, which in turn increase the likelihood of selection on unobserved characteristics undermining the correlation between the use of substance and risky sexual behavior.[8]

The inclusion of 8^{th} grade personal characteristics, a set of expanded covariates highly proxy the third unobserved personal risk factor, also attenuate the magnitude of estimates in column four of both tables. The observed robust positive association between illicit drug use and risky sexual behavior disappears, while OLS coefficients remains significant on the 10^{th} and 12^{th} grade alcohol use towards the probability of having sex for both gender and the likelihood of engaging in risky sex only for male respondent.

[8] See Grossman, Kaestner and Markowitz, 2002.

This finding provides the evidence to support the idea that the problem of the unobserved omitted, "third variables", such as a thrill-seeking personality may undermine the correlation between substance use and risky sexual behavior.

4.3 TSLS Estimates

Under the influence of an omitted "third variable" such as a "thrill-seeking" personality, the observed positive correlation from OLS estimation is biased, which can not reflect the causal impact of substance use towards the probability of having sex and risky sex. In order to purge the endogeneous measures of alcohol and illicit drug use, the employment of TSLS methodology aims to gauge the true causal link between substance use and risky sexual behavior.

Table 6 through Table 11 documents the estimates from TSLS models for each measure of substance use in both the 10^{th} and 12^{th} grade, controlling for gender difference. In each table, column 1-2 summarize the estimates from TSLS model of specification including a limited set of covariates which is considered to be exogenous from youth's perspective. Column 3-4 show results from an expanded TSLS regression model by including an addition set of high school student and school characteristics and students' preexisting risk factor in 8^{th} grade. Estimates from reduced form equation are summarized in table 12 and table 13, which provides an alternatively analysis of the use of substance towards risky sexual behavior. Tables 14-16 present the coefficients of instrument variables in the first stage.

Table 6 shows the results of both the 10^{th} and 12^{th} grade alcohol use towards the probability of having sex. For female respondents, the TSLS coefficients on the 10^{th}

grade alcohol use are positive, but not statistically significant. The magnitudes of estimates for male respondents who use alcohol in the 10th grade are 43.2-45.1 percentage points, which are consistent across all TSLS models of specification. However, only results in the models consisting of exogenous covariates are robust. For example, in model 1 with only state-level price and control policy as instrument and without the inclusion of state sentiment variables, the TSLS estimate for male alcohol user is positive and significant, but only at 10 percent level of significance. With the inclusion of state sentiment variables in model 2, the magnitude of coefficient does not vary substantially, while the predictive power of TSLS estimation increases to 5 percent level of significance.

Several methods are employed to test the validity of the instrument variables and the efficacy of TSLS estimation strategy. First, Sargan's overidentification test statistic indicates that the overidentifying restrictions are not rejected at any reasonable level. Second, the partial F-statistic test on the first stage is significant, but somewhat low, only 2.99 and 4.92 respectively[9]. However, beer tax in the first stage (Table 14) fails to demonstrate the expected sign and is an insignificant predictor of the use of alcohol. Both marijuana fine and cocaine price are negative and significant suggesting in some extent that the consumptions of marijuana, cocaine are complement to the use of alcohol. Marijuana jail term and the possession of cocaine arrest do not provide expected signs. The predictor of the possession of marijuana arrest on alcohol use is negative, but not statistically significant. The Durbin-Wu-Hausman F test statistics does not indicate that

[9] See Bound et al. 1995, show that the bias in the TSLS estimates approximate that of OLS as the F-statistic on the identifying variables gets smaller, bring question on the credibility of the TSLS estimate.

the endogeneity of the 10th grade alcohol use measure affect the consistency of the OLS estimates. Furthermore, reduced form estimates in table 12 show that none of the coefficients of identifying variables has robust predictive powers on the likelihood of having sex. These test results suggest that alcohol use for 10th grade male students does not lead to engage in sex and risky sex. For the 12th grade alcohol use, only the coefficient on female from model 2 is 24.4 percentage points, which is robust at 10 percent level of significance. Notwithstanding the significant overidentifying statistic and partial F-test on the first stage, the null hypothesis of the consistent estimates is not rejected by Durbin-Wu-Hausman test, which implies that OLS estimate may be better than TSLS estimation. Compared to the estimate from Model 1, the increasing in magnitude and predictive power to 10 percent level of significance is due to the inclusion of state sentiment variables. This finding is consistent with the idea that state alcohol policy is correlated with some state time invariant factor.

Table 7 shows TSLS estimates for both the 10th grade and 12th grade alcohol use on the likelihood of engaging in risky sex. Although the TSLS results of the 10th grade alcohol use are positive, none of them is statistically significant across all models of specification. Estimates on the 12th grade alcohol use even turn out to be negative and insignificant across all models for male respondents. Effects for 12th grade female respondents are blended but still insignificant. Hausman Test across all TSLS models suggests that TSLS is no better than OLS estimation. Beer tax in the reduced form estimation fails to demonstrate negative predict power on the likelihood of engaging in risky sex for both male and female. Empirical evidences suggest that both the 10th grade and 12th grade alcohol uses are not good predictors for risky sex.

Table 8 and 9 summarize the effects of marijuana use towards engaging in sex and risky sex respectively. First, in table 8 for both genders neither 10^{th} grade nor 12^{th} grade marijuana use has causal impact on the probability of having sex in a fully specified model. While in the model with only exogenous covariates and without the state sentiment variables, two estimates are robust, but only at 10 percent level of significance. One is 10^{th} grade marijuana use for male respondent, the other is marijuana use in the 12^{th} grade for female counterpart. However, the latter one fails to pass the Durbin-Wu-Hausman test. Regarding the coefficient on marijuana use for 10^{th} grade male student, Hausman test is only rejected at 10 percent leve. The F-test on the first stage is quite low about only 3.49. Indeed, none of the coefficients on state level marijuana control policy provides robust, expected negative sign both in the first stage and reduced form estimation as well. Furthermore, as the inclusion of state sentiment variables, the magnitude of estimate reduces to 0.308 and insignificant. These several findings cast some doubt on the validity of instrument variables and the estimation of TSLS procedure. Secondly, in table 9, the measure of 12^{th} grade marijuana use is not statistically significant, though is positive, across all models and gender. For male who use marijuana in 10^{th} grade, estimates from models with the inclusion of state sentiment variables are robust and pass three tests on the validity of TSLS estimation strategy. However, it is possible that the significant results are due to the high correlation of instrument variables to the state time-invariant factors. In the reduced form (in table 13), high marijuana fine reduce the probability of engaging in risky sex, while marijuana jail term and possession of arrest have no predictive power.

In table 10 and table 11, the majority of estimates show that the use of cocaine is not related to the probability of having sex and risky sex. Except for female, estimates of the 12^{th} grade cocaine use on the probability of having sex are robust across models. Although most hausman test is rejected, overidentification restriction test is also rejected at reasonable level. Indeed, none of instruments in the first stage provide robust negative predictive power on the consumption of cocaine, thus the TSLS estimates are questioned.

5 Conclusion

The difficulty in establishing the causal relationship between the use of substance such as alcohol, marijuana and cocaine has been witnessed in recent studies. The goal of this paper is to investigate the extent to which the observed positive correlation between the two behaviors reflects causality running from substance use to risky sex by using data from NELS88.

Estimates from OLS regression models show a positive association between the use of substance and risky sexual behavior among adolescence and young adults, consistent with previous studies. By controlling for a rich set of individual-level characteristics, OLS estimates also indicate the high probability of selection into unobserved effect, considered as an omitted, the third variable such as a "thrill-thinking" personality influencing both problem outcomes.

TSLS estimates suggest that alcohol use does not increase the probability of having sex and the likelihood of engaging in risky sex for both male and female. For 10^{th} grade male respondent only, marijuana use does increase the likelihood of having sex and risky sex, however results are somewhat sensitive to the inclusion of state sentiment variables.

Instrument variables in the first stage fail to provide statistically significant results. These two findings cast some doubt on the credibility of TSLS estimation. Suffering from the problem of weak instrument variables, estimates also show that cocaine use is not a cause of having sex and risky sex.

In addition, the difficulty in linking the casual effect of substance use towards risky sexual behavior may be partially attributable to the limitation of the employed data set. In both 10^{th} grade and 12^{th} grade sub-sample sets, the measures of substance use are lagged rather than contemporaneous, which may inevitably alleviate biases if unobserved factor varies over time. On the other hand, lagged substance use may have weak causal effect on current risky sexual behavior. Establishing a causal effect of substance use such as alcohol, marijuana and cocaine on sexual behavior is essential to the design of effective public policies targeting at improving public health by affecting sexual behavior. However, despite all the effort to establish the causal link between substance use and risky sexual behavior, the causal impact of substance use on risky sexual behavior remains intricate.

Table I-1 Descriptive Analysis: Sample Mean and Standard Deviation

Variable	Definition	Mean (Standard Deviation)	
Dependent variables		10^{th} grade sample (N = 6,147)	12^{th} grade sample (N = 4,483)
Had sex in last month	Binary variable = 1 if respondent had at least 1 sexual intercourse in last month, 0 otherwise	0.503 (0.500)	0.490 (0.500)
Risky Sex	Binary variable = 1 if respondent had sex in last the past month and didn't use birth control, 0 otherwise	0.069 (0.254)	0.061 (0.240)
Predictors			
Used marijuana in lifetime	Dummy variable = 1 if respondent reports use of marijuana in lifetime, 0 otherwise	0.183 (0.386)	0.257 (0.437)
Used marijuana in last year	Dummy variable = 1 if respondent reports use of marijuana in last year, 0 otherwise	0.121 (0.327)	0.174 (0.379)
Used marijuana in last 30 days	Dummy variable = 1 if respondent reports use of marijuana in last 30 days, 0 otherwise	0.063 (0.243)	0.096 (0.295)
Used cocaine in lifetime	Dummy variable = 1 if respondent reports use of cocaine in lifetime, 0 otherwise	0.031 (0.174)	0.037 (0.190)
Used cocaine in last year	Dummy variable = 1 if respondent reports use of cocaine in last year, 0 otherwise	0.018 (0.131)	0.0199 (0.140)
Used cocaine in last 30 days	Dummy variable = 1 if respondent reports use of cocaine in last 30 days, 0 otherwise	0.008 (0.087)	0.008 (0.090)
Used alcohol in lifetime	Dummy variable = 1 if respondent reports use of alcohol in lifetime, 0 otherwise	0.826 (0.380)	0.894 (0.308)
Used alcohol in last year	Dummy variable = 1 if respondent reports use of alcohol in last year, 0 otherwise	0.687 (0.463)	0.784 (0.412)

Table I-1 Cont.			
Used alcohol in last 30 days	Dummy variable = 1 if respondent reports use of alcohol in last 30 days, 0 otherwise	0.399 (0.490)	0.519 (0.500)
Smokes daily	Dummy variable = 1 if respondent reports daily smoking, 0 otherwise	0.151 (0.358)	0.203 (0.402)
Other predictors			
Demographic Characteristics			
Female	Dummy variable = 1 if respondent is female, 0 otherwise	0.529 (0.499)	0.537 (0.499)
Asian	Dummy variable =1 if respondent is Asian, 0 otherwise	0.068 (0.252)	0.070 (0.256)
Hispanic	Dummy variable =1 if respondent is Hispanic, 0 otherwise	0.088 (0.284)	0.075 (0.263)
African-American	Dummy variable =1 if respondent is African-American, 0 otherwise	0.081 (0.273)	0.068 (0.251)
Native American	Dummy variable =1 if respondent is Native American, 0 otherwise	0.008 (0.090)	0.007 (0.082)
Central	Dummy variable = 1 if respondent lives in central region, 0 otherwise	0.317 (0.465)	0.336 (0.472)
South	Dummy variable = 1 if respondent lives in south region, 0 otherwise	0.311 (0.463)	0.300 (0.458)
West	Dummy variable = 1 if respondent lives in west region, 0 otherwise	0.168 (0.374)	0.153 (0.360)
Urban	Dummy variable = 1 if respondent lives in urban area, 0 otherwise	0.258 (0.438)	0.244 (0.430)
Rural	Dummy variable = 1 if respondent lives in rural area, 0 otherwise	0.330 (0.470)	0.338 (0.473)
Catholic	Dummy variable =1 if respondent is catholic, 0 otherwise	.284 (.451)	0.301 (0.459)

Table I-1 Cont.

Baptist or Methodist	Dummy variable = 1 if respondent is Baptist or Methodist, 0 otherwise	.256 (.437)	0.242 (0.429)
Other Christian	Dummy variable = 1 if respondent is other Christian, 0 otherwise	.086 (.280)	0.083 (0.277)
Other Religion	Dummy variable = 1 if respondent is other religion, 0 otherwise	.288 (.453)	0.296 (0.456)
Religion activity	Dummy variable = 1 if respondent spent time on religion activities, 0 otherwise	0.408 (0.492)	0.422 (0.494)
Hobbies	Dummy variable = 1 if respondent spent time on working hobbies, 0 otherwise	0.542 (0.498)	0.548 (0.498)
Family characteristics			
Mother high school drop out	Dummy variable = 1 if respondent's mother is a high school dropout, 0 otherwise	0.107 (0.309)	0.088 (0.283)
Mother some college	Dummy variable = 1 if respondent's mother completed some college but did not graduate, 0 otherwise	0.305 (0.460)	0.311 (0.463)
Mother college graduate	Dummy variable = 1 if respondent's mother is a college graduate, 0 otherwise	0.260 (0.439)	0.275 (0.446)
Father high school drop out	Dummy variable = 1 if respondent's father is a high school dropout, 0 otherwise	0.109 (0.312)	0.096 (0.294)
Father some college	Dummy variable = 1 if respondent's father completed some college but did not graduate, 0 otherwise	0.305 (0.461)	0.301 (0.459)
Father college graduate	Dummy variable = 1 if respondent's father is a college graduate, 0 otherwise	0.313 (0.464)	0.336 (0.473)
Step-family	Dummy variable = 1 if respondent lives with one biological parent and another non-biological parent figure, 0 otherwise	0.100 (0.300)	0.094 (0.292)
Single parent family	Dummy variable = 1 if respondent lives with one biological parent or relative only, 0 otherwise	0.147 (0.354)	0.132 (0.339)

Table I-1 Cont.			
Family income	Family income measured in 8th grade	10.105 (2.367)	10.263 (2.291)
Number of siblings	Number of siblings	2.119 (1.477)	2.075 (1.458)
High School Characteristics			
Was offered drugs	Dummy variable = 1 if respondent reports that someone offered to sell him/her drugs at school during first semester of current school year, 0 otherwise	0.145 (0.352)	0.136 (0.343)
Punishment for drug possession is expulsion	Dummy variable = 1 if school administrator reports that the punishment for the first occurrence of illegal drug possession is expulsion from school, 0 otherwise	0.408 (0.492)	0.405 (0.491)
Punishment for alcohol possession is expulsion	Dummy variable = 1 if school administrator reports that the punishment for the first occurrence of alcohol possession is expulsion from school, 0 otherwise	0.220 (0.414)	0.214 (0.410)
Drugs are a problem at this school	Dummy variable = 1 if school administrator reports that student use of illegal drugs is a moderate or serious problem at this school, 0 otherwise	.241 (.427)	0.198 (0.398)
Alcohol are a problem at this school	Dummy variable = 1 if school administrator reports that student use of alcohol is a moderate or serious problem at this school, 0 otherwise	.401 (.490)	0.474 (0.499)
8th grade personal characteristics			
Smoking daily	Dummy variable = 1 if respondent smoked daily in 8th grade, 0 otherwise	0.401 (0.198)	0.036 (0.186)
Number of times school called parents about behavior	Dummy variable = 1 if respondent reports that school called his/her parents about behavior, 0 otherwise	0.158 (0.365)	0.147 (0.354)

Table I-1 Cont.			
Was offered drugs in 8th grade	Dummy variable = 1 if respondent reports that someone offered to sell him/her drugs at school during first semester of current school year, 0 otherwise	0.073 (0.261)	0.065 (0.247)
State Illicit Drug and alcohol prices			
Marijuana Fine	Midpoint of minimum and maximum fine for marijuana possession, in 1,000 dollars	0.94 (6.05)	.983 (6.234)
Marijuana Jail Term	Midpoint of minimum and maximum jail term for marijuana possession, 1st weight category, in years	0.22 (0.33)	.221 (.304)
Marijuana Arrests	Possession arrest of marijuana	8.62 (7.58)	8.64 (8.03)
Cocaine Arrests	Possession arrest of cocaine	16.56 (29.63)	14.00 (23.25)
State cocaine price	Predicted price of a gram of pure cocaine using a model that assumes potency to be endogenous and restricts the coefficient of potency and net weight to be the same in the second stage of the regression.	136.42 (35.16)	101.081 (29.102)
State beer Tax	Real state excise tax on beer per gallon (deflated by the CPI)	0.15 (0.12)	0.147 (0.111)
State Sentiment Variables			
Protestant	% of state that is Protestant	23.61 (8.50)	22.836 (8.309)
Southern Baptist	% of state that is Southern Baptist	7.52 (9.87)	7.191 (9.681)
Catholic	% of state that is Catholic	21.85 (12.17)	22.040 (12.039)
Mormon	% of state that is Mormon	1.27 (5.43)	1.247 (5.401)
Income	Real income in state in thousands	146.90 (20.49)	146.939 (18.964)
Unemployment	State unemployment rate	5.48 (0.92)	7.193 (1.401)

Note: Standard deviation is in brackets

Table I-2-A Sexual Behaviors and Observed Characteristics conditional on Drug and Alcohol use of 10th graders (for all users and non-users)

	10th Grade Sample (N = 6,147)					
	Marijuana Use		Cocaine Use		Alcohol Use	
	No	Yes	No	Yes	No	Yes
Had sex	0.463	0.681**	0.497	0.688**	0.332	0.539**
Risky sex	0.058	0.123**	0.067	0.149**	0.053	0.073**
Female	0.536	0.500**	0.531	0.464	0.536	0.528
Asian	0.076	0.034**	0.069	0.036	0.103	0.061**
Hispanic	0.085	0.102	0.087	0.130**	0.075	0.091
African-American	0.085	0.061**	0.081	0.068	0.143	0.069**
Native American	0.007	0.015**	0.008	0.010	0.009	0.008
Central	0.315	0.322	0.318	0.276	0.267	0.327**
South	0.317	0.283**	0.308	0.380**	0.365	0.299**
West	0.162	0.192**	0.167	0.177	0.192	0.162**
Urban	0.258	0.261	0.257	0.307	0.258	0.258
Rural	0.337	0.299**	0.331	0.297	0.342	0.327
Catholic	0.286	0.276	0.284	0.292	0.183	0.305**
Baptist or Methodist	0.263	0.224**	0.258	0.208	0.296	0.248**
Other Christian	0.087	0.082	0.287	0.063	0.092	0.084
Other Religion	0.291	0.274	0.086	0.313	0.350	0.275**
Religion activity	0.442	0.254**	0.412	0.292**	0.560	0.376**
Hobbies	0.537	0.560	0.541	0.573	0.529	0.544
Mother high school drop out	0.102	0.130**	0.105	0.182**	0.115	0.105
Mother some college	0.308	0.291	0.305	0.313	0.320	0.302
Mother college graduate	0.271	0.210**	0.264	0.135**	0.261	0.260
Father high school drop out	0.104	0.134**	0.107	0.172**	0.115	0.108
Father some college	0.302	0.319	0.303	0.359	0.318	0.302
Father college graduate	0.324	0.263**	0.317	0.198**	0.317	0.312
Step-family	0.087	0.160**	0.098	0.156**	0.057	0.109**
Single parent family	0.134	0.206**	0.145	0.214**	0.125	0.151**
Family income	10.152	9.895**	10.120	9.662**	9.864	10.156**
Number of siblings	2.104	2.183	2.112	2.333	2.317	2.077**
10th grade Student and School Characteristics						

Table I-2-A Cont.						
Marijuana users	-----	-----	0.158	0.964**	0.005	0.220**
Cocaine users	0.001	0.165**	-----	------	0.001	0.038**
Alcohol users	0.790	0.996**	0.822	0.995**	------	------
Smoke daily	0.077	0.480**	0.134	0.672**	0.022	0.178**
Was offered drugs	0.084	0.415**	0.408	0.573**	0.043	0.166**
Punishment for drug possession is expulsion	0.409	0.404	0.131	0.411	0.427	0.404
Punishment for alcohol possession is expulsion	0.219	0.224	0.220	0.224	0.247	0.214**
Drugs are problem at this school	0.233	0.273**	0.239	0.281	0.206	0.248**
Alcohol is a problem at this school	0.395	0.428**	0.401	0.417	0.359	0.410**
8th Grade problem Behaviors						
Smoked daily	0.016	0.154**	0.034	0.245**	0.007	0.048**
School called parents about behavior	0.122	0.321**	0.149	0.443**	0.095	0.172**
Offered drugs in 8th grade	0.045	0.199**	0.065	0.328**	0.030	0.082**

Note: The results of ttest statistics are presented in this panel. Variables with * are statistically significant at 10% level, with ** are significant at 5% level and variables with *** are statistically significant at 1% level.

Table I-2-B Sexual Behaviors and Observed Characteristics conditional on Drug and Alcohol use of 12th graders (for all users and non-users)

	12th Grade Sample (N = 4,483)					
	Marijuana Use		Cocaine Use		Alcohol Use	
	No	Yes	No	Yes	No	Yes
Had sex	0.433	0.653**	0.480	0.75**	0.217	0.522**
Risky sex	0.048	0.101**	0.058	0.143**	0.023	0.066**
Female	0.554	0.487**	0.541	0.435**	0.549	0.535
Asian	0.083	0.035**	0.072	0.030**	0.116	0.065**
Hispanic	0.068	0.093**	0.073	0.107	0.053	0.077**
African-American	0.077	0.042**	0.069	0.030**	0.131	0.060**
Native American	0.006	0.010	0.006	0.012	0.008	0.006
Central	0.335	0.340	0.337	0.321	0.248	0.346**
South	0.315	0.254**	0.302	0.226**	0.383	0.290**
West	0.147	0.171**	0.150	0.238**	0.211	0.146**
Urban	0.242	0.250	0.246	0.202	0.234	0.245
Rural	0.356	0.286**	0.341	0.262**	0.341	0.338
Catholic	0.291	0.330**	0.072	0.030	0.166	0.317**
Baptist or Methodist	0.258	0.197**	0.073	0.107	0.309	0.235**
Other Christian	0.080	0.092	0.069	0.030	0.084	0.083
Other Religion	0.305	0.268**	0.779	0.821	0.383	0.285**
Religion activity	0.472	0.276**	0.430	0.214**	0.648	0.395**
Hobbies	0.541	0.569	0.547	0.577	0.545	0.549
Mother high school drop out	0.088	0.087	0.086	0.149**	0.088	0.088
Mother some college	0.310	0.313	0.311	0.310	0.331	0.308
Mother college graduate	0.279	0.263	0.280	0.137**	0.288	0.273
Father high school drop out	0.094	0.102	0.094	0.149**	0.082	0.097
Father some college	0.301	0.303	0.300	0.333	0.328	0.298
Father college graduate	0.337	0.333	0.341	0.220**	0.356	0.334
Step-family	0.082	0.130**	0.092	0.137	0.055	0.099**
Single parent family	0.119	0.171**	0.130	0.196**	0.114	0.134
Family income	10.228	10.365	10.270	10.101	10.029	10.29**
Number of siblings	2.087	2.041	2.076	2.042	2.265	2.053**
12th grade Student and School Characteristics						

Table I-2-B Cont.						
Marijuana users	------	------	0.230	0.952**	0.011	0.286**
Cocaine users	0.002	0.139**	------	------	0.000	0.042**
Alcohol users	0.859	0.996**	0.890	1.000**	------	------
Smoke daily	0.102	0.494**	0.186	0.649**	0.021	0.224**
Was offered drugs	.0636	0.345**	0.117	0.607**	0.051	0.146**
Punishment for drug possession is expulsion	0.405	0.406	0.406	0.375	0.415	0.404
Punishment for alcohol possession is expulsion	0.213	0.215	0.214	0.196	0.261	0.208**
Drugs are problem at this school	0.1948	0.207	0.197	0.232	0.251	0.192**
Alcohol is a problem at this school	0.469	0.487	0.472	0.506	0.486	0.472
8th Grade problem Behaviors						
Smoked daily	0.017	0.089**	0.033	0.119**	0.008	0.039**
School called parents about behavior	0.107	0.262**	0.137	0.411**	0.078	0.155**
Offered drugs in 8th grade	0.041	0.137**	0.059	0.238**	0.023	0.070**

Note:The results of ttest statistics are presented in this table. Variables with ** are statistically significant at 5% level,

Table I-3 Sample Mean of Sexual Behaviors and Substances use along Observed Characteristics by Gender

	10th graders sample (N = 6,147)		12th graders sample (N = 4,483)	
	Male (N=2,893)	**Female (N=3,254)**	**Male (N=2,076)**	**Female (N=2,474)**
Had sex in last month	.521**	.488	.503	.478
Risky sex	.072	.067	.067	.056
Marijuana use	.069	.058	.108**	.086
Cocaine use	.011**	.004	.014**	.003
Alcohol use	.422**	.378	.567**	.478
Asian	.069	.067	.068	.072
Hispanic	.086	.090	.071	.078
African-American	.065**	.095	.055**	.079
Native American	.006**	.010	.006	.007
Central	.319	.315	.342	.331
South	.303	.317	.286	.312
West	.168	.167	.153	.153
Urban	.257	.259	.240	.247
Rural	.329	.331	.344	.333
Catholic	.287	.281	.307	.295
Baptist or Methodist	.237**	.274	.224	.259
Other Christian	.081	.090	.078	.088
Other Religion	.293	.283	.302	.290
Religion activity	.373**	.439	.385**	.453
Hobbies	.600**	.490	.608**	.496
Mother high school drop out	.091**	.121	.074**	.100
Mother some college	.297	.312	.308	.313
Mother college graduate	.283**	.239	.302**	.251
Father high school drop out	.104	.114	.090	.100
Father some college	.288**	.320	.291	.310
Father college graduate	.333**	.295	.359**	.317
Step-family	.095	.105	.090	.098
Single parent family	.141	.152	.123	.140
Family income	10.219**	10.005	10.391**	10.153
Number of siblings	2.091	2.144	2.010**	2.132
Smoke daily	.135**	.164	.197	.207
Was offered drugs	.193**	.102	.188**	.091
Punishment for drug possession is expulsion	.409	.407	.406	.405
Punishment for alcohol possession is expulsion	.221	.219	.214	.214

Table I-3 Cont.

Drugs are problem at this school	.250	.232	.191	.204
Alcohol is a problem at this school	.412	.391	.476	.471
Smoked daily in 8th grade	.044	.038	.039	.033
School called parents about behavior	.222**	.102	.206**	.096
Offered drugs in 8th grade	.088**	.060	.079**	.053

Note: The results of T-test statistics are presented in this table. Variables with ** are significant at the level of 5%.

Table I-4 Substance Use and Had Sex in OLS estimation

	(1)		(2)		(3)		(4)	
	No controls		Basic Controls (with only exogenous covariates)		Model (2) with addition of high school variables		Model (3) with addition of 8th grade personal variables (a full set of covariates)	
Had sex in last month	Male	Female	Male	Female	Male	Female	Male	Female
Alcohol use in 10th grade	0.202 (10.06)	0.186 (9.44)	0.190 (9.77)	0.144 (7.67)	0.167 (7.75)	0.114 (5.91)	0.158 (7.40)	0.109 (5.46)
Alcohol use in 12th grade	0.235 (11.21)	0.158 (7.25)	0.224 (11.25)	0.136 (5.95)	0.202 (8.88)	0.092 (4.34)	0.197 (8.64)	0.088 (4.15)
Marijuana use in 10th grade	0.180 (5.60)	0.239 (8.24)	0.150 (5.01)	0.167 (5.85)	0.054 (1.97)	0.065 (1.95)	0.039 (1.46)	0.050 (1.65)
Marijuana use in 12th grade	0.161 (4.61)	0.273 (7.94)	0.142 (3.91)	0.204 (5.02)	0.072 (1.77)	0.106 (2.34)	0.057 (1.39)	0.099 (2.20)
Cocaine use in 10th grade	0.193 (2.68)	0.211 (3.52)	0.152 (2.22)	0.163 (2.85)	0.043 (0.67)	0.030 (0.47)	0.016 (0.25)	-0.011 (-0.16)
Cocaine use in 12th grade	0.286 (4.80)	0.231 (2.96)	0.255 (3.79)	0.142 (1.74)	0.156 (2.32)	-0.011 (-0.13)	0.131 (1.88)	-0.037 (-0.42)

Notes:

1. T-statistics in parentheses. Standard errors are adjusted for clustering on state of residence.
2. Column (2) basic controls: female, race/ethnicity categories, region categories, urban, rural, religion categories, mother high school drop out, mother some college, mother college graduate, father high school drop out, father some college, father college graduate, step family, single parent family, family income, number of siblings.
3. Column (3) high school variables: smokes daily in the current school year, was offered drugs in 10th grade, Punishment for drug possession is expulsion, punishment for alcohol possession is expulsion, drugs are a problem at this school, alcohol is a problem at this school.
4. Column (4) 8th grade personal variables: smoking daily in 8th grade, school called parents about students' problematic behavior in 8th grade, was offered drug in 8th grade.

Table I-5 Substance Use and Risky Sex in OLS estimation

	(1)		(2)		(3)		(4)	
	No controls		Basic Controls (with only exogenous covariates)		Model (2) with addition of high school variables		Model (3) with addition of 8th grade personal variables (a full set of covariates)	
Last month risky sex	Male	Female	Male	Female	Male	Female	Male	Female
Alcohol use in 10th grade	0.045 (5.53)	0.032 (3.87)	0.045 (5.11)	0.025 (2.85)	0.034 (3.85)	0.011 (1.22)	0.032 (3.55)	0.009 (0.99)
Alcohol use in 12th grade	0.042 (4.30)	0.029 (3.46)	0.041 (4.01)	0.030 (3.34)	0.028 (2.70)	0.013 (1.24)	0.026 (2.54)	0.011 (1.02)
Marijuana use in 10th grade	0.084 (3.23)	0.087 (4.59)	0.075 (2.89)	0.071 (3.96)	0.049 (1.71)	0.038 (1.62)	0.044 (1.57)	0.030 (1.30)
Marijuana use in 12th grade	0.060 (3.42)	0.082 (4.14)	0.062 (3.54)	0.079 (3.82)	0.040 (1.92)	0.049 (2.14)	0.036 (1.85)	0.046 (2.05)
Cocaine use in 10th grade	0.107 (2.02)	0.086 (1.42)	0.089 (1.76)	0.076 (1.30)	0.044 (0.81)	0.032 (0.52)	0.039 (0.70)	0.010 (0.15)
Cocaine use in 12th grade	0.099 (1.87)	0.092 (1.81)	0.094 (1.76)	0.077 (1.56)	0.061 (1.11)	0.030 (0.59)	0.056 (1.00)	0.021 (0.43)

Notes:

1. T-statistics in parentheses. Standard errors are adjusted for clustering on state of residence.
2. Column (2) basic controls: female, race/ethnicity categories, region categories, urban, rural, religion categories, mother high school drop out, mother some college, mother college graduate, father high school drop out, father some college, father college graduate, step family, single parent family, family income, number of siblings.
3. Column (3) high school variables: smokes daily in the current school year, Was offered drugs in 10th grade, Punishment for drug possession is expulsion, punishment for alcohol possession is expulsion, drugs are a problem at this school, alcohol is a problem at this school.
4. Column (4) 8th grade personal variables: smoking daily in 8th grade, school called parents about students' problematic behavior in 8th grade, was offered drug in 8th grade.

Table I-6 Had Sex and Alcohol Use, 2SLS estimates

	Exogenous covariates only				A full set of covariates			
	(1) 2SLS with state policies only as IVs		(2) Model (2) with state sentiment variables		(3) 2SLS with state policies only as IVs		(4) Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Alcohol Use	0.449 (1.75)	-0.086 (-0.11)	0.451 (2.03)	0.714 (1.39)	0.432 (1.43)	-0.084 (-0.14)	0.444 (1.67)	0.663 (1.22)
R-Squared	0.034	0.054	0.036	0.086	0.050	0.084	0.047	0.106
F-test on identifying IVs	2.990 [0.014]	0.780 [0.591]	4.920 [0.001]	0.960 [0.462]	2.950 [0.015]	1.740 [0.120]	5.310 [0.000]	0.870 [0.525]
Over-identification Test	3.001 [0.700]	7.050 [0.217]	4.091 [0.537]	4.624 [0.464]	3.821 [0.575]	8.935 [0.112]	5.010 [0.415]	4.896 [0.429]
Hausman Test	1.02 [0.317]	0.10 [0.752]	1.60 [0.212]	2.23 [0.142]	0.92 [0.341]	0.10 [0.749]	1.350 [0.251]	2.480 [0.121]
12^{th} Grade Alcohol Use	0.361 (1.03)	0.156 (0.69)	0.312 (0.98)	0.244 (1.92)	0.299 (0.87)	0.083 (0.31)	0.129 (0.41)	0.229 (1.27)
R-Squared	0.089	0.102	0.104	0.097	0.116	0.124	0.126	0.113
F-test on identifying IVs	1.82 [0.115]	13.23 [0.000]	2.060 [0.075]	15.690 [0.000]	1.69 [0.144]	9.11 [0.000]	2.22 [0.057]	8.76 [0.000]
Over-identification Test	2.003 [0.849]	11.213 [0.047]	5.986 [0.308]	7.407 [0.192]	2.866 [0.721]	12.589 [0.028]	6.339 [0.275]	8.358 0.138
Hausman Test	0.16 [0.692]	0.01 [0.927]	0.090 [0.762]	0.810 [0.373]	12.60 [0.001]	1.96 [0.168]	0.04 [0.843]	0.69 [0.409]

Notes:

1. T-statistics in parentheses, P-values in brackets. Standard errors are adjusted for clustering on the state of residence.
2. Exogenous variables: female, Asian, Hispanic, African-American, Native American, Central, South, West, Urban, Rural, Catholic, Baptist or Methodist, Other Christian, Other Religion, Religion activity, Hobbies, Mother high school drop out, Mother some college, Mother college graduate, Father high school drop out, Father some college, Father college graduate, Step-family, Single parent family, Family income, Number of siblings
3. Expanded set of variables: high school variables including smokes daily in the current school year, Was offered drugs in 10^{th} grade, Punishment for drug possession is expulsion, punishment for alcohol possession is expulsion, drugs are a problem at this school, alcohol is a problem at this school; And 8^{th} grade personal variables containing smoking daily in 8^{th} grade, school called parents about students' problematic behavior in 8^{th} grade, was offered drug in 8^{th} grade
4. State sentiment variables: religious composition of state, State real income, unemployment rate
5. State illicit drug and alcohol policy instruments: midpoint of minimum and maximum real fine for marijuana possession, midpoint of minimum and maximum jail term for marijuana possession, possession arrest of marijuana, cocaine price, possession arrest of cocaine, real beer tax

Table I-7 Risky Sex and Alcohol Use, 2SLS estimates

	Exogenous covariates only				A full set of covariates			
	(1) 2SLS with state policies only as IVs		(2) Model (2) with state sentiment variables		(3) 2SLS with state policies only as IVs		(4) Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Alcohol Use	0.033	0.275	0.108	0.087	0.066	0.230	0.126	0.084
	(0.32)	(0.98)	(1.00)	(0.41)	(0.50)	(1.04)	(0.93)	(0.39)
R-Squared	0.035	0.037	0.025	0.027	0.043	0.050	0.023	0.034
F-test on identifying IVs	2.990	0.780	4.920	0.960	2.950	1.740	5.310	0.870
	[0.014]	[0.591]	[0.001]	[0.462]	[0.015]	[0.120]	[0.000]	[0.525]
Over-identification Test	8.319	2.699	7.878	4.532	9.341	2.681	8.219	5.974
	[0.140]	[0.746]	[0.163]	[0.476]	[0.092]	[0.749]	[0.145]	[0.309]
Hausman Test	0.01	0.92	0.32	0.10	0.06	1.24	0.510	0.150
	[0.907]	[0.342]	[0.575]	[0.755]	[0.802]	[0.271]	[0.478]	[0.700]
12^{th} Grade Alcohol Use	-0.280	0.078	-0.209	0.023	-0.350	0.053	-0.285	-0.025
	(-1.19)	(1.07)	(-1.17)	(0.28)	(-1.65)	(0.55)	(-1.74)	(-0.27)
R-Squared	0.026	0.020	0.029	0.033	0.039	0.044	-0.276	0.049
F-test on identifying IVs	1.82	13.23	2.060	15.690	1.69	9.11	2.22	8.76
	[0.115]	[0.000]	[0.075]	[0.000]	[0.144]	[0.000]	[0.057]	[0.000]
Over-identification Test	8.611	4.832	11.738	2.694	8.922	5.846	11.944	1.287
	[0.126]	[0.437]	[0.038]	[0.747]	[0.112]	[0.322]	[0.036]	[0.936]
Hausman Test	2.18	0.045	2.12	0.000	5.28	0.26	3.53	0.14
	[0.147]	[0.507]	[0.152]	[0.947]	[0.026]	0.610	[0.066]	[0.710]

Notes: See Table I-6

Table I-8 Had Sex and Marijuana Use, 2SLS estimates

	Exogenous covariates only				A full set of covariates			
	(1) 2SLS with state policies only as IVs		(2) Model (2) with state sentiment variables		(3) 2SLS with state policies only as IVs		(4) Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Marijuana Use	0.561 (1.91)	-0.200 (-1.06)	0.308 (1.56)	-0.615 (-1.61)	1.484 (1.24)	-0.895 (-1.24)	1.216 (1.54)	-2.222 (-2.11)
R-Squared	0.064	0.083	0.070	0.086	0.093	0.104	0.097	0.106
F-test on identifying IVs	3.49 [0.006]	0.93 [0.484]	2.73 [0.043]	0.89 [0.509]	5.23 [0.000]	4.00 [0.002]	3.450 [0.006]	1.33 [0.262]
Over-identification Test	1.586 [0.903]	5.570 [0.350]	3.43 [0.635]	3.08 [0.687]	2.181 [0.824]	7.207 [0.206]	4.050 [0.542]	3.730 0.589
Hausman Test	3.75 [0.058]	2.04 [0.160]	3.07 [0.09]	4.37 [0.042]	4.28 [0.044]	1.56 [0.217]	3.420 [0.071]	3.560 [0.065]
12^{th} Grade Marijuana Use	0.197 (0.29)	0.903 (1.76)	-0.294 (-0.81)	0.999 (1.13)	0.018 (0.03)	0.620 (1.53)	-0.487 (-1.27)	0.494 (1.01)
R-Squared	0.066	0.086	0.006	0.090	0.093	0.054	0.009	0.086
F-test on identifying IVs	1.91 [0.098]	4.99 [0.001]	2.09 [0.072]	1.26 [0.292]	1.78 [0.122]	10.43 [0.000]	2.770 [0.021]	4.190 [0.002]
Over-identification Test	3.084 [0.687]	7.948 [0.159]	6.51 [0.260]	8.19 [0.146]	3.792 [0.580]	9.974 [0.076]	6.500 [0.261]	9.715 [0.084]
Hausman Test	0.01 [0.936]	2.72 [0.106]	1.49 [0.228]	1.22 [0.274]	21.12 [0.000]	5.38 [0.025]	2.320 [0.134]	0.730 [0.356]

Notes: See Table I-6

Table I-9 Risky Sex and Marijuana Use, 2SLS estimates

	Exogenous covariates only				A full set of covariates			
	(1) 2SLS with state policies only as IVs		(2) Model (2) with state sentiment variables		(3) 2SLS with state policies only as IVs		(4) Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Marijuana Use	0.138 (0.50)	0.047 (0.11)	0.676 (1.87)	-0.180 (-0.43)	0.188 (0.61)	0.399 (1.06)	0.760 (1.83)	-0.145 (-0.26)
R-Squared	0.030	0.040	0.032	0.038	0.029	0.050	0.047	0.032
F-test on identifying IVs	3.49 [0.006]	0.93 [0.484]	2.37 [0.043]	0.89 [0.509]	5.23 [0.000]	4.00 [0.002]	3.45 [0.006]	1.33 [0.262]
Over-identification Test	8.626 [0.125]	3.690 [0.595]	6.88 [0.230]	3.60 [0.609]	9.736 [0.083]	2.016 [0.847]	5.973 [0.309]	5.575 [0.350]
Hausman Test	0.05 [0.825]	0.00 [0.958]	2.86 [0.097]	0.34 [0.563]	0.21 [0.647]	1.13 [0.293]	3.320 [0.074]	0.090 [0.771]
12^{th} Grade Marijuana Use	0.357 (1.08)	0.301 (1.59)	0.018 (0.08)	0.161 (0.45)	0.480 (1.28)	0.280 (1.68)	0.026 (0.11)	0.125 (0.53)
R-Squared	0.025	0.027	0.031	0.028	0.038	0.051	0.043	0.048
F-test on identifying IVs	1.91 [0.098]	4.99 [0.001]	2.09 [0.072]	1.26 [0.292]	1.78 [0.122]	10.43 [0.000]	2.770 [0.021]	4.190 [0.002]
Over-identification Test	9.799 [0.081]	3.456 [0.630]	12.35 [0.030]	2.19 [0.822]	9.478 [0.091]	2.832 [0.726]	12.757 [0.026]	0.927 [0.968]
Hausman Test	1.00 [0.322]	1.53 [0.223]	0.03 [0.853]	0.06 [0.815]	0.78 [0.380]	0.24 [0.627]	0.000 [0.962]	0.110 [0.736]

Notes: See Table I-6

Table I-10 Had Sex and Cocaine Use, 2SLS estimates

	Exogenous covariates only				A full set of covariates			
	(1) 2SLS with state policies only as IVs		(2) Model (2) with state sentiment variables		(3) 2SLS with state policies only as IVs		(4) Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Cocaine Use	1.541	-3.563	-0.600	-4.264	0.220	-3.185	-3.082	-2.930
	(0.78)	(-1.73)	(-0.36)	(-1.38)	(0.09)	(-1.78)	(-1.74)	(-1.40)
R-Squared	0.063	0.084	0.024	0.087	0.089	0.105	0.097	0.106
F-test on identifying IVs	2.08	8.32	1.68	3.10	1.47	11.12	1.570	6.26
	[0.072]	[0.000]	[0.145]	[0.012]	[0.208]	[0.000]	[0.175]	[0.000]
Over-identification Test	7.323	1.044	7.69	1.49	7.066	2.193	3.194	3.834
	[0.198]	[0.959]	[0.174]	[0.914]	[0.216]	[0.822]	[0.670]	[0.574]
Hausman Test	0.44	8.98	0.23	7.54	0.01	5.28	6.190	3.100
	[0.509]	[0.004]	[0.632]	[0.008]	[0.934]	[0.026]	[0.016]	[0.085]
12^{th} Grade Cocaine Use	-0.928	1.040	-3.137	1.059	-1.381	1.010	-4.023	1.079
	(-0.49)	(1.75)	(-1.05)	(2.27)	(-0.77)	(1.73)	(-1.46)	(2.55)
R-Squared	0.060	0.042	0.069	0.044	0.098	0.062	-0.238	0.058
F-test on identifying IVs	2.07	8.34	0.960	4.310	3.19	2.25	1.60	2.92
	[0.043]	[0.000]	[0.459]	[0.002]	[0.010]	[0.055]	[0.167]	[0.017]
Over-identification Test	2.282	11.514	2.487	9.564	1.787	12.581	1.212	11.061
	[0.809]	[0.043]	[0.778]	[0.089]	[0.878]	[0.028]	[0.944]	[0.050]
Hausman Test	0.41	1.79	4.420	4.280	15.58	6.14	8.93	5.95
	[0.523]	[0.187]	[0.041]	[0.044]	[0.000]	[0.017]	[0.004]	[0.019]

Notes: See Table I-6

Table I-11 Risky Sex and Cocaine Use, 2SLS estimates

	Exogenous covariates only				A full set of covariates			
	(1) 2SLS with state policies only as IVs		(2) Model (2) with state sentiment variables		(3) 2SLS with state policies only as IVs		(4) Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Cocaine Use	-1.758 (-1.64)	0.146 (0.24)	-1.846 (-2.23)	-0.061 (-0.08)	-3.080 (-1.68)	0.398 (0.71)	-2.105 (-1.66)	0.319 (0.47)
R-Squared	0.029	0.037	0.032	0.035	0.045	0.020	0.047	0.032
F-test on identifying IVs	2.08 [0.072]	8.32 [0.000]	1.68 [0.145]	3.10 [0.012]	1.47 [0.208]	11.12 [0.000]	1.570 [0.175]	6.260 [0.000]
Over-identification Test	3.948 [0.557]	2.342 [0.800]	2.02 [0.847]	3.58 [0.611]	1.993 [0.850]	3.059 [0.891]	2.750 [0.738]	4.472 [0.484]
Hausman Test	7.97 [0.007]	0.01 [0.910]	16.85 [0.000]	0.03 [0.862]	11.55 [0.001]	0.54 [0.504]	9.130 [0.004]	0.210 [0.646]
12^{th} Grade Cocaine Use	-1.309 (-1.42)	-0.180 (-0.49)	-3.361 (-1.48)	-0.169 (-0.43)	-1.061 (-1.30)	-0.134 (-0.35)	-2.733 (-1.92)	-0.063 (-0.18)
R-Squared	0.026	0.011	0.032	0.015	0.039	0.045	-2.806	0.052
F-test on identifying IVs	2.07 [0.073]	8.34 [0.000]	0.960 [0.460]	4.310 [0.002]	3.19 [0.010]	2.25 [0.055]	1.60 [0.167]	2.92 [0.017]
Over-identification Test	7.332 [0.197]	4.198 [0.521]	3.375 [0.642]	1.721 [0.886]	9.210 [0.101]	5.642 [0.343]	4.965 [0.420]	1.378 [0.927]
Hausman Test	2.87 [0.097]	0.59 [0.447]	9.590 [0.003]	0.510 [0.478]	4.43 [0.040]	0.00 [0.972]	11.97 [0.001]	0.06 [0.807]

Notes: See Table I-6

Table I-12 Had Sex and Substance Use, Reduced form estimates

	Exogenous covariates only				A full set of covariates			
	(1)		(3)		(3)		(4)	
	2SLS with state policies only as IVs		Model (2) with state sentiment variables		2SLS with state policies only as IVs		Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th grade Sample								
Marijuana Fine	-1.81e-07	5.70e-07	-9.06E-07	1.90E-08	-2.04E-07	2.19E-07	-8.20E-07	-3.42E-07
	(-0.26)	(1.11)	(-1.33)	(0.04)	(-0.30)	(0.41)	(-1.26)	(-0.67)
Marijuana Jail Term	0.030	0.019	0.022	0.030	0.022	0.026	0.015	0.035
	(1.64)	(0.85)	(1.14)	(1.94)	(1.27)	(1.09)	(0.80)	(2.15)
Marijuana arrests	-0.002	0.004	-0.002	0.003	-0.002	0.004	-0.002	0.003
	(-0.65)	(2.30)	(-0.93)	(1.60)	(-0.90)	(2.42)	(-0.94)	(1.75)
Cocaine price	-0.0004	0.0001	-0.0004	-0.0001	-0.0003	0.0001	-0.0002	-0.0002
	(-1.19)	(0.35)	(-1.05)	(-0.35)	(-0.98)	(0.30)	(-0.68)	(-0.50)
Cocaine arrests	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001	-0.001
	(1.40)	(-1.81)	(1.32)	(-1.69)	(1.73)	(-1.86)	(1.56)	(-1.76)
Beer Tax	0.129	0.152	0.196	0.169	0.146	0.163	0.201	0.164
	(1.32)	(1.89)	(2.21)	(2.35)	(1.50)	(2.07)	(2.17)	(2.34)
12th Grade Sample								
Marijuana Fine	-1.94e-07	1.24e-06	-1.64E-06	9.16E-07	-4.89E-07	5.09E-07	-1.89E-06	1.44E-07
	(-0.22)	(1.93)	(-2.09)	(1.52)	(-0.57)	(0.77)	(-2.51)	(0.23)
Marijuana Jail Term	0.032	0.0004	0.042	0.0160	0.027	0.010	0.037	0.023
	(1.08)	(0.01)	(1.64)	(0.57)	(1.01)	(0.25)	(1.58)	(0.80)
Marijuana arrests	-0.003	0.004	-0.002	0.004	-0.003	0.003	-0.002	0.003
	(-0.97)	(2.66)	(-0.99)	(2.76)	(-1.05)	(1.78)	(-1.06)	(1.92)
Cocaine price	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-1.11)	(-1.32)	(-2.62)	(-1.51)	(-0.88)	(-1.60)	(-2.38)	(-2.06)
Cocaine arrests	0.001	-0.001	0.005	-0.001	0.001	-0.001	0.001	-0.001
	(1.07)	(-1.92)	(0.57)	(-1.84)	(1.30)	(-1.44)	(0.94)	(-1.09)
Beer Tax	0.022	0.287	0.068	0.298	0.022	0.295	0.048	0.284
	(0.14)	(3.88)	(0.51)	(4.40)	(0.16)	(4.47)	(0.41)	(5.09)

Table I-13 Risky Sex and Substance Use, Reduced form estimates

	Exogenous covariates only				A full set of covariates			
	(1)		(3)		(3)		(4)	
	2SLS with state policies only as IVs		Model (2) with state sentiment variables		2SLS with state policies only as IVs		Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th grade Sample								
Marijuana Fine	-7.54e-07	0.000	-6.93E-07	-1.34E-07	-7.08E-07	-4.09E-07	-6.11E-07	-4.06E-07
	(-2.95)	(-0.65)	(-2.47)	(-0.64)	(-2.69)	(-1.77)	(-2.12)	(-1.81)
Marijuana Jail Term	-0.0004	0.002	0.002	0.001	-0.0001	0.004	0.001	0.004
	(-0.03)	(0.18)	(0.09)	(0.14)	((-0.01)	(0.46)	(0.04)	(0.38)
Marijuana arrests	-0.002	0.000	-0.002	-0.001	-0.002	-0.001	-0.001	-0.001
	(-1.66)	(-0.56)	(-1.23)	(-1.59)	(-1.65)	(-0.79)	(-1.20)	(-1.75)
Cocaine price	0.00001	0.000	0.000	-0.0002	0.000	-0.0001	0.000	-0.0002
	(0.10)	(-0.85)	(-0.02)	(-1.50)	(0.38)	(-0.83)	(0.33)	(-1.53)
Cocaine arrests	0.001	0.000	0.001	0.0003	0.001	0.0002	0.001	0.0003
	(2.30)	(1.15)	(2.15)	(1.58)	(2.29)	(1.46)	(2.20)	(1.86)
Beer Tax	0.135	0.001	0.114	0.010	0.131	0.007	0.107	0.013
	(2.46)	(0.01)	(2.50)	(0.28)	(2.56)	(0.16)	(2.51)	(0.32)
12th Grade Sample								
Marijuana Fine	-5.15e-07	2.88e-07	-6.94E-07	5.22E-07	-5.13E-07	-2.42E-07	-6.64E-07	-4.40E-08
	(-1.54)	(0.98)	(-2.08)	(1.89)	(-1.44)	(-0.75)	(-1.83)	(-0.15)
Marijuana Jail Term	-0.020	-0.010	-0.012	-0.009	-0.019	-0.007	-0.011	-0.004
	(-1.39)	(-0.73)	(-0.83)	(-0.64)	(-1.42)	(-0.49)	(-0.90)	(-0.32)
Marijuana arrests	-0.002	-0.0004	-0.001	-0.001	-0.002	-0.0004	-0.001	-0.00 4
	(-1.34)	(-0.46)	(-0.86)	(-0.79)	(-1.35)	(-0.45)	(-0.88)	(-0.52)
Cocaine price	-0.0004	-0.0002	-0.001	0.0001	-0.0004	-0.0002	-0.001	-0.0001
	(-1.72)	(-0.84)	(-3.11)	(-0.30)	(-1.58)	(-0.97)	(-2.96)	(-0.62)
Cocaine arrests	0.001	0.0003	0.0003	0.0002	0.001	0.0003	0.0004	0.0002
	(1.72)	(1.11)	(0.66)	(0.66)	(1.82)	(1.08)	(0.94)	(0.59)
Beer Tax	0.187	-0.010	0.175	0.014	0.189	-0.004	0.168	0.015
	(2.73)	(-0.25)	(3.24)	(0.29)	(2.79)	(-0.11)	(3.06)	(0.33)

Table I-14 Alcohol Use, First Stage Estimates

	Exogenous covariates only				A full set of covariates			
	(1)		(3)		(3)		(4)	
	2SLS with state policies only as IVs		Model (2) with state sentiment variables		2SLS with state policies only as IVs		Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Alcohol Use								
Marijuana Fine	-1.48E-06	6.72E-07	-2.34E-06	4.60E-07	-1.72E-06	-2.16E-07	-2.41E-06	-3.36E-07
	(-3.01)	(1.24)	(-4.37)	(0.91)	(-3.17)	(-0.47)	(-4.63)	(-0.70)
Marijuana Jail Term	0.053	0.016	0.075	0.043	0.045	0.029	0.067	0.051
	(2.13)	(0.80)	(2.71)	(1.76)	(1.83)	(1.60)	(2.47)	(2.22)
Marijuana arrests	-0.002	0.0002	-0.002	-0.0004	-0.001	0.001	-0.0005	0.001
	(-0.78)	(0.09)	(-0.79)	(-0.23)	(-0.56)	(0.30)	(-0.24)	(0.28)
Cocaine price	-0.001	-0.0002	-0.001	0.000	-0.001	-0.0002	-0.001	7.65E-05
	(-2.12)	(-0.46)	(-2.79)	(0.17)	(-1.86)	(-0.50)	(-2.18)	(0.32)
Cocaine arrests	0.001	0.0002	0.0004	0.0004	4.27E-05	0.0002	0.0003	0.0002
	(0.21)	(0.33)	(0.82)	(0.74)	(0.09)	(0.38)	(0.62)	(0.47)
Beer Tax	0.056	-0.039	0.109	0.077	0.067	-0.060	0.108	0.035
	(0.46)	(-0.46)	(0.77)	(0.87)	(0.69)	(-0.78)	(0.91)	(0.41)
12th Grade Alcohol Use								
Marijuana Fine	-2.09E-07	4.59E-06	-1.14E-06	4.48E-06	-2.50E-08	3.14E-06	-8.83E-07	2.89E-06
	(-0.22)	(6.80)	(-1.31)	(7.43)	(-0.03)	(4.50)	(-1.03)	(4.90)
Marijuana Jail Term	0.076	0.044	0.076	0.078	0.078	0.058	0.075	0.091
	(2.08)	(1.66)	(2.15)	(2.51)	(2.39)	(2.35)	(2.42)	(3.10)
Marijuana arrests	-0.003	0.0001	-0.004	-0.000	-0.002	-0.001	-0.003	-0.001
	(-0.82)	(0.03)	(-1.46)	(0.00)	(-0.51)	(-0.23)	(-1.19)	(-0.26)
Cocaine price	-0.0002	-0.0001	-0.0001	0.0001	0.0001	-0.0002	0.0002	0.0001
	(-0.23)	(-0.15)	(-0.21)	(0.20)	(0.16)	(-0.28)	(0.33)	(-0.10)
Cocaine arrests	0.002	0.001	0.001	0.0003	0.001	0.001	0.001	0.001
	(1.49)	(1.50)	(0.63)	(0.34)	(1.32)	(1.94)	(0.75)	(0.98)
Beer Tax	-0.209	-0.120	-0.042	0.063	-0.150	-0.114	-0.013	0.049
	(-1.60)	(-1.01)	(-0.37)	(0.55)	(-1.22)	(-0.94)	(-0.11)	(0.41)

Table I-15 Marijuana Use, First Stage Estimates

	Exogenous covariates only				A full set of covariates			
	(1)		(3)		(3)		(4)	
	2SLS with state policies only as IVs		Model (2) with state sentiment variables		2SLS with state policies only as IVs		Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Marijuana Use								
Marijuana Fine	4.81E-07	1.61E-07	3.11E-07	3.28E-07	2.66E-07	-4.50E-07	2.39E-07	-2.76E-07
	(1.99)	(0.46)	(1.12)	(0.95)	(1.26)	(-1.54)	(1.02)	(-0.95)
Marijuana Jail Term	0.010	-0.013	0.003	-0.018	0.007	-0.003	0.001	-0.008
	(1.08)	(-1.09)	(0.44)	(-1.54)	(0.78)	(-0.34)	(0.17)	(-0.93)
Marijuana arrests	-0.001	-0.0001	-0.001	-0.001	-0.0001	0.0002	-0.0002	-0.0003
	(-0.65)	(-0.12)	(-0.94)	(-0.97)	(-0.11)	(0.29)	(-0.28)	(-0.31)
Cocaine price	-0.0003	0.0001	-0.0002	0.0002	-0.0002	0.0001	-0.000	0.0001
	(-1.48)	(0.77)	(-1.19)	(1.25)	(-1.20)	(0.74)	(-0.26)	(1.18)
Cocaine arrests	0.0005	0.0002	0.001	0.0003	0.0005	0.0002	0.001	0.0002
	(2.40)	(0.80)	(2.95)	(0.94)	(2.67)	(0.84)	(3.17)	(0.80)
Beer Tax	0.031	-0.028	0.036	-0.003	0.034	-0.019	0.040	-0.003
	(0.62)	(-0.71)	(0.68)	(-0.07)	(0.86)	(-0.62)	(1.05)	(-0.10)
12th Grade Marijuana Use								
Marijuana Fine	9.88E-07	-4.21E-08	8.05E-07	2.29E-07	7.47E-07	-1.10E-06	6.35E-07	-8.38E-07
	(2.29)	(-0.15)	(1.70)	(0.64)	(1.87)	(-3.75)	(1.48)	(-2.71)
Marijuana Jail Term	-0.005	0.0095	-0.010	-0.004	-0.011	0.023	-0.017	0.009
	(-0.26)	(0.76)	(-0.47)	(-0.37)	(-0.64)	(2.15)	(-0.87)	(0.95)
Marijuana arrests	-0.003	0.001	-0.004	0.001	-0.002	0.001	-0.003	0.0002
	(-2.68)	(1.00)	(-2.99)	(0.43)	(-1.66)	(1.14)	(-2.31)	(0.17)
Cocaine price	0.0002	-0.000	0.0003	0.0002	0.0004	-0.000	0.001	0.0002
	(0.69)	(-0.17)	(1.04)	(0.73)	(1.74)	(-0.18)	(2.08)	(0.70)
Cocaine arrests	0.001	0.0004	0.001	0.0005	0.001	0.001	0.001	0.001
	(3.22)	(1.11)	(2.13)	(1.44)	(2.48)	(1.73)	(1.73)	(2.55)
Beer Tax	-0.019	0.039	0.037	0.040	0.038	0.044	0.082	0.029
	(-0.26)	(0.71)	(0.52)	(0.92)	(0.63)	(0.92)	(1.40)	(0.69)

Table I-16 Cocaine Use, First Stage Estimates

	Exogenous covariates only				A full set of covariates			
	(1)		(3)		(3)		(4)	
	2SLS with state policies only as IVs		Model (2) with state sentiment variables		2SLS with state policies only as IVs		Model (3) with state sentiment variables	
	Male	Female	Male	Female	Male	Female	Male	Female
10th Grade Cocaine Use								
Marijuana Fine	4.84E-07	-2.48E-07	4.89E-07	-2.15E-07	4.24E-07	-5.15E-07	4.81E-07	-4.95E-07
	(2.41)	(-1.71)	(2.32)	(-1.58)	(2.47)	(-3.27)	(2.69)	(-3.22)
Marijuana Jail Term	-0.0008	-0.005	-0.0004	-0.004	-0.001	-0.001	-0.001	0.001
	(-0.09)	(-1.01)	(-0.04)	(-0.68)	(-0.18)	(-0.34)	(-0.11)	(0.14)
Marijuana arrests	-0.0001	-0.0003	1.28E-05	-0.001	0.0001	-0.0002	0.0003	-0.0003
	(-0.2)	(-0.73)	(0.02)	(-0.98)	(0.23)	(-0.44)	(0.63)	(-0.54)
Cocaine price	-0.0001	0.000	-0.0001	0.000	-0.000	-1E-05	0.000	-0.000
	(-1.61)	(0.26)	(-0.91)	(0.37)	(-0.63)	(-0.18)	(0.37)	(-0.03)
Cocaine arrests	1.57E-05	6.12E-05	-2.35E-05	7.92E-05	-4.99E-9	2.24E-05	-3.85E-05	3.33E-05
	(0.12)	(0.45)	(-0.17)	(0.55)	(0.00)	(0.15)	(-0.28)	(0.22)
Beer Tax	-0.010	-0.049	-0.005	-0.038	-0.009	-0.041	-0.005	-0.033
	(-0.31)	(-2.47)	(-0.12)	(-1.86)	(-0.41)	(-2.44)	(-0.21)	(-1.85)
12th Grade Cocaine Use								
Marijuana Fine	6.75E-07	2.48E-07	6.13E-07	1.78E-07	5.85E-07	-2.79E-08	5.38E-07	-1.02E-07
	(2.26)	(1.68)	(2.09)	(1.11)	(2.28)	(-0.18)	(2.09)	(-0.61)
Marijuana Jail Term	-0.009	0.032	0.002	0.034	-0.013	0.035	-0.002	0.037
	(-1.07)	(2.46)	(0.30)	(2.58)	(-1.77)	(2.83)	(-0.31)	(2.89)
Marijuana arrests	-0.0004	0.001	-0.0002	0.001	0.0001	0.0002	0.0004	0.0003
	(-0.65)	(1.31)	(-0.26)	(1.72)	(0.19)	(0.50)	(0.60)	(0.80)
Cocaine price	0.0001	0.000	0.0001	-0.000	0.0002	-0.000	0.0002	-0.000
	(0.92)	(0.05)	(0.65)	(-0.26)	(1.70)	(-0.35)	(1.34)	(-0.77)
Cocaine arrests	0.0003	-0.000	0.0002	-0.000	0.0001	0.0001	0.0001	0.0001
	(1.18)	(-0.23)	(0.60)	(-0.12)	(0.53)	(0.64)	(0.25)	(0.79)
Beer Tax	-0.060	0.019	-0.034	0.019	-0.039	0.027	-0.023	0.022
	(-1.46)	(1.18)	(-0.91)	(1.21)	(-0.99)	(1.60)	(-0.62)	(1.30)

CHAPTER II

1 Introduction

In recent years, quite a few studies[1] attempt to explore the causal impact of substance use such as alcohol, marijuana and cocaine on risky sexual behavior among adolescence and young adults. However, despite all the efforts, the causal link between substance use and risky sexual behavior remains unknown. The difficulty in establishing the causality lies in the significant likelihood that an adolescent's sexual behavior and substance use is partially confounded by a common set of personal and social factors, some of which are unmeasured.

Researchers attempt to cope with the omitted variable bias by using a credible estimation strategy, for instance, 2SLS estimation, bivariate probit estimation and so on. One practical challenge of implementing these methods is whether the instruments meet the two requirements of valid exclusion restrictions. One is whether variables are sufficiently strongly correlated with substance use. The other is whether variables are exogenous and not related to risky sexual behavior.

In these studies, measures of state level substance taxes, prices, and control policies are commonly employed as identifying variables. State level alcohol and drug policies are expected to predict the consumption of alcohol and illicit drugs but not risky sexual behavior. Findings, somehow, indicate that these policy variables have poor predictive power. Both low F-test statistics in the first stage of TSLS estimation strategy and either Durbin-Wu-Hausman or Wald endogeneity test suggest that IV estimates are no better

[1] Chesson et al (2000); Ree et al. (2001); Sen (2002); Grossman and Markovitz, forthcoming; Rashad and Kaestner (2004);

than biased OLS estimates. In addition to these concerns about predictive power, state level substance policies are presumably highly correlated with state sentiment variables that may confound the association between risky sexual behavior and substance use.

With these regard, this paper aims to gauge the causal effect of substance use on risky sexual behavior by experimenting with two novel classes of identifying variables in the 2SLS estimation strategy. First, a set of school level substance policies are used as identifying variables in cross-sectional variation analysis within the state of residence. Secondly, the value of lagged difference of substance use itself is employed as instrument as is to estimate the 12^{th} grade alcohol and marijuana use in the individual level equation.

2 Empirical Model

This paper of analysis is based on the following model:

$$(1) \qquad S_i = \alpha_1 D_i + \alpha_2 X_i + \alpha_3 \mu_i + \varepsilon_i$$

$$(2) \qquad D_i = \beta_1 X_i + \beta_2 Z_i + \beta_3 \mu_i + \eta_i$$

In equation (1), sexual behavior (S) of individual (i) depends on substance use (D) and other variables (X). Substance use (D) in equation (2) depends on some of the same variables as sexual behavior (X) and instrument variables (Z) with unique direct or indirect causal paths to it. However, OLS estimates from the first equation are biased, because substance use itself is a problematic causal variable. It is correlated with variable μ a vector of common unmeasured personal or social factors, such as "a thrill-seeking" personality, which appears in both equations. To correct the spurious estimate of substance use on risky sexual behavior resulted from a third common unmeasured factor, the model is then estimated by 2SLS method using NELS 88. The dependent variables of

interest are the probability of having sex in the past month and the likelihood of having risky sex in the past month.

The key estimation issue is whether instrument variables Z have valid exclusion restriction that only influence substance use but not sexual activity. With this being considered, the 2SLS estimation strategy is carried out by introducing two classes of novel identifying variables.

First, a set of high school and prior school level substance policies applied as predictors of current school year alcohol and marijuana use[2] in each sub-sampling data set are the following:

- School administrator reports that the punishment for the first occurrence of illegal drug possession is expulsion from school;
- School administrator reports that the punishment for the first occurrence of alcohol possession is expulsion from school;
- School administrator reports that the student use of illegal drugs is a moderate or severe problem at this school;
- School administrator reports that the student use of alcohol is a moderate or severe problem at this school.

School substance policies and environment are assumed to be valid instrument, because they affect sexual behavior only through their impact on substance use. To predict 10^{th} grade alcohol and marijuana use, identifying Z variables are: the 8^{th} and the 10^{th} grade school level policies. The 12^{th} grade school policies are included as an additional set of instruments to remove the endogeneity of the 12^{th} grade alcohol and marijuana use. However, not all the school level policies are available in the 12^{th} grade sub-sampling except for variables regarding school alcohol and drug environment. Since most students attended the same school in the 10^{th} and the 12^{th} grade, the high school alcohol and drug policies are considered to be the same by simply extrapolating the 10^{th}

[2] Pinka Chatterji, gauges the causal impact of illicit drug use on educational attainment in NELS88 (2004)

grade school stringent policies to the 12th grade. In addition, the causal effect of each substance use is estimated with and without the inclusion of state sentiment variables to assess the sensitivity of school level substance policies. For instance, a state whose residents have higher than average concern and involvement in youth development and abstinence education may enact particularly stringent alcohol and illicit drug school policies. In such case, school level policies are not exogenous and can no longer serve as valid identifying variables.

Secondly, the above TSLS model only accounts for the cross-sectional variation but not time variation. Thus, to examine whether the probability of the 12th grade substance use, a lagged value, has causal impact on sexual behavior when most of youth in their early twenties, the modified model of specification on the basis of equation (1) is:

(3) $$S_4 = \alpha_1 D_3 + \alpha_2 X + \varepsilon_4$$

In this case, the 12th grade substance use (D_3) is considered as a predetermined variable, which is correlated with the past value of error term (ε_3), but not the current value of error term (ε_4) in the level equation (3). The value of the first difference of alcohol and marijuana use ($\Delta D_3 = D_3 - D_2$) is orthogonal to current value of error term (ε_4), which can be used to fit the 2SLS model.[3] Therefore, the first difference of substance use is a valid instrument variable to predict the 12th grade alcohol and marijuana use. The causal effect of the 12th grade substance use is estimated in models with a set of exogenous covariates and a set of full covariates respectively.

All models are estimated using robust standard errors that account for clustering of observation at state level of residents. The validity of exclusion restriction of instrument

[3] Jean Salvati, Estimating and Testing dynamic Panel Data Models with Stata (2004)

variables is examined by F-statistics in the first stage and Dubin-Wu-Hausman endogeneity test. The validity of the over-identifying restriction is also assessed by using Sargan Chi-squared statistics. Furthermore, the eligibility of instrument variables is alternatively examined through reduced form equation (4) by replacing substance use using instrument variables in equation (1):

(4) $S = \gamma_1 X_i + \gamma_2 Y_i + \gamma_3 \mu_i + \varepsilon_i + \eta_i$

3 Results

Table 1 displays the descriptive analysis of school level substance policies. In the 10th grade sub-sampling data set, approximately 41 percent of schools impose stringent policy on drug possession. The rate of stringent policy regarding alcohol possession is relative moderate for about 22 percent. The prevalence of alcohol problem is quite high at high school in the range from 40 percent to 47 percent.

Tables 2-10 summarize the estimates of the impact of high school substance use on the likelihood of engaging in sex intercourse and risky sex. In each table, estimates are presented separately by gender and in the order of OLS model, TSLS model, the first Stage of TSLS estimation strategy and reduced form equation. To assess the degree of sensitivity for school level substance policies to state sentiment variables, tables 11-19 report the results of the same model by including the state sentiment variables additionally. The t-ratios brackets are calculated based on standard errors which are clustered by state[4]. The detailed summaries are reported in the following.

[4] Huber, 1997

Table 2 shows the impact of the 10th grade alcohol use on the probability of having sex in a multivariate analysis. The OLS result in column 1 shows that for male alcohol use is positively correlated with having sex. Estimate of TSLS is positive while not statistically significant at 5 percent level of confidence. A number of procedures are employed to examine the efficacy of TSLS estimation strategy. First, Sargan Chi-squared over-identification exclusion restriction are valid. It is worth to note that over-identification test usually has poor estimation power. Secondly partial F-statistics is tested for the 10th and the 8th grade school level substance policies and environment in the first stage. The significant but small F-statistics, which is only 2.40, indicates that TSLS estimate approaches OLS estimate. Most of school level substance policies show expected signs except for the positive 10th grade drug expulsion. However, none of the instruments is a statistically significant predictor of alcohol consumption in the first stage. The reduced form equation is alternatively used to check the validity of school level instrument variables, since the only way for identifying variables to affect sexual behavior is through the prediction of substance use. Only the 10th grade alcohol expulsion is negatively correlated with the probability of having sex and statistically significant. Indeed, the Durbin-Wu-Hausman F statistics for testing the endogenous 10th grade alcohol use is not rejected, which suggests that TSLS estimate is not more consistent than OLS estimate. Thus, the reliability of TSLS estimate is questionable.

Columns 5-8 in Table 2 display the results for female respondents. The biased OLS estimate shows strongly positive association between the 10th grade alcohol use and the selection into having sex. The magnitude of TSLS estimate is only half of male counterpart's, but not statistically significant. Although it passes the over-identification

restriction test, both low partial F-statistics and the rejection from DWH test cast some doubt on the credibility of TSLS estimate. In addition, only the 10^{th} grade alcohol environment has a positive and significant coefficient in the first stage. Except for the 10^{th} grade alcohol expulsion, majority coefficients of the instruments in the reduced form equation are statistically insignificant, providing further evidence for females, the 10^{th} grade alcohol use can not predict the probability of having sex in the past month.

Table 3 summarizes the results of the impact of 10^{th} grade alcohol use on engaging in risky sex. For both genders, OLS estimates suggest that alcohol use is positively associated with the likelihood of risky sex. However, this result is not upheld in the TSLS estimate for males. The TSLS coefficient on the 10^{th} grade alcohol use is negative and statistically insignificant. For females, though the result stays positive, the coefficient of alcohol use is also statistically insignificant. Notwithstanding the valid over-identification restriction, DWH test demonstrates that TSLS estimate is not better than OLS estimate. Furthermore, insignificant coefficients of the instruments in the reduced form equation provide additional evidence that the 10^{th} grade alcohol use is not a good predictor of the probability of risky sex for both genders.

Table 4 and Table 5 show the impact of the 10^{th} grade marijuana use on the likelihood of having sex and risky sex respectively. In table 4, results of both OLS estimation and TSLS estimation are positive, however TSLS estimates are insignificant. For female respondents, the effect of marijuana use on risky sex even turns out to be negative. In both tables, although the problem of pre-high school drug environment provides significant and positive prediction for high school marijuana use, the overall low partial F-statistics suggests that the bias of TSLS estimate approximates that of OLS estimate.

Over-identification restriction test is valid while DWH test rejects the endogeneity of the 10^{th} grade marijuana use. Most of estimates of the instruments are poor predictors of both probabilities of having sex and risky sex in the reduce form equation. The above evidences suggest that the 10^{th} grade marijuana use has no causal impact on either the likelihood of having sex or the probability of risky sex.

Table 6 and 7 present the estimates of the 12^{th} grade alcohol use affecting the probability of having sex and risky sex. The results of OLS estimation again show a strongly positive association between these two behaviors. Unlike the insignificantly negative TSLS estimates of female respondents, the result from TSLS estimation, for male counterpart, shows that the 12^{th} grade alcohol use significantly affect the probability of engaging in sex intercourse. In this case, over-identification restriction test is valid. The first stage partial F-test statistics is significant. Here, problems of alcohol environment in both the 12^{th} grade and pre-high school positively predict the 12^{th} grade alcohol use at 5 percent level of significance. In the reduced form equation, the high school drug problems will increase the probability of having sex. However, the lower F score and the rejection by the DWH endogeneity test bring this TSLS estimate into question. No causal link can be absolutely determined in the relationship between the 12^{th} grade substance use and risky sex for both genders.

Table 8 and 9 shows the effects of the 12^{th} grade marijuana use towards the selection into having sex and risky sex respectively. Despite the positive association is demonstrated by the OLS estimates, no causal link can be concluded from the TSLS estimation strategy. Besides, some of TSLS estimates even turn out to be negative. As been seen previously, the first stage partial F-test statistics is significant, although over-

identification is valid, DWH test reject the inconsistency of OLS estimates. Majority instruments are poor predictors of the likelihood of having sex and risky sex. With these evidence presented, the increasing in the 12th grade marijuana use does not lead to the increasing in having sex and risky sex.

The inclusion of state sentiment variables in the same multivariate analysis serves as an alternative method to check the validity of school level identifying variables as it infers the efficacy of TSLS estimation strategy. As showed in table 10-17, the magnitude of estimates varies in both OLS and TSLS models of specification across all cases. As explained previously, the variation in magnitude of coefficients suggest that the school level substance policies can no longer be treated as valid instruments since there is a high degree of correlation between state sentiment variables and school level instrument variables. For instance, in table 14, after the inclusion of a set of instrument variables, the once significant TSLS coefficient of the 12th grade alcohol use on the probability of having sex is no longer statistically significant at 10 percent level. Similar pattern of changing in the magnitude of coefficients is observed for all estimates.

In order to capture the true causal link between the use of substance and risky sexual behavior, this paper experiments with the second class of instrument variable. Tables 18-21 display the results of the impact of the 12th grade substance use on the probability of having sex and risky sex when the first difference of the 12th grade substance use itself is introduced as identifying variable in the TSLS estimation strategy. The first two tables summarize the estimates of TSLS model with only a set of exogenous covariates, while the latter two show the results with a full set of covariates. Each table has two panels: the top one summarizes the results of the probability of having sex; and the one in bottom is

for the likelihood of risky sex. Estimates in this table and tables following are presented separately by male respondents and female respondents respectively.

Results in all tables intend to infer the causal effect of the 12th grade marijuana and alcohol use towards risky sexual behavior. TSLS estimates of both models across all group respondents are positive. For both genders, while majority coefficients of marijuana and alcohol on the probability of having sex are strongly significant, overall DWH endogeneity tests reject the endogenous substance use suggesting that TSLS estimates are not better than OLS estimates, which cast some doubt on the credibility of overall TSLS estimates. As for the likelihood of risky sex, again the DWH F-test statistics suggest that OLS estimates are generally consistent. For instance, in table 18 for males, the TSLS estimate of the 12th grade marijuana use does not significantly result in the selection into risky sex. The coefficient in the reduced form equation further proves that the first difference of the 12th grade marijuana use is a poor predictor for the probability of risky sex. Indeed, the DWH endogeneity test rejects the inconsistency of OLS estimation. The same findings, regarding the risky sex for male respondents, are reported in the next three tables. Exceptionally, as for female respondents in table 21, the 12th grade alcohol use is found to increase risky sex in the model with a full set of covariates. Evidences from both DWH test and the power of prediction in the reduced form equation support this finding. However, this finding is subjective to the sensitivity to different models of specification.

4 Conclusion

The purpose of this study is to both establish the causal relationship and find the empirical evidence, between the use of substance and risky sexual behavior for adolescence and young adults. If substance use has real causal impact on risky sexual behavior, then public policies aim at reducing substance use can be mainly implemented for yielding risky sexual behavior. However, due to the limitation in the design of NELS88, it only allows me to perform the cross-sectional variation analysis, since the indicator of sexual behavior only available for one round in a panel data setting. Therefore, the model of specification is unable to controlling for the time-invariant individual effect, which may confound the observed relationship between these two behaviors. Despite all the efforts, it only can be concluded that when the third common unmeasured factors are considered, using alcohol and marijuana does not lead to an increase in the probability of having sex and risky sex, but the consumption of such substance is strongly positively associated with risky sexual behavior.

Table II -1 Descriptive Analysis

	Definition	10th Grade Sample	12th Grade Sample
8th grade drug expulsion	Dummy variable = 1 if school administrator reports that the punishment for the first occurrence of illegal drug possession is expulsion from school, 0 otherwise	0.241 (0.428)	0.240 (0.427)
8th grade alcohol expulsion	Dummy variable = 1 if school administrator reports that the punishment for the first occurrence of alcohol possession is expulsion from school, 0 otherwise	0.145 (0.353)	0.142 (0.349)
8th grade drug problem	Dummy variable = 1 if school administrator reports that the student use of illegal drugs is a moderate or severe problem at this school, 0 otherwise	0.232 (0.422)	0.229 (0.420)
8th grade alcohol problem	Dummy variable = 1 if school administrator reports that the student use of alcohol is a moderate or severe problem at this school, 0 otherwise	0.308 (0.462)	0.308 (0.462)
drug expulsion	Dummy variable = 1 if school administrator reports that the punishment for the first occurrence of illegal drug possession is expulsion from school, 0 otherwise	0.408 (0.492)	0.405 (0.491)
alcohol expulsion	Dummy variable = 1 if school administrator reports that the punishment for the first occurrence of alcohol possession is expulsion from school, 0 otherwise	0.220 (0.414)	0.214 (0.410)
drug problem	Dummy variable = 1 if school administrator reports that student use of illegal drugs is a moderate or serious problem at this school, 0 otherwise	.241 (.427)	0.198 (0.398)
alcohol problem	Dummy variable = 1 if school administrator reports that student use of alcohol is a moderate or serious problem at this school, 0 otherwise	.401 (.490)	0.474 (0.499)

Notes: The school policies of drug or alcohol expulsion are assumed to be the same in both 10th grade and 12th grade.

Table II-2 10th Grade Alcohol Use and Had Sex

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 10th grade	0.190 (9.77)	0.328 (1.18)			0.144 (7.67)	0.165 (0.69)		
10th grade drug expulsion			0.042 (1.36)	0.021 (0.79)			-0.003 (-0.14)	0.028 (1.39)
10th grade alcohol expulsion			-0.002 (-0.05)	-0.068 (-2.42)			0.041 (1.66)	-0.060 (-2.82)
10th grade drug problem			0.001 (0.05)	0.0155 (0.52)			-0.004 (-0.18)	-0.004 (-0.16)
10th grade alcohol problem			0.020 (0.78)	-0.026 (-1.28)			0.063 (3.13)	0.016 (0.58)
8th grade drug expulsion			-0.010 (-0.24)	0.035 (1.34)			0.005 (0.15)	0.035 (1.45)
8th grade alcohol expulsion			-0.030 (-0.70)	0.009 (0.27)			-0.026 (-0.79)	0.004 (0.10)
8th grade drug problem			0.040 (1.30)	0.022 (0.66)			0.040 (1.23)	0.043 (1.29)
8th grade alcohol problem			0.036 (1.26)	0.038 (1.47)			0.018 (0.64)	-0.011 (-0.50)
R-squared	0.097	0.079	0.046	0.068	0.101	0.101	0.076	0.086
F-test on instruments		2.40 [0.028]				2.64 [0.017]		
Over-identification Test		12.177 [0.095]				8.96 [0.255]		
Hausman Test		0.24 [0.623]				0.01 [0.933]		

Notes:

1. T-statistics in parentheses, P-values in brackets. Standard errors are adjusted for clustering on the state of residence.
2. Exogenous variables: female, Asian, Hispanic, African-American, Native American, Central, South, West, Urban, Rural, Catholic, Baptist or Methodist, Other Christian, Other Religion, Religion activity, Hobbies, Mother high school drop out, Mother some college, Mother college graduate, Father high school drop out, Father some college, Father college graduate, Step-family, Single parent family, Family income, Number of siblings

Table II-3 10th Grade Alcohol Use and Risky Sex

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 10th grade	0.045 (5.11)	-0.105 (-0.99)			0.025 (2.85)	0.013 (0.12)		
10th grade drug expulsion			0.042 (1.36)	0.002 (0.27)			-0.002 (-0.14)	-0.002 (-0.19)
10th grade alcohol expulsion			-0.002 (-0.05)	-0.002 (-0.13)			0.041 (1.66)	-0.001 (-0.08)
10th grade drug problem			0.001 (0.05)	-0.017 (-0.96)			-0.004 (-0.18)	0.016 (1.59)
10th grade alcohol problem			0.019 (0.78)	0.010 (0.68)			0.063 (3.13)	-0.002 (-0.19)
8th grade drug expulsion			-0.010 (-0.24)	0.027 (1.33)			0.005 (0.15)	0.003 (0.24)
8th grade alcohol expulsion			-0.030 (-0.70)	-0.014 (-0.73)			-0.026 (-0.79)	-0.010 (-0.51)
8th grade drug problem			0.040 (1.30)	0.008 (0.49)			0.040 (1.23)	0.004 (0.29)
8th grade alcohol problem			0.036 (1.26)	-0.018 (-1.09)			0.018 (0.64)	-0.011 (-1.03)
R-squared	0.036	0.032	0.046	0.031	0.039	0.038	0.076	0.038
F-test on instruments		2.40 [0.028]				2.64 [0.017]		
Over-identification Test		2.72 [0.910]				6.10 [0.529]		
Hausman Test		2.04 [0.159]				0.02 [0.901]		

Note: See Table II-2

Table II-4 10th Grade Marijuana Use and Had Sex

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 10th grade	0.150	0.344			0.167	0.430		
	(5.01)	(0.77)			(5.85)	(0.92)		
10th grade drug expulsion			-0.004	0.021			-0.010	0.028
			(-0.28)	(0.79)			(-0.86)	(1.39)
10th grade alcohol expulsion			-0.001	-0.068			0.014	-0.060
			(-0.08)	(-2.42)			(1.30)	(-2.82)
10th grade drug problem			-0.004	0.015			0.011	-0.004
			(-0.45)	(0.52)			(0.96)	(-0.16)
10th grade alcohol problem			0.002	-0.026			-0.004	0.016
			(0.15)	(-1.28)			(-0.45)	(0.58)
8th grade drug expulsion			0.015	0.035			0.008	0.035
			(0.75)	(1.34)			(0.52)	(1.45)
8th grade alcohol expulsion			-0.002	0.009			-0.016	0.004
			(-0.09)	(0.27)			(-1.11)	(0.10)
8th grade drug problem			0.044	0.022			0.027	0.043
			(2.69)	(0.66)			(1.82)	(1.29)
8th grade alcohol problem			-0.006	0.038			0.016	-0.011
			(-0.35)	(1.47)			(1.06)	(-0.50)
R-squared	0.069	0.058	0.024	0.068	0.089	0.074	0.042	0.086
F-test on instruments			2.16 [0.047]				2.74 [0.014]	
Over-identification Test		6.864 [0.443]				8.348 [0.303]		
Hausman Test		3.44 [0.170]				0.29 [0.594]		

Note: See Table II-2

Table II-5 10th Grade Marijuana Use and Risky Sex

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 10th grade	0.075 (2.89)	0.084 (0.29)			0.071 (3.96)	-0.037 (-0.19)		
10th grade drug expulsion			-0.004 (-0.28)	0.002 (0.27)			-0.010 (-0.86)	-0.002 (-0.19)
10th grade alcohol expulsion			-0.001 (-0.08)	-0.002 (-0.13)			0.014 (1.30)	-0.001 (-0.08)
10th grade drug problem			-0.004 (-0.45)	-0.017 (-0.96)			0.011 (0.96)	0.016 (1.59)
10th grade alcohol problem			0.002 (0.15)	0.010 (0.68)			-0.004 (-0.45)	-0.002 (-0.19)
8th grade drug expulsion			0.015 (0.75)	0.027 (1.33)			0.008 (0.52)	0.003 (0.24)
8th grade alcohol expulsion			-0.002 (-0.09)	-0.014 (-0.73)			-0.016 (-1.11)	-0.010 (-0.51)
8th grade drug problem			0.044 (2.69)	0.008 (0.49)			0.027 (1.82)	0.004 (0.29)
8th grade alcohol problem			-0.006 (-0.35)	-0.018 (-1.09)			0.016 (1.06)	-0.011 (-1.03)
R-squared	0.034	0.034	0.024	0.031	0.041	0.031	0.042	0.038
F-test on instruments			2.16 [0.047]				2.74 [0.014]	
Over-identification Test		3.786 [0.804]				6.025 [0.537]		
Hausman Test		0.00 [0.976]				0.35 [0.556]		

Note: See Table II-2

Table II-6 12th Grade Alcohol Use and Had Sex

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 12th grade	0.224 (11.21)	0.652 (1.96)			0.136 (6.06)	-0.029 (-0.14)		
12th grade drug problem			-0.042 (-1.33)	-0.083 (-2.35)			-0.019 (-0.75)	0.023 (0.66)
12th grade alcohol problem			0.058 (1.98)	0.008 (0.25)			-0.018 (-0.85)	-0.006 (-0.28)
10th grade drug expulsion			0.043 (1.26)	-0.003 (-0.10)			-0.008 (-0.26)	0.029 (1.23)
10th grade alcohol expulsion			-0.023 (-0.56)	-0.062 (-1.91)			-0.008 (-0.21)	-0.055 (-2.28)
10th grade drug problem			0.031 (0.77)	0.043 (1.42)			0.020 (0.79)	-0.026 (-0.78)
10th grade alcohol problem			-0.047 (-1.60)	-0.043 (-1.96)			0.051 (1.95)	0.022 (0.81)
8th grade drug expulsion			0.017 (0.42)	0.051 (1.58)			0.028 (0.83)	0.062 (2.63)
8th grade alcohol expulsion			0.027 (0.56)	0.038 (0.96)			-0.018 (-0.38)	-0.015 (-0.42)
8th grade drug problem			-0.023 (-0.60)	0.034 (0.80)			-0.057 (-1.82)	0.081 (2.50)
8th grade alcohol problem			0.056 (1.82)	0.025 (0.70)			0.065 (2.08)	-0.028 (-1.09)
R-squared	0.107	0.063	0.062	0.071	0.103	0.077	0.074	0.092
F-test on instruments			3.38 [0.002]				1.94 [0.062]	
Over-identification Test		16.468 [0.058]				13.259 [0.151]		
Hausman Test		1.80 [0.186]				0.60 [0.443]		

Note: See Table II-2

Table II-7 12th Grade Alcohol Use and Risky Sex

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 12th grade	0.041 (4.00)	0.097 (0.89)			0.030 (3.29)	-0.087 (-0.99)		
12th grade drug problem			-0.043 (-1.33)	-0.031 (-2.43)			-0.019 (-0.75)	-0.002 (-0.14)
12th grade alcohol problem			0.058 (1.98)	0.011 (0.94)			-0.018 (-0.85)	-0.024 (-2.45)
10th grade drug expulsion			0.043 (1.26)	0.007 (0.63)			-0.008 (-0.26)	-0.007 (-0.54)
10th grade alcohol expulsion			-0.023 (-0.56)	-0.013 (-0.83)			-0.008 (-0.21)	-0.010 (-0.78)
10th grade drug problem			0.031 (0.77)	-0.011 (-0.49)			0.020 (0.79)	0.005 (0.39)
10th grade alcohol problem			-0.047 (-1.60)	0.013 (0.74)			0.051 (1.95)	-0.006 (-0.53)
8th grade drug expulsion			0.017 (0.42)	0.014 (0.64)			0.028 (0.83)	-0.004 (-0.36)
8th grade alcohol expulsion			0.027 (0.56)	-0.006 (-0.31)			-0.018 (-0.38)	0.001 (0.08)
8th grade drug problem			-0.023 (-0.60)	-0.002 (-0.11)			-0.057 (-1.82)	0.021 (1.76)
8th grade alcohol problem			0.056 (1.82)	-0.003 (-0.13)			0.065 (2.08)	-0.022 (-1.93)
R-squared	0.031	0.019	0.062	0.028	0.030	-0.029	0.074	0.031
F-test on instruments			3.38 [0.002]				1.94 [0.062]	
Over-identification Test		8.112 [0.523]				13.141 [0.156]		
Hausman Test		0.25 [0.619]				1.67 [0.203]		

Table II-8 12th Grade Marijuana Use and Had Sex

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 12th grade	0.142	0.058			0.204	-0.246		
	(3.92)	(0.09)			(4.99)	(-0.46)		
12th grade drug problem			0.006	-0.083			-0.0003	0.023
			(0.25)	(-2.35)			(-0.02)	(0.66)
12th grade alcohol problem			0.002	0.008			-0.009	-0.006
			(0.09)	(0.25)			(-0.87)	(-0.28)
10th grade drug expulsion			0.002	-0.003			0.006	0.029
			(0.13)	(-0.10)			(0.29)	(1.23)
10th grade alcohol expulsion			0.033	-0.062			0.010	-0.055
			(1.68)	(-1.91)			(0.46)	(-2.28)
10th grade drug problem			-0.010	0.043			0.035	-0.026
			(-0.45)	(1.42)			(2.11)	(-0.78)
10th grade alcohol problem			0.012	-0.043			-0.0004	0.022
			(0.67)	(-1.96)			(-0.04)	(0.81)
8th grade drug expulsion			0.011	0.051			0.004	0.062
			(0.48)	(1.58)			(0.19)	(2.63)
8th grade alcohol expulsion			-0.005	0.038			-0.010	-0.015
			(-0.15)	(0.96)			(-0.39)	(-0.42)
8th grade drug problem			0.020	0.034			-0.016	0.081
			(0.72)	(0.80)			(-0.76)	(2.50)
8th grade alcohol problem			0.016	0.025			0.032	-0.028
			(0.81)	(0.70)			(2.10)	(-1.09)
R-squared	0.067	0.065	0.049	0.071	0.098	0.037	0.053	0.092
F-test on instruments			2.08				2.04	
			[0.044]				[0.050]	
Over-identification Test		21.02				13.233		
		[0.013]				[0.152]		
Hausman Test		0.02				0.88		
		[0.894]				[0.352]		

Note: See Table II-2

Table II-9 12th Grade Marijuana Use and Risky Sex

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 12th grade	0.062 (3.54)	-0.061 (-0.26)			0.079 (3.85)	-0.238 (-1.35)		
12th grade drug problem			0.006 (0.25)	-0.031 (-2.43)			-0.0003 (-0.02)	-0.002 (-0.14)
12th grade alcohol problem			0.002 (0.09)	0.011 (0.94)			-0.009 (-0.87)	-0.024 (-2.45)
10th grade drug expulsion			0.002 (0.13)	0.007 (0.63)			0.006 (0.29)	-0.007 (-0.54)
10th grade alcohol expulsion			0.033 (1.68)	-0.013 (-0.83)			0.010 (0.46)	-0.010 (-0.78)
10th grade drug problem			-0.009 (-0.45)	-0.011 (-0.49)			0.035 (2.11)	0.005 (0.39)
10th grade alcohol problem			0.012 (0.67)	0.013 (0.74)			-0.0004 (-0.04)	-0.006 (-0.53)
8th grade drug expulsion			0.011 (0.48)	0.014 (0.64)			0.004 (0.19)	-0.004 (-0.36)
8th grade alcohol expulsion			-0.005 (-0.15)	-0.006 (-0.31)			-0.010 (-0.39)	0.001 (0.08)
8th grade drug problem			0.020 (0.72)	-0.002 (-0.11)			-0.016 (-0.76)	0.021 (1.76)
8th grade alcohol problem			0.016 (0.81)	-0.003 (-0.13)			0.032 (2.10)	-0.022 (-1.93)
R-squared	0.030	0.008	0.049	0.028	0.035	-0.106	0.053	0.031
F-test on instruments			2.08 [0.044]				2.04 [0.050]	
Over-identification Test		9.290 [0.411]				15.566 [0.076]		
Hausman Test		0.28 [0.596]				3.91 [0.054]		

Note: See Table II-2

Table II-10 10th Grade Alcohol Use and Had Sex (State Sentiment Variables)

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 10th grade	0.187	0.287			0.144	0.100		
	(9.77)	(1.04)			(7.66)	(0.41)		
10th grade drug expulsion			0.040	0.020			-0.006	0.029
			(1.43)	(0.77)			(-0.35)	(1.47)
10th grade alcohol expulsion			0.006	-0.070			0.049	-0.063
			(0.17)	(-2.40)			(1.93)	(-3.06)
10th grade drug problem			-0.0002	0.009			-0.0004	-0.003
			(-0.01)	(0.29)			(-0.02)	(-0.12)
10th grade alcohol problem			0.015	-0.026			0.054	0.013
			(0.61)	(-1.24)			(2.57)	(0.49)
8th grade drug expulsion			-0.019	0.027			0.006	0.040
			(-0.48)	(1.00)			(0.20)	(1.60)
8th grade alcohol expulsion			-0.031	0.006			-0.029	0.001
			(-0.76)	(0.17)			(-0.86)	(0.03)
8th grade drug problem			0.040	0.020			0.039	0.043
			(1.33)	(0.60)			(1.20)	(1.30)
8th grade alcohol problem			0.036	0.040			0.019	-0.012
			(1.26)	(1.51)			(0.70)	(-0.58)
R-squared	0.101	0.092	0.052	0.074	0.103	0.102	0.082	0.089
F-test on instruments			2.71 [0.015]				2.22 [0.042]	
Over-identification Test		12.94 [0.074]				9.502 [0.219]		
Hausman Test		0.13 [0.720]				0.03 [0.857]		

Notes:
1. T-statistics in parentheses, P-values in brackets. Standard errors are adjusted for clustering on the state of residence.
2. Exogenous variables: female, Asian, Hispanic, African-American, Native American, Central, South, West, Urban, Rural, Catholic, Baptist or Methodist, Other Christian, Other Religion, Religion activity, Hobbies, Mother high school drop out, Mother some college, Mother college graduate, Father high school drop out, Father some college, Father college graduate, Step-family, Single parent family, Family income, Number of siblings
3. State sentiment variables: religious composition of state, State real income, unemployment rate.

Table II-11 10th Grade Alcohol Use and Risky Sex (State Sentiment Variables)

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 10th grade	0.046 (5.01)	-0.105 (-0.99)			0.025 (2.77)	0.008 (0.08)		
10th grade drug expulsion			0.040 (1.43)	0.005 (0.53)			-0.006 (-0.35)	-0.003 (-0.32)
10th grade alcohol expulsion			0.006 (0.17)	-0.006 (-0.41)			0.049 (1.93)	0.001 (0.09)
10th grade drug problem			-0.0002 (-0.01)	-0.017 (-0.95)			-0.0004 (-0.02)	0.017 (1.74)
10th grade alcohol problem			0.015 (0.61)	0.011 (0.78)			0.054 (2.57)	-0.003 (-0.31)
8th grade drug expulsion			-0.019 (-0.48)	0.026 (1.29)			0.006 (0.20)	0.005 (0.36)
8th grade alcohol expulsion			-0.031 (-0.76)	-0.017 (-0.86)			-0.029 (-0.86)	-0.009 (-0.52)
8th grade drug problem			0.040 (1.33)	0.009 (0.56)			0.039 (1.20)	0.004 (0.26)
8th grade alcohol problem			0.036 (1.26)	-0.019 (-1.18)			0.019 (0.70)	-0.011 (-1.00)
R-squared	0.039	-0.040	0.052	0.034	0.040	0.039	0.082	0.039
F-test on instruments			2.71 [0.015]				2.22 [0.042]	
Over-identification Test		3.040 [0.881]				6.771 [0.453]		
Hausman Test		2.08 [0.155]				0.03 [0.873]		

Notes: See Table II-10

Table II-12 10th Grade Marijuana Use and Had Sex (State Sentiment Variables)

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 10th grade	0.143 (4.79)	1.24 (0.60)			0.168 (5.86)	0.354 (0.76)		
10th grade drug expulsion			-0.005 (-0.31)	0.020 (0.77)			-0.012 (-1.01)	0.029 (1.47)
10th grade alcohol expulsion			0.00001 (0.00)	-0.070 (-2.40)			0.017 (1.57)	-0.063 (-3.06)
10th grade drug problem			-0.007 (-0.70)	0.009 (0.29)			0.012 (1.08)	-0.003 (-0.12)
10th grade alcohol problem			0.003 (0.23)	-0.026 (-1.24)			-0.005 (-0.57)	0.013 (0.49)
8th grade drug expulsion			0.011 (0.57)	0.027 (1.00)			0.010 (0.59)	0.040 (1.60)
8th grade alcohol expulsion			-0.001 (-0.05)	0.006 (0.17)			-0.016 (-1.10)	0.001 (0.03)
8th grade drug problem			0.043 (2.60)	0.020 (0.60)			0.027 (1.75)	0.043 (1.30)
8th grade alcohol problem			-0.005 (-0.28)	0.040 (1.51)			0.017 (1.08)	-0.012 (-0.58)
R-squared	0.074	-0.226	0.027	0.074	0.091	0.084	0.045	0.089
F-test on instruments			2.26 [0.038]				2.92 [0.009]	
Over-identification Test		6.726 [0.458]				9.168 [0.241]		
Hausman Test		2.67 [0.108]				0.15 [0.699]		

Notes: See Table II-10

Table II-13 10th Grade Marijuana Use and Risky Sex (State Sentiment Variables)

10th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 10th grade	0.077 (2.91)	0.053 (0.18)			0.069 (3.85)	-0.030 (-0.16)		
10th grade drug expulsion			-0.005 (-0.31)	0.005 (0.53)			-0.012 (-1.01)	-0.003 (-0.32)
10th grade alcohol expulsion			0.00001 (0.00)	-0.006 (-0.41)			0.017 (1.57)	0.001 (0.09)
10th grade drug problem			-0.007 (-0.70)	-0.017 (-0.95)			0.012 (1.08)	0.017 (1.74)
10th grade alcohol problem			0.003 (0.23)	0.011 (0.78)			-0.005 (-0.57)	-0.003 (-0.31)
8th grade drug expulsion			0.011 (0.57)	0.026 (1.29)			0.010 (0.59)	0.005 (0.36)
8th grade alcohol expulsion			-0.001 (-0.05)	-0.017 (-0.86)			-0.016 (-1.10)	-0.009 (-0.52)
8th grade drug problem			0.043 (2.60)	0.009 (0.56)			0.027 (1.75)	0.004 (0.26)
8th grade alcohol problem			-0.005 (-0.28)	-0.019 (-1.18)			0.017 (1.08)	-0.011 (-1.00)
R-squared	0.037	0.037	0.027	0.034	0.042	0.034	0.045	0.039
F-test on instruments			2.26 [0.038]				2.92 [0.009]	
Over-identification Test		3.828 [0.799]				6.640 [0.467]		
Hausman Test		0.01 [0.934]				0.33 [0.570]		

Notes: See Table II-10

Table II-14 12th Grade Alcohol Use and Had Sex (State Sentiment Variables)

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 12th grade	0.219 (11.17)	0.58 (1.50)			0.138 (5.93)	-0.477 (-1.47)		
12th grade drug problem			-0.038 (-1.21)	-0.075 (-2.02)			-0.017 (-0.61)	0.020 (0.60)
12th grade alcohol problem			0.049 (1.55)	0.001 (0.04)			-0.007 (-0.31)	0.0004 (0.02)
10th grade drug expulsion			0.037 (1.22)	-0.001 (-0.04)			-0.011 (-0.33)	0.030 (1.25)
10th grade alcohol expulsion			-0.010 (-0.27)	-0.060 (-1.89)			0.003 (0.08)	-0.060 (-2.57)
10th grade drug problem			-0.009 (-0.22)	-0.025 (-0.74)			0.007 (0.30)	-0.007 (-0.18)
10th grade alcohol problem			0.041 (1.49)	0.053 (1.71)			-0.021 (-1.04)	0.032 (1.13)
8th grade drug expulsion			0.001 (0.03)	0.032 (0.93)			0.026 (0.74)	0.060 (2.44)
8th grade alcohol expulsion			0.031 (0.68)	0.040 (1.00)			-0.025 (-0.53)	-0.007 (-0.18)
8th grade drug problem			-0.021 (-0.59)	0.034 (0.80)			-0.057 (-1.90)	0.079 (2.38)
8th grade alcohol problem			0.052 (1.73)	0.021 (0.60)			0.068 (2.27)	-0.027 (-1.10)
R-squared	0.112	-0.008	0.072	0.078	0.108	-0.241	0.080	0.097
F-test on instruments			2.14 [0.039]				1.61 [0.133]	
Over-identification Test		14.732 [0.099]				13.062 [0.160]		
Hausman Test		0.95 [0.335]				5.37 [0.025]		

Notes: See Table II-10

Table II-15 12th Grade Alcohol Use and Risky Sex (State Sentiment Variables)

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Alcohol use in 12th grade	0.043 (4.04)	0.147 (1.28)			0.029 (3.22)	-0.124 (-1.03)		
12th grade drug problem			-0.038 (-1.21)	-0.032 (-2.79)			-0.017 (-0.61)	-0.001 (-0.09)
12th grade alcohol problem			0.049 (1.55)	0.013 (1.08)			-0.007 (-0.31)	-0.025 (-2.89)
10th grade drug expulsion			0.037 (1.22)	0.010 (0.85)			-0.011 (-0.33)	-0.009 (-0.69)
10th grade alcohol expulsion			-0.010 (-0.27)	-0.017 (-1.06)			0.003 (0.08)	-0.006 (-0.56)
10th grade drug problem			-0.009 (-0.22)	-0.003 (-0.23)			0.007 (0.30)	0.002 (0.17)
10th grade alcohol problem			0.041 (1.49)	0.008 (0.46)			-0.021 (-1.04)	0.004 (0.36)
8th grade drug expulsion			0.001 (0.03)	0.012 (0.52)			0.026 (0.74)	-0.003 (-0.26)
8th grade alcohol expulsion			0.031 (0.68)	-0.009 (-0.53)			-0.025 (-0.53)	0.001 (0.06)
8th grade drug problem			-0.021 (-0.59)	-0.001 (-0.06)			-0.057 (-1.90)	0.021 (1.74)
8th grade alcohol problem			0.052 (1.73)	-0.004 (-0.19)			0.068 (2.27)	-0.021 (-1.95)
R-squared	0.035	-0.005	0.072	0.031	0.033	-0.069	0.080	0.034
F-test on instruments			2.14 [0.039]				1.61 [0.133]	
Over-identification Test		8.223 [0.512]				13.891 0.126		
Hausman Test		0.78 [0.382]				1.21 0.277		

Notes: See Table II-10

Table II-16 12th Grade Marijuana Use and Had Sex (State Sentiment Variables)

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 12th grade	0.137 (3.79)	0.355 (0.68)			0.203 (5.03)	-0.202 (-0.30)		
12th grade drug problem			0.005 (0.20)	-0.075 (-2.02)			0.004 (0.24)	0.020 (0.60)
12th grade alcohol problem			0.005 (0.28)	0.001 (0.04)			-0.002 (-0.21)	0.0004 (0.02)
10th grade drug expulsion			0.002 (0.12)	-0.001 (-0.04)			0.007 (0.33)	0.030 (1.25)
10th grade alcohol expulsion			0.033 (1.59)	-0.060 (-1.89)			0.013 (0.56)	-0.060 (-2.57)
10th grade drug problem			0.016 (0.99)	-0.025 (-0.74)			0.027 (1.53)	-0.007 (-0.18)
10th grade alcohol problem			0.015 (1.04)	0.053 (1.71)			-0.004 (-0.28)	0.032 (1.13)
8th grade drug expulsion			0.003 (0.14)	0.032 (0.93)			0.0001 (0.01)	0.060 (2.44)
8th grade alcohol expulsion			-0.003 (-0.09)	0.040 (1.00)			-0.013 (-0.52)	-0.007 (-0.18)
8th grade drug problem			0.018 (0.64)	0.034 (0.80)			-0.017 (-0.76)	0.079 (2.38)
8th grade alcohol problem			0.016 (0.79)	0.021 (0.60)			0.032 (2.06)	-0.027 (-1.10)
R-squared	0.075	0.057	0.052	0.078	0.102	0.054	0.058	0.097
F-test on instruments			1.84 [0.075]				1.60 [0.136]	
Over-identification Test		15.504 [0.078]				14.243 [0.114]		
Hausman Test		0.18 [0.677]				0.37 [0.547]		

Notes: See Table II-10

Table II-17 12th Grade Marijuana Use and Risky Sex (State Sentiment Variables)

12th grade sample	Male Respondents				Female Respondents			
	OLS	TSLS	1st Stage	Reduced Form	OLS	TSLS	1st Stage	Reduced Form
Marijuana use in 12th grade	0.063 (3.57)	-0.084 (-0.47)			0.077 (3.78)	-0.288 (-1.25)		
12th grade drug problem			0.005 (0.20)	-0.032 (-2.79)			0.004 (0.24)	-0.001 (-0.09)
12th grade alcohol problem			0.005 (0.28)	0.013 (1.08)			-0.002 (-0.21)	-0.025 (-2.89)
10th grade drug expulsion			0.002 (0.12)	0.010 (0.85)			0.007 (0.33)	-0.009 (-0.69)
10th grade alcohol expulsion			0.033 (1.59)	-0.017 (-1.06)			0.013 (0.56)	-0.006 (-0.56)
10th grade drug problem			0.016 (0.99)	-0.003 (-0.23)			0.027 (1.53)	0.002 (0.17)
10th grade alcohol problem			0.015 (1.04)	0.008 (0.46)			-0.004 (-0.28)	0.004 (0.36)
8th grade drug expulsion			0.003 (0.14)	0.012 (0.52)			0.0001 (0.01)	-0.003 (-0.26)
8th grade alcohol expulsion			-0.003 (-0.09)	-0.009 (-0.53)			-0.013 (-0.52)	0.001 (0.06)
8th grade drug problem			0.018 (0.64)	-0.001 (-0.06)			-0.017 (-0.76)	0.021 (1.74)
8th grade alcohol problem			0.016 (0.79)	-0.004 (-0.19)			0.032 (2.06)	-0.021 (-1.95)
R-squared	0.034	0.002	0.052	0.031	0.038	-0.149	0.058	0.034
F-test on instruments			1.84 [0.079]				1.60 [0.136]	
Over-identification Test		9.569 [0.387]				18.405 [0.031]		
Hausman Test		0.72 [0.401]				3.51 [0.067]		

Notes: See Table II-10

Table II-18 First Difference of the 12th Grade Marijuana Use as IV (Exogenous Covariates)

Havesex	**Male Respondents**			**Female Respondents**		
	TSLS	1st Stage	Reduced Form	TSLS	1st Stage	Reduced Form
12th grade marijuana use	0.169			0.218		
	(3.51)			(4.69)		
FD		0.633	0.107		0.548	0.12
		(27.02)	(3.31)		(23.34)	(4.29)
R-squared	0.066	0.627	0.067	0.097	0.578	0.093
F-test on instruments		730.25			544.61	
		[0.000]			[0.000]	
Hausman Test		1.12			0.38	
		[0.295]			[0.540]	
Riskysex						
12th grade marijuana use	0.033			0.073		
	(1.43)			(2.91)		
FD		0.633	0.021		0.548	0.040
		(27.02)	(1.39)		(23.34)	(2.86)
R-squared	0.032	0.627	0.029	0.037	0.578	0.033
F-test on instruments		730.25			544.61	
		[0.000]			[0.000]	
Hausman Test		2.54			0.07	
		[0.118]			[0.796]	

Notes:
1. T-statistics in parentheses, P-values in brackets. Standard errors are adjusted for clustering on the state of residence.
2. Exogenous variables: female, Asian, Hispanic, African-American, Native American, Central, South, West, Urban, Rural, Catholic, Baptist or Methodist, Other Christian, Other Religion, Religion activity, Hobbies, Mother high school drop out, Mother some college, Mother college graduate, Father high school drop out, Father some college, Father college graduate, Step-family, Single parent family, Family income, Number of siblings

Table II-19 First Difference of the 12th Grade Alcohol Use as IV (Exogenous Covariates)

Havesex	**Male Respondents**			**Female Respondents**		
	TSLS	1st Stage	Reduced Form	TSLS	1st Stage	Reduced Form
12th grade alcohol use	0.226			0.144		
	(6.86)			(4.47)		
FD		0.498	0.113		0.504	0.073
		(107.29)	(6.65)		(82.52)	(4.42)
R-squared	0.107	0.528	0.084	0.103	0.544	0.095
F-test on instruments		11511.36			6810.24	
		[0.000]			[0.000]	
Hausman Test		0.00			0.13	
		[0.961]			[0.721]	
Riskysex						
12th grade alcohol use	0.025			0.052		
	(1.82)			(3.67)		
FD		0.498	0.012		0.504	0.026
		(107.29)	(1.79)		(82.52)	(3.63)
R-squared	0.033	0.528	0.029	0.031	0.544	0.035
F-test on instruments		11511.36			6810.24	
		[0.000]			[0.000]	
Hausman Test		2.16			4.00	
		[0.148]			[0.051]	

Notes: See Table II-18

Table II-20 First Difference of the 12th Grade Marijuana Use as IV (Full covariates)

Havesex	**Male Respondents**			**Female Respondents**		
	TSLS	1st Stage	Reduced Form	TSLS	1st Stage	Reduced Form
12th grade marijuana use	0.094			0.127		
	(1.67)			(2.40)		
FD		0.593	0.055		0.500	0.064
		(24.17)	(1.61)		(24.44)	(2.27)
R-squared	0.093	0.651	0.094	0.120	0.625	0.120
F-test on instruments		584.05			597.17	
		[0.000]			[0.000]	
Hausman Test		0.94			0.82	
		[0.338]			[0.370]	
Riskysex						
12th grade marijuana use	0.004			0.044		
	(0.16)			(1.58)		
FD		0.593	0.002		0.500	0.0221
		(24.17)	(0.15)		(24.44)	(1.56)
R-squared	0.038	0.651	0.038	0.053	0.625	0.052
F-test on instruments		584.05			597.17	
		[0.000]			[0.000]	
Hausman Test		3.62			0.01	
		[0.063]			[0.926]	

Notes:

1. T-statistics in parentheses, P-values in brackets. Standard errors are adjusted for clustering on the state of residence.
2. Exogenous variables: female, Asian, Hispanic, African-American, Native American, Central, South, West, Urban, Rural, Catholic, Baptist or Methodist, Other Christian, Other Religion, Religion activity, Hobbies, Mother high school drop out, Mother some college, Mother college graduate, Father high school drop out, Father some college, Father college graduate, Step-family, Single parent family, Family income, Number of siblings
3. Expanded set of variables: high school variables including smokes daily in the current school year, Was offered drugs in 10th grade, Punishment for drug possession is expulsion, punishment for alcohol possession is expulsion, drugs are a problem at this school, alcohol is a problem at this school; And 8th grade personal variables containing smoking daily in 8th grade, school called parents about students' problematic behavior in 8th grade, was offered drug in 8th grade

Table II-21 First Difference of the 12th Grade Alcohol Use as IV (Full Covariates)

Havesex	**Male Respondents**			**Female Respondents**		
	TSLS	1st Stage	Reduced Form	TSLS	1st Stage	Reduced Form
12th grade alcohol use	0.195			0.099		
	(5.27)			(3.08)		
FD		0.472	0.092		0.473	0.047
		(92.40)	(5.17)		(71.53)	(3.05)
R-squared	0.124	0.556	0.107	0.124	0.572	0.121
F-test on instruments		8538.28			5116.44	
		[0.0000]			[0.0000]	
Hausman Test		0.01			0.29	
		[0.933]			[0.596]	
Riskysex						
12th grade alcohol use	0.004			0.035		
	(0.26)			(2.17)		
FD		0.472	0.002		0.473	0.016
		(92.40)	(0.25)		(71.53)	(2.14)
R-squared	0.039	0.556	0.038	0.049	0.572	0.053
F-test on instruments		8538.28			5116.44	
		0.000			0.0000	
Hausman Test		2.93			4.07	
		[0.093]			[0.049]	

Note: See Table II-20

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