Sex, Teen Pregnancies, STDs, and Beer Prices: Empirical Evidence from Canada

Anindya Sen
Associate Professor
Department of Economics
University of Waterloo

May Luong
Policy Analyst
Social Development Canada

Abstract

We evaluate the effects of higher beer prices on gonorrhea, chlamydia, and teen pregnancy rates by pooling data across Canadian provinces over time. Higher real beer prices are significantly correlated with a reduction in both gonorrhea and chlamydia rates with price elasticities ranging from -0.6 to -1.4. In contrast, an increase in the minimum legal drinking age is significantly associated with a reduction in teen pregnancies as well as births. Finally, Instrumental Variables (IV) estimates from the 1996 National Population Health Surveys (NPHS) validate that increased alcohol consumption is correlated with risky sexual practices, and ultimately with an increased likelihood of being infected with a sexually transmitted disease (STD).

Keywords: STDs, Teen pregnancies, Teen Births, Beer Taxes

JEL Classification Codes: H29, I18

I. Introduction

While possessing obvious benefits, sexual activity can also result in significant societal costs. Specifically, sex without proper protection can ultimately lead to an increase in the incidence of sexually transmitted diseases and therefore considerable health treatment costs.[1] However, other non-treatment costs might be even larger in magnitude. For example, children born to teenage mothers have lower birth weights.[2] Further, as pointed out by Dryburgh (2001), pregnant teens themselves are also at greater risk of health problems.[3]

However, the costs of sexual activity are not exclusively health related. Teen parenting is correlated with delayed educational attainment as well as reduced labor market opportunities.[4] Further, children born to teenage mothers are more likely to perform poorly in school, and are at greater risk of abuse and neglect. [5] Hence, understanding the effects of policies that might reduce unsafe sex or alternatively, encourage safer and more responsible practice, assumes enhanced importance.

In this respect, economists have conducted a considerable amount of empirical research aimed at evaluating the efficacy of a variety of alcohol policies and regulations on STDs and teen childbearing. The intuition, of course, is that a decrease in alcohol

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[1] For example, U.S. estimates of the costs of chlamydia and associated complications in 1994 are US$2 billion (Institute of Medicine, 1996). Frank (1996) reports that the annual costs of treating AIDS patients have been estimated at over CD$200 million in Canada (Frank, 1996). However, as noted by Patrick (1996), "Such costs for health care and related expenditures do not begin to approximate the costs in lost income and productivity associated with AIDS or the consequence of other STD."

[2] Wolfe and Perozek (1997) and Health Canada (1999).

[3] For example, anemia, hypertension, renal disease, eclampsia and depressive disorders. Please see Combes-Orme (1993) and Turner et al. (1990) for further details.

[4] The Alan Guttmacher Institute (1999) and Coté (1994).

[5] Maynard (1996) and George and Lee (1997).

consumption should result in less risky sexual behavior, and therefore a reduction in STDs and teen pregnancies. This paper attempts to contribute to the existing literature by employing Canadian data to evaluate the effects of beer prices on teen pregnancies and STDs across all ages. This is accomplished by exploiting variation in: teen pregnancy and birth rates and gonorrhea rates for all ages across provinces and over time between 1980 and 1998 and corresponding provincial chlamydia rates from 1991 to 1998.

Such an exercise has obvious benefits from the perspective of Canadian policy. However, there are wider applications. First, given that most research has been exclusively confined to the analysis of U.S. policies, the evaluation of similar Canadian regulatory measures is a useful counterfactual analysis in terms of understanding the efficacy of a variety of policies from a different but comparable jurisdiction. The merits of such research are enhanced by the fact, that while the United States does have the highest rates of teen pregnancy and STDs among western countries, the decline in STD rates and teen childbearing in Canada has also been comparable, with teen pregnancies dropping by roughly 16% and gonorrhea rates falling by approximately 93% from the early nineteen-eighties to the late nineteen-nineties.

Second, different studies using U.S. data arrive at varying conclusions regarding the efficacy of beer or alcohol taxes. Specifically, while Chesson et al. (2000) obtain rather large implied tax effects with respect to state level gonorrhea and syphilis rates, Carpenter (2000) finds beer taxes to be insignificantly correlated with youth gonorrhea rates. On the other hand, using comparable data, Grossman, Kaestner, and Markowitz (2004) find higher beer taxes to be significantly associated with a reduction in male gonorrhea rates. The use of Canadian data across a reasonable number of jurisdictions and a relatively long time period should be useful in resolving these ambiguities.

Third, employing Canadian data is also a contribution with respect to the literature on teen fertility and alcohol policies. Specifically, our enquiries with the National Centre of Vital Statistics suggest that U.S. data on teen births and pregnancies are only available for a limited number of years. In contrast, information on province specific births and pregnancies in Canada are available from the late nineteen-seventies onwards.

Fourth, it might also be the case that the conflicting results of previous studies reflect the effects of unobserved state specific policies and/or factors such as the increase in the use of contraceptives and improvements in birth control methods witnessed over the same time period. In this respect, employing cross province time-series Canadian data allows us to control for the impacts of policies or initiatives or policies that are specific to time or jurisdiction or trending within jurisdictions through time with the help of two-way fixed effects and province specific linear and quadratic trends.

Another contribution from the use of Canadian data stems from the reliance of U.S. studies on excise beer taxes. This empirical strategy makes sense from a reduced form perspective as higher taxes should result in higher prices and therefore less consumption. However, we argue that a better methodology is to match STD and pregnancy rates to beer prices instead of taxes. As pointed out by Young and Bielinska-Kwapisz (2002), economic theory suggests that prices rather than taxes directly impacts individual choice and hence better reflects alcohol costs. Another reason, of course, is that excise taxes might reflect unobserved state specific attitudes or attributes and thus lead to unreliable inferences on the efficacy of alcohol regulation. The traditional emphasis of U.S. studies on beer taxes rather than prices can probably be explained by the difficulties associated with obtaining such data across states and over a relatively long time period. In comparison, data on provincial Canadian beer and alcohol prices are available from the nineteen-seventies onwards.

Finally, we attempt to identify the effects of alcohol consumption on STDs by exploiting available data from the 1996 wave of the National Population Health Surveys (NPHS). A plausible relationship between higher alcohol taxes and the incidence of sexually transmitted diseases is predicated on a positive correlation between STDs, risky behavior, and alcohol consumption. A resulting contribution from this analysis is our attempt to evaluate the effects of increased alcohol consumption on risky sexual practices – as measured through having multiple partners within the past year – while including other covariates intended at capturing individual risk-taking behavior (breaking speed limits, not wearing a seatbelt, drinking and driving, daily smoker for a number of years).

This is an important as previous studies have emphasized that coefficient estimates of the effects of individual alcohol consumption with respect to risky sexual practices such as having sex without a condom and possessing multiple sexual partners might reflect individual proclivities for risk-taking rather than true causal impacts. But the more unique contribution results from the data allowing us to correlate changes in alcohol consumption to risky sexual practices as well as to the probability of having a sexually transmitted disease. We employ Instrumental Variables (IV) to specifically estimate the effects of alcohol consumption on the likelihood of having multiple partners through first stage regressions and the impacts of subsequently identified sexual practices on the probability of having a STD through second-stage regressions. This methodology follows the causal pathways suggested by epidemiologists. To the best of our knowledge, other studies have been unable to achieve this is because of a lack of similar data.

Our findings suggest higher beer prices do result in lower STD rates and price elasticities within a range of –0.6 to –1.4. While real beer prices have no impact on teen pregnancy and birth rates, an increase in the minimum legal drinking age from 18 to 19 years does have a negative impact. Our estimates from the 1996 wave of the National Population Health Surveys (NPHS) confirm that higher alcohol consumption is significantly correlated with an increase in the likelihood of risky sexual practices and more importantly, coefficient estimates of the impact of alcohol consumption remain statistically significant and relatively unchanged in magnitude with the inclusion of other covariates intended at controlling for risk taking behaviour. Specifically, having 10 drinks a day on average results in roughly a 60% increase in the probability of possessing multiple partners within the past year. Finally, having multiple partners is correlated with roughly a 2% increase in the likelihood of having a STD.

The reminder of our paper is structured as follows. The next section consists of an overview of the literature. Section 3 presents data trends. The empirical model is presented in section 4. Section 5 discusses our econometric estimates. Finally, section 6 concludes with a summary of the main findings.

II. Background Literature

a. *STDs, teen pregnancies, and beer taxes*

Recent research by economists suggests that more stringent alcohol control policies result in positive externalities in terms of leading to lower STD rates. In a seminal paper, Chesson *et al*. (2000) find that increased beer taxes significantly reduce STD rates among the overall population, implying that higher alcohol taxes are a particularly powerful deterrent to risky sexual behavior. Specifically, employing cross-state data from 1981 to 1995, they find a $1 increase in the per-gallon beer tax to be correlated with 25.4% and 93.3% reduction in all-age gonorrhea and syphilis rates, respectively. In addition, the authors find that a one year increase in the minimum legal age is associated with between a 6.5-8% fall in gonorrhea rates among 15-19 year olds.

Grossman, Kaestner, and Markowitz (2004b) focus on the effects of beer taxes on gonorrhea rates among 15 to 19 and 20 to 24 year olds across states from 1981 to 2001. They also estimate the impact of beer taxes on AIDS rates across Municipal Statistical Areas (MSAs) over the same time period. Interestingly, they do not control for variation in the minimum legal drinking age. Their results suggest that higher beer taxes and the presence of zero tolerance laws are associated with reductions in the male youth gonorrhea rates. More importantly, their estimates suggest elasticities within a plausible interval of between -0.3 and -0.5.

Carpenter (2004) estimates the effects of zero-tolerance drunk driving laws on state level gonorrhea rates between 1981 to 2000. His results suggest that the enactment of such laws is correlated with a reduction in gonorrhea rates among white males in the 15 to 19 years age group. In most cases, coefficient estimates of the effects of an increase in beer taxes and the minimum legal drinking age are statistically insignificant.

To the best of our knowledge, there are only two papers that specifically focus on the effects of alcohol control policies on teen childbearing. Employing state level data from 1975 to 1992, Dee (2001) finds that higher minimum legal drinking ages have a negative effect on teen motherhood rates among black adolescents, but not among white adolescents. However, he does not control for beer taxes. On the other hand, Sen (2003) uses state-level data from four years (1985, 1988, 1992, and 1996) to investigate the effects of beer taxes on teen birth and abortion rates, but does not control for differences in the minimum legal drinking age. Her results suggest that an increase in beer taxes have no effects on teen birthrates, and very small negative effects on teen abortion rates, with the latter result being sensitive to the inclusion of state fixed effects. Further, her reliance on only four years of data is unsurprising given that our correspondence with the U.S. National Centre of Vital Statistics confirms that data on teen births and pregnancies are only available for a limited number of years.[6]

The above discussion underscores the merits of employing Canadian data in order to investigate the effects of higher beer taxes and an increase in the minimum legal drinking age on STDs and teen pregnancies. First, all previous research has been exclusively conducted with U.S. data. Hence, evidence on the corresponding effects of similar alcohol regulation from a comparable jurisdiction should be of interest. This is all the more relevant, given the comparable declines in STDs and teen pregnancies witnessed in Canada over the same time period.

Second, very few studies have simultaneously controlled for changes in beer taxes as well as in the minimum legal drinking age in evaluating the impacts of alcohol control policies on either STDs or teen pregnancies. Third, the findings of previous studies are ambiguous with some finding a significant correlation between higher beer taxes and lower STDs/teen pregnancies while others obtain contrary results. These estimates might

[6] The lack of data over a long time period probably explains why Dee (2001) constructs teen birth and pregnancy rates from secondary sources.

in fact, be an artifact of unobserved state-specific attitudes and attributes rather than changes in beer taxes reflecting true causal impacts.[7] Similarly, there exists conflicting evidence on the effects of an increase in the minimum legal drinking age. Fourth, unlike corresponding U.S. data, Canadian information on teen births and pregnancies is available over a much longer time span, allowing us to better identify the true impacts of alcohol control policies.

Finally, instead of exclusively relying on variation in beer taxes, we match annual changes in beer prices to corresponding shifts in STDs and teen pregnancies, which is consistent with economic theory and a better methodology if the objective is to evaluate whether making alcohol more expensive has significant impacts. Young and Bielinska-Kwapisz (2002) suggest that most papers that have studied the impacts of alcohol consumption, use beer or some variant of alcohol taxes instead of price data collected by the American Chamber of Commerce Research Association (ACCRA) because of: (1) changes in definition of alcohol over time; (2) and significant gaps in information across states and over time.[8]

However, Young and Bielinska-Kwapisz (2002) point to problems from using beer tax data also. Specifically, using multivariate regression analysis, they find beer taxes to be poor predictors of corresponding variation in prices. Further, beer taxes only constitute a small portion of total beer prices. And as mentioned above, other research

[7] This concern assumes particular relevance given the findings by Dee (1999). Specifically, most studies on the effectiveness of drunk-driving legislation enacted in the U.S. during the nineteen-eighties and early nineties suggest that higher beer taxes are an effective mechanism to deter drinking and driving (e.g., Chaloupka et al., 1993). However, Dee (1999) demonstrates that beer taxes in fact, become statistically insignificant over a longer time period with the inclusion of state fixed effects, suggesting that the results of previous research may be confounded due to the inability to disentangle the impact of higher beer taxes from other state specific characteristics.

[8] Beer tax data are available from the Distilled Spirits Council of the United States.

focused on evaluating the determinants of harmful consequences of alcohol consumption such as impaired driving, find beer taxes to reflect unobserved state specific characteristics rather than true causal impacts. For these reasons, we believe that using beer prices constitutes a more refined empirical strategy that employing taxes and is a contribution from the use of Canadian data.

b. *STDs and alcohol consumption*

Our research also attempts to contribute to the literature by identifying the effects of alcohol consumption on STDs. This is accomplished by exploiting the 1996 wave of the National Population Health Surveys (NPHS). From the simplest perspective, available data from this survey allows us to conduct a counterfactual analysis by verifying whether an increase in alcohol consumption, on average, results in an enhanced likelihood of participating in risky sexual activities (such as multiple sexual partners over a limited time period), which then increases the probability of having a STD. While this is a relatively straightforward exercise, it is important, as to the best of our knowledge, no study has simultaneously evaluated the impact of greater alcohol consumption on risky sexual practices *and* the effects of such behavior on the likelihood of having a STD. The closest to such an exercise is Grossman, Kaestner, and Markowitz (2004a) who employ three waves of the 1997 National Longitudinal Youth Survey and biennial waves of the Youth Risk Behavioral Surveys, and find that while alcohol consumption shares a statistically insignificant relationship with the probability of having sex, it does seem to lower contraceptive use among sexually active teens.

The other, perhaps more important objective is to cleanly identify the impacts of alcohol consumption on the prevalence of STDs. Specifically, the existence of a negative correlation between beer taxes and STDs is premised on the assumption that enhanced alcohol consumption increases the likelihood of risky behavior, or conversely reduces the precautionary care an individual might otherwise exhibit.[9] Hence, an increase in beer taxes should lead to lower STDs by first resulting in a decline in alcohol consumption.

However, simply regressing measures of STD prevalence or risky sexual practices on alcohol consumption might result in biased and confounded estimates of the true relationship between them. This is because both alcohol consumption and participation in risky sexual practices might be driven by an underlying proclivity for high-risk behavior. The key challenge then, is to separate the unobserved effects of general risk taking behavior from admitted alcohol consumption, in order to obtain a robust and reliable estimate of the impacts of alcohol on risky sexual practices.[10]

Grossman, Kaestner, and Markowitz (2004a) address this problem by using instruments that only vary by state and year but not by individual. As pointed out by Rashad and Kaestner (2004) such an empirical strategy possesses some shortcomings. We adapt a slightly different and simpler methodology, which again is made possible by the unique information available from the NPHS survey. Specifically, when estimating the effects of alcohol consumption on risky sexual practices, we construct and include covariates for self-reported drinking and driving, speeding, and smoking. Such behavior are obvious and plausible measures for risk-taking and their inclusion should be helpful in mitigating any bias in coefficient estimates of the effects of alcohol consumption.

[9] Please see Chesson et al. (2000) and Sen (2003) for excellent reviews of this literature.

[10] In related work, Sen (2002) and Rees et al. (2001) examine the link between alcohol use and adolescent sexual activity.

III. Trends in Gonorrhea, Chlamydia, and Teen Pregnancies

Gonorrhea is a sexually transmitted disease that affects both men and women, and can be transmitted through oral, vaginal and anal sex. Gonorrhea can be passed on to a newborn during birth and cause eye infections or blindness. If left untreated, gonorrhea can cause serious complications including pelvic inflammatory disease (PID) in women and infertility for both sexes.[11]

Chlamydia can also be transmitted through vaginal, anal and oral sex and can be transmitted from mother to child during childbirth.[12] Untreated chlamydia among women can lead to pelvic inflammatory disease (PID). Babies born to pregnant women with Chlamydia may be premature, have eye infections or develop pneumonia. Men can develop scarring of the urethra, making urination difficult and occasionally causing infertility. Although rare, both sexes are at risk of a type of arthritis known as Reiter's Syndrome - an inflammation and swelling caused by the spread of the infection through the bloodstream into the joints. Both gonorrhea and Chlamydia can be treated through antibiotics.

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[11] For women, symptoms may include: new or different discharge from the vagina; burning sensation during urination; pain in the lower abdomen; fever; chills; pain during sex; vaginal bleeding between periods or after intercourse; and rectal pain and/or discharge. Males who have symptoms may experience: yellow-green discharge from the penis; burning feeling when urinating; pain or swelling of the testicles; and rectal pain and/or discharge. This description has been taken from Health Canada, specifically available at: http://www.phac-aspc.gc.ca/std-mts/ud-gonorrhea-200503_e.html.

[12] Symptoms of infection for women can include: vaginal discharge; a burning sensation when urinating; pain in the lower abdomen, sometimes with fever and chills; pain during sex; vaginal bleeding between periods or after intercourse. Symptoms for men can include: discharge from the penis; burning sensation when urinating; burning or itching at the opening of the penis; pain and/or swelling in the testicles; and rectal pain, bleeding and discharge. This description has been taken from http://www.hc-sc.gc.ca/iyh-vsv/diseases-maladies/chlamyd_e.html.

The United States has the highest STD and teen pregnancy rates among western industrializes nations.[13] Although the prevalence of STDs and teen pregnancies are much lower in Canada, it is interesting to note the existence of some patterns over time. For example, the nineteen-eighties and nineties witnessed a sharp decline in gonorrhea rates in both Canada and the Unite States. Specifically, as demonstrated in figure 1, gonorrhea rates per 100,000 of population fell by roughly 93% and 70% in Canada and the U.S., respectively, from 1981 to 1999.[14] What is perhaps, more interesting and relevant is that these movements are more or less parallel over this time period. On the other hand, trends in chlamydia rates are quite dissimilar, with Canada witnessing a decline of approximately 28% and corresponding rates in the U.S. trending upwards (figure 2). This is intriguing given that rates in the two countries were virtually identical in 1991.

In contrast, there are similarities in trends in teen pregnancies as well as births (per 1,000 of female teens) over time. Employing comparable U.S. data (from 1986) from the Alan Gutmacher Institute, figure 3 suggests that teen pregnancies started increasing in the U.S. during the late nineteen-eighties and early nineties but then began declining.[15] In comparison, while teen pregnancies in Canada began increasing around the same time, the corresponding drop occurred sometime later, roughly during the mid nineteen-nineties. In summary, these figures suggest that movements in gonorrhea rates as well as teen pregnancies and births have been similar in Canada and the U.S., and therefore an

[13] http://www.guttmacher.org/pubs/fb_teens.html.

[14] Data on Canadian gonorrhea and Chlamydia rates are available at http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/00vol26/26s6/. Information on corresponding U.S. rates can be found at http://www.cdc.gov/std/stats01/tables/table1.htm.

[15] Canadian data on teen pregnancies were obtained from Statistics Canada. U.S. rates are available at http://www.guttmacher.org/pubs/state_pregnancy_trends.pdf.

evaluation of the determinants of gonorrhea and teen pregnancy and birth rates in Canada might be useful to U.S. policymakers as well.

The question is then whether alcohol control policies have been responsible for the decline in Canadian gonorrhea and chlamydia rates and teen births and pregnancies. Statistics Canada data suggest that beer prices certainly become higher over the sample period– specifically, increasing by roughly 10% between 1980 and 1999. Coupled along with the observed 93% and 28% decline in gonorrhea and Chlamydia rates, these figures denote crude and rather large price elasticities of -9 and -3, respectively. The relevant point of course, is whether similar estimates are obtainable from a more rigorous empirical methodology.

The relevance of beer prices stems from the use of beer taxes as a fiscal policy instrument. In this respect, there exists considerable variation in the Provincial Sales Tax (PST) across jurisdictions and over time.[16] Available data from 1986 to 1999 shows that British Columbia, Manitoba, Nova Scotia, and Newfoundland increased its PST from: 7 to 10%; 6 to 7%; 10 to 15%; and 12 to 15%, respectively. With respect to the other provinces: Alberta did not impose any PST; Saskatchewan reduced its PST from 10 to 7%; Quebec dropped its corresponding tax from 9 to 7.5%; and finally, Prince Edward Island remained constant at 10%.[17]

The other policy instrument of key relevance is the minimum legal drinking age. In this respect, the variation is chiefly cross-province, as only Prince Edward Island increased its minimum legal drinking age during the sample period (from 18 to 19 in

[16] We ignore variation in federal levies over time as these are common to all provinces.

[17] Tax data were obtained from the Brewers Association of Canada.

1988). Specifically, Quebec, Manitoba, and Alberta had a legal drinking age of 18 while the other provinces had a corresponding regulated age of 19.

In conclusion, there seems to have been pronounced province-specific trends among a wide array of alcohol control initiatives. The next section attempts to disentangle the impacts of each of these policies within a more rigorous econometric framework.

IV. Empirical Results

a. Cross- Province and Time-Series Results- STDs

This section sets an empirical baseline for evaluating the impacts of beer taxes and the minimum legal drinking age on gonorrhea rates employing province specific data from 1981 to 1999, and on Chlamydia rates between 1991 and 1999. In this respect, the following empirical specification is employed; [18]

$$STD_{it} = \beta_0 + \beta_1 BEERP_{it} + \beta_2 MINDUM_{it} + \beta_3 STD_{it}(-1) + \beta_4 UNEMP_{it} + \beta_5 PCI_{it} + \beta_{6i}\sum_i P_i + \beta_{7t}\sum_t Y_t + \beta_{8i}\sum_i T_{it} + \beta_{9i}\sum_i T_{it}^2 + \varepsilon_{it} \qquad (1)$$

STD_{it} denotes the specific sexually transmitted disease, $RBEERP_{it}$ proxies real beer prices, $MINDUM_{it}$ is a dummy that is 1 if a province has a minimum legal drinking age of 19 years and is zero otherwise, STD_{it} (-1) is the lagged dependent variable that captures the underlying mechanism of transmission of these diseases (Chesson et al. 2000), and PCI_{it} is real per capita income while $UNEMP_{it}$ is the provincial unemployment rate, both of which are intended at capturing business cycle effects.

[18] The use of a level approach is validated by results from Likelihood Ratio tests based on Box-Cox regressions that do not reject the use of a levels specification.

Finally, P_i are province fixed effects, Y_t are year fixed effects, T_{it} consists of province specific linear trends, T_{it}^2 are province specific quadratic trends, and ε_{it} is the error term. [19] Summary statistics and data sources of all variables are contained in table 1.

Table 2 consists of OLS estimates of equation (1) with respect to gonorrhea rates with the standard errors of all covariates being White and Newey-West corrected for heteroskedasticity and first order autocorrelation. Panels A, B, and C contain empirical estimates of the effects of real beer prices and the minimum legal drinking age on total, male and female gonorrhea rates, respectively. Column 1 consists of the base specification and controls for the effects of real beer prices, per capita income, unemployment rates, province and year fixed effects, and finally, province specific linear trends. Province specific quadratic trends are added in column 2 while the effects of the minimum legal drinking age are evaluated in column 3. Finally, column 4 conducts a sensitivity analysis by adding variables that have also significantly trended over time.

The possibility of beer prices reflecting the impact of other unobserved initiatives or policies should be mitigated by our use of province specific linear and quadratic trends. Nonetheless, we include measures for medical care such as real per capita health expenditures and the number of per capita physicians that can plausibly impact movements in STDs and teen pregnancies, and have also significantly changed over time and varied across provinces. Further, we include a covariate for cigarette prices, which experienced significant changes over time and across provinces over the sample period. Specifically, roughly a 50% tax cut was imposed in Ontario, Quebec, New Brunswick,

[19] It is also important to acknowledge the possible impacts of impaired driving laws. Carpenter (2005) emphasizes the effects such legislation have had in reducing certain gonorrhea rates. However, given that most legislative changes in Canada were enacted in the nineteen-seventies and eighties (Sen, 2001) we rely on linear and quadratic trends rather than explicit covariates.

Nova Scotia, and Prince Edward Island by both federal and provincial governments in February nineteen ninety-four. The corresponding decline in cigarettes taxes in other provinces was much lower.[20]

The first important result is the statistically significant and negative coefficient estimate of real beer prices across all columns and panels in table 2. Unsurprisingly, there is variation in the magnitude of coefficient estimates across columns. Specifically, the implied beer price elasticity in panel A increases from -0.776 to -0.905 between columns 1 to 4. Similarly, the implied beer price elasticity with respect to males (panel B) increases from -0.803 to -0.876. In contrast, the corresponding increase for females (panel C) is more pronounced, from -0.679 to -0.843. In summary: (1) an increase in real beer prices is robustly correlated with a decline in gonorrhea rates (2) further, there does not seem to be a significant difference in price elasticities across gender.

In terms of other important results, coefficient estimates of the minimum legal drinking age are in most cases positive and statistically insignificant. Unsurprisingly, the lagged gonorrhea rate is positive and statistically significant across all columns. However, it is also important to note the considerable decline in coefficient estimates across all columns and panels, highlighting the importance of using a well specified model, as coefficient estimates of lagged gonorrhea rates may otherwise simply reflect the impacts of other unobserved determinants.

Table 3 consists of OLS estimates of the effects of real beer prices on chlamydia rates per 100,000 of population between 1991 and 1999. Similar to table 2, panels A, B, and C consist of econometric estimates with respect to total, male, and female chlamydia

[20] In 1993 the mean tax per carton in the other provinces (British Columbia, Alberta, Saskatchewan, Manitoba, and Newfoundland) was $37. In the next year it had declined to $31.

rates, respectively. Column 1 consists of the baseline estimates and apart from beer prices, specifically contains the lagged Chlamydia rate, province and year fixed effects, and province linear trends. Column 2 adds the unemployment rate and per capita income. Finally, column 3 includes province specific quadratic trends.[21]

Empirical estimates are remarkably similar across panels and columns. First, beer prices are negative and statistically significant across all columns with results in column 3 specifically implying a price elasticity of -1.14. Interestingly, the corresponding estimates from column 3 in panels B and C imply that males are more price elastic (-1.4015) than females (-0.9665). In this respect these results are slightly different than the previous estimates with respect to gonorrhea rates but they are consistent in the sense that an increase in prices is significantly correlated with a decrease in the STD rate in question. Further, as in the case of gonorrhea rates, lagged chlamydia rates are statistically significant but possess negative coefficients.

A key thesis of this paper is that the use of real beer prices is better than employing changes in tax rates in order to evaluate whether making alcohol more expensive ultimately results in lower STD rates through a decline in consumption. The reasons for this are obvious. Real beer prices change for a variety of reasons other than changes to tax rates. Hence matching trends in STD rates to changes in taxes may result in underestimates of the true impacts of more expensive alcohol. Further, as discussed earlier, coefficient estimates of beer taxes might reflect unobserved state specific attributes or sentiments rather than true causal impacts.

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[21] Due to the smaller sample size relative to gonorrhea rates, the minimum legal drinking age had to be excluded in order to accommodate province specific fixed effects.

In order to investigate this possibility, table 4 consists of estimates of changes in the provincial sales tax for beer (converted in $ per litre) on gonorrhea and chlamydia rates. Panels A and B consist of estimates with respect to gonorrhea and chlamydia, respectively. Column 1 contains estimates with respect to the total rate while columns 2 and 3 focus on males and females separately. While beer taxes are sporadically significant with respect to gonorrhea rates, they possess counter-intuitive positive signs. On the other hand, beer taxes are statistically significant with respect to chlamydia rates. However, the coefficient estimates are much larger in magnitude than corresponding results from table 3 and suggest elasticities of between -3 and -8.66, which seem rather large and less plausible. These results illustrate the benefits of relying on actual variation in real beer prices as opposed to taxes

In summary, our results suggest that higher beer prices are significantly correlated with a reduction in STD rates. However, from the perspective of fiscal policy, it is important to ascertain whether an increase in the provincial sales tax will result in higher alcohol prices. Hence, employing the above cross-province time-series we ran a simple empirical specification motivated by other studies that have analyzed the effects of tax changes on prices. Specifically, we regressed the natural logarithm of provincial sales tax ($ per litre) on the natural logarithm of real beer prices per litre and also employed province and year fixed effects, province specific linear trends, and the natural logarithms of unemployment rates and per capita income. Simple OLS (with standard errors White corrected for heteroskedasticity and Newey-West corrected for autocorrelation) yield the following results;

ln (*real beer prices*) = intercept + 0.81147 ln(*tax*) + 0.093828 ln (*unemployment rate*) - 0.01294 ln (*per capita income*) + province and year fixed effects + province linear trends

adjusted R Square = 0.9480

Hence, a 1% increase in real taxes is significantly (at 5%) correlated with a 0.81% increase in real per litre beer prices. These results confirm that an increase in prices generated by higher taxes should result in lower STD rates.

b. IV results - STDs

As noted by Grossman, Kaestner, and Markowitz (2004b), using lagged dependent variables on the right hand side might result in some problems. Specifically, Baltagi (2001) has pointed out that coefficient estimates of lagged dependent variables in fixed effects models might be inconsistent even in the absence of autocorrelation, thus impacting coefficient estimates of other covariates that are correlated with the lagged dependent variables. In order to remedy this we use Instrumental Variables (IV) estimation, the results of which are presented in table 5.

Panels A and B contain estimates with respect to gonorrhea and chlamydia rates, respectively. Columns 1, 3, and 5 consist of first stage regression results where the lagged STD rate is specifically instrumented by the lagged value of ad valorem or provincial sales tax on beer consumption, converted in dollar terms as well as interactions of the lagged value of this tax variable with dummy variables representing the political party in power in a province. Specifically, we construct two dummy variables each of which assumes a value of 1 (and 0 otherwise) if the political party it represents is in power in a province. In this respect, there is one dummy variable each for the Liberal Party and the New Democratic Party, with the Conservative Party comprising the omitted fixed effect.[22] [23] [24] The distinction between the columns is that 1 consists of estimates with respect to total STD rates and columns 3 and 5 look at males and females, respectively. Corresponding second stage regression results for total, male, and female STD rates are contained in columns 2, 4, and 6.

Constructing instruments based on the political party in power in addition to lagged taxes enables us to construct a test for overidentifying restrictions. By interacting the lagged values of provincial sales taxes (in dollars) with the political party in power, we are attempting to ascertain whether changes in taxes can be identified with changes in provincial governments. This is intuitively plausible. Further, these instruments should not be directly correlated with the right hand side error term.

Empirical estimates from panel A of columns 1, 3, 5 reveal that changes in lagged beer taxes are negatively correlated with corresponding changes in lagged total, male, and female gonorrhea rates. However, coefficient estimates of lagged beer taxes are statistically insignificant. The only instrument which is significant is Lagged Beer Tax (in $) * New Democratic Party or the interaction of lagged beer taxes with the New Democratic Party, in columns 1 and 3. Further, employing *F* tests of joint significance, we cannot reject the null hypothesis that the coefficient estimates of the instruments are

[22] Along with the Conservative Party these are the national political parties in Canada. The Conservatives are considered right wing and the Liberals and the New Democratic Party left wing, with the New Democrats considered to be further left than the Liberals. Other parties are smaller and regionally based.

[23] For example, if the average real beer price per litre in a province for a given year is $10 and the sales tax is 5%, then the corresponding dollar component of price is $0.50.

[24] Our sample size is restricted to 1986-1999 due to data availability on political parties.

equal to zero. Therefore, the results from the second stage regressions must be treated with caution.[25] However, it is reassuring that coefficient estimates of real beer prices from columns 1, 3, and 5 are negative and are not that dissimilar in terms of implied elasticities from table 3.

On the other hand, empirical estimates from first stage regressions with respect to chlamydia rates (columns 1, 3, and 5 from panel B) are quite different. Specifically, while the interactions of lagged taxes with different political parties are statistically insignificant, coefficient estimates of lagged beer taxes are statistically significant across all columns. Further, p values from F tests of joint significance are very low, allowing us to comfortably reject the null hypothesis of the coefficient estimates of the instruments equaling zero, across all columns. Finally, we perform a test of overidentifying restrictions as suggested by Hansen (1982).[26] The null hypothesis of exogeneity of the instruments cannot be rejected ($p > 0.10$)).

Second stage regression results in columns 2, 4, and 6 with respect to chlamydia demonstrate that coefficient estimates of real beer prices are statistically significant and more importantly implied elasticities that are slightly larger than but in line with corresponding OLS estimates from table 3. In summary, OLS estimates derived from

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[25] As pointed out by Bound et al. (1995) and Staiger and Stock (1997), IV coefficient estimates will be inconsistent and biased if instruments are only weakly correlated with potential simultaneously determined variables.

[26] The test statistic is given by $O = s^2(Z'e)'(Z'Z)^{-1}(Z'e)$, where Z is the matrix of instruments, e is the vector of error terms from the second-stage IV estimation routine and s^2 is the estimated variance of the error terms from this regression. Under the null hypothesis of exogeneity of the instruments, O is distributed χ^2 with degrees of freedom given by the number of overidentifying restrictions (J +1), where J is the number of endogenous variables.

employing a wide array of covariates, province and year fixed effects, province specific linear and quadratic trends consistently imply that an increase in real beer prices is significantly correlated with a reduction in gonorrhea as well as chlamydia rates. Corresponding IV estimates are consistent with OLS results in the sense of possessing negative coefficients, and in most cases, denoting comparable elasticities.

c. Cross- Province and Time-Series Results- Teen Births and Pregnancies

OLS (1981-1999) and IV (1986-1999) estimates of the impacts of increases in real beer prices and the minimum legal drinking age on teen pregnancies and birth rates derived from cross-province time-series data are presented in table 6.[27] There are of course, some differences in the empirical specification relative to the one employed for the analysis on STDs, and which are consistent with the specific literature on teen pregnancies.[28] First, there is no lagged dependent variable. Second, consistent with the relevant literature, we include a variable that represents average government transfers to female lone parent families as a number of studies have found a correlation between teen pregnancies and welfare payments.[29] Third, while we estimate the contemporaneous effects of real beer prices, the minimum legal drinking age, and average government transfers on teen pregnancies, only the effects of lagged versions of these covariates are estimated on teen births, given the gestation period from pregnancy to birth. Finally, taking into consideration the limited time-series variation in teen pregnancies and births over time, we do not use province specific quadratic trends, and instead rely on province

[27] The rates are specifically for females under the age of 20 per 1,000 of respective population.

[28] Dee (2001) and Sen (2003).

[29] Examples include but are not restricted to Levine (1995) and Lundberg (1996).

and year fixed effects and province specific linear trends to control for the confounding effects of unobserved determinants.

Panel A of table 6 consists of empirical estimates with respect to teen pregnancies while panel B contains corresponding estimates for teen births. Columns 1 and 2 consist of OLS estimates, with the difference between the columns stemming from the inclusion of province specific linear trends in column 2. Corresponding IV estimates are contained in columns 3 and 4, with the difference again being the inclusion of province specific linear trends in column 4. The only covariate instrumented is average government transfers to female lone parent families, specifically by political dummy variables (Liberal Party and New Democrat Party). Of course, only the lagged versions of these instruments are employed when estimating the effects of lagged transfers on teen births in panel B.

The first result of importance is the statistical insignificance (in most cases) and positive signs of both OLS and IV coefficient estimates of real beer prices. Average transfers are statistically significant in panel A (teen pregnancies) in columns 3 and 4 but largely statistically imprecise in panel B (teen births). Of more interest is the consistently negative and statistically significant (in most cases) coefficient estimates of the minimum legal drinking age. Specifically, these coefficient estimates suggest that an increase in the minimum legal drinking age from 18 to 19 years is associated with between: (1) a to 3.2924 to 9.0556 decline in teen pregnancies; and a (2) 2.8227 to 10.407 fall in teen births per 1,000 of relevant population.

Considering that the implicit variation in the minimum legal drinking age variable (1-if 19, 0 if 18) is chiefly cross-province, it is quite possible that its statistical significance is a result of other unobserved province specific initiatives rather than true causal impacts. However, it is also quite plausible that enhanced difficulties associated with accessing alcohol teen pregnancies in provinces with a higher legal drinking age and births could result in lower teen pregnancies and births. As noted, these results are consistent with comparable estimates obtained by Dee (2001) with respect to cross-state and time-series U.S. data. In terms of the general statistical insignificance of real beer prices, it is also worthwhile to emphasize that Sen (2003) also did not find beer prices to share a consistently significant relationship with either teen pregnancies or abortions.

d. 1996 National Population Health Survey

Table 8 contains estimates of the effects of alcohol consumption on whether an individual had more than one sexual partner in the past year and the impact of multiple partners on the likelihood of having a STD. The 1996 NPHS consists of over 80,000 observations. In order to conduct our analysis we only kept individuals who confirmed that they had sexual intercourse at least once in the past year, are single, and are less than 55 years of age, leaving us with a sample of 11,431 observations.

Alcohol consumption is captured as the number of average daily drinks in the past year and the square of the number of daily drinks. In order to mitigate concerns that coefficient estimates of alcohol consumption might be capturing risk taking behavior, we include the following as covariates: number of years as daily smoker; number of years as daily smoker- squared; if the individual regularly breaks speed limits; and finally, the number of times the individual has driven after having too many drinks in the past year. We also include male, age, household income, education, and province fixed effects.[30]

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[30] We construct education fixed effects for: high school; some college; college; some university; undergraduate; and graduate. Income fixed effects are: less than 5000; 5,000-9999; 10000-14999; 15000-

Figure 5 gives the proportion of survey respondents according to arbitrary drinking thresholds. Table 7 consists of means according to the same alcohol consumption classification. Discounting the last column (having 10 or more drinks daily) which only consists of 29 survey respondents, there is a pronounced increase across columns and hence in the mean number of respondents that answer affirmatively to having multiple partners and STDs, offering evidence of a positive correlation between increased alcohol consumption, risky sexual partners (multiple partners), and having a STD. Similarly, the mean amount of years being a daily smoker increases with alcohol consumption. On the other hand, the proportion of respondents who answer affirmatively to breaking speed limits decreases with alcohol consumption.

Panel A of table 8 consists of estimates with respect to all ages while B contains regressions with respect to teens. Otherwise both columns are organized similarly. Columns 1-3 consist of OLS estimates with having multiple partners (1-yes,0-no) as the dependent variable.[31] Column 1 consists of daily alcohol and daily alcohol consumption squared along with the different fixed effects. Column 2 evaluates the effects of adding breaking speed limits and the number of times the individual has driven impaired. Number of years as a daily smoker and its squared term are included in column 3. Column 4 consists of OLS estimates of the effects of possessing multiple partners on the likelihood of having a STD while corresponding IV estimates are in column 5, with possessing multiple partners being instrumented by breaking speed limits, number of

19999; 20000-29999; 30000-39999; 40-49999; 50-5999; 60-7999; and greater than 80000. Age fixed effects are for the following categories: 20-24; 25-29; 30-34; 35-39; 40-44; 45-49; and 50-54. The omitted category is 15-19 year olds.

[31] An individual has a STD if he/she suffers from any one or more of the following: chlamydia; gonorrhea; syphilis; genital warts; herpes; hepatitis; AIDS; pelvic inflammatory disease; any other.

times the individual has driven impaired, years as a daily smoker and number of years as a daily smoker squared.[32]

The first result of importance is the fact that alcohol consumption is statistically significant with relatively little change in coefficient estimates across columns. In panel A, column 1, the coefficient estimate of alcohol consumption implies that individuals who consume 10 drinks on a daily basis are 70% more likely to have multiple partners. By column 3, the coefficient estimate drops slightly to 60%. Coefficient estimates of speeding and driving impaired are also statistically significant across columns 2 and 3. However, speeding possesses a counter-intuitive negative sign. On the other hand, one incident of impaired driving is roughly correlated with a 9% increase in the likelihood of having multiple partners. Similarly being a daily smoker is positively correlated with having multiple partners. Specifically, being a daily smoker for 10 years is associated with a 5% increase in the probability of multiple partners. Interestingly, the corresponding coefficient estimates with respect to teens (panel B) are not all that different from panel A.

In summary, most of the risk-taking covariates do possess the expected positive coefficients. But perhaps more importantly, their inclusion does not significantly impact empirical estimates of alcohol consumption. This gives us some confidence that our estimates accurately reflect the effects of alcohol consumption on risky sexual practices rather than unobserved behavior that is also correlated with alcohol consumption.

Finally, columns 4 and 5 consist of OLS and IV estimates, respectively, of the impacts of having multiple partners. Coefficient estimates of the effects of having

[32] We specifically employ OLS as opposed to logistic or probit estimation because of the ease in conducting and comparing OLS and IV results. However, results from logistic regressions (in the absence of fixed effects ar equite similar to OLS estimates.

multiple partners are remarkably similar across panel as well as columns; specifically such behavior is positively correlated with a 2.4 to 2.8% increase in the probability of having a STD. The small magnitude of coefficient estimates is probably a result of underreporting among survey respondents, which is unsurprising when one considers the social stigma associated with having a STD.[33] Nonetheless, despite the small magnitude, it is still reassuring that we are able to obtain a positive correlation between STDs and having multiple partners. This result along with the positive association between alcohol consumption and possessing more than one partner adds credibility to our findings of a statistically precise relationship between higher beer taxes and lower STD rates.

VI. Conclusion

We attempt to contribute to the literature by employing Canadian data to estimate the effects of beer prices on gonorrhea and chlamydia rates across provinces and over time from the nineteen-eighties and early nineteen-nineties onwards. Such an exercise is merited by the rather steep decline in both STD rates that occurred over the sample period and the conflicting results obtained by U.S. studies. Coincidentally, there was also considerable variation in ad valorem tax rates at the same time. A thesis of this paper is that matching beer prices to STD rates is probably a better empirical strategy than directly estimating the effects of beer taxes on STD rates as beer prices accurately reflect costs of alcohol consumption and previous studies have found beer taxes to reflect unobserved state specific characteristics. In this respect using Canadian data makes sense as there exists available information across provinces and over time without significant gaps, unlike U.S. data. We also estimate the effects of beer prices and the minimum legal

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[33] For example please see Cunningham et al. (2002).

drinking age on teen childbearing and pregnancies. Finally, we employ survey data to confirm whether higher alcohol consumption is correlated with having multiple partners and the incidence of STDs.

Our results suggest that higher beer prices are significantly correlated with lower gonorrhea and chlamydia rates and beer price elasticities within the range of -0.6 to -1.4. Further, we confirm that estimating the effects of beer taxes on STDs might not be the best methodology as we obtain rather conflicting results. However, beer prices do not have any statistically significant impact on either teen births or pregnancies. In contrast, both OLS and IV estimates suggest that an increase in the minimum legal drinking age is significantly associated with lower teen births and pregnancies. Finally, results from the 1996 NPHS confirm that higher alcohol consumption is indeed correlated with an increased likelihood of having multiple partners and ultimately a STD, even after controlling for individual risk taking behavior.

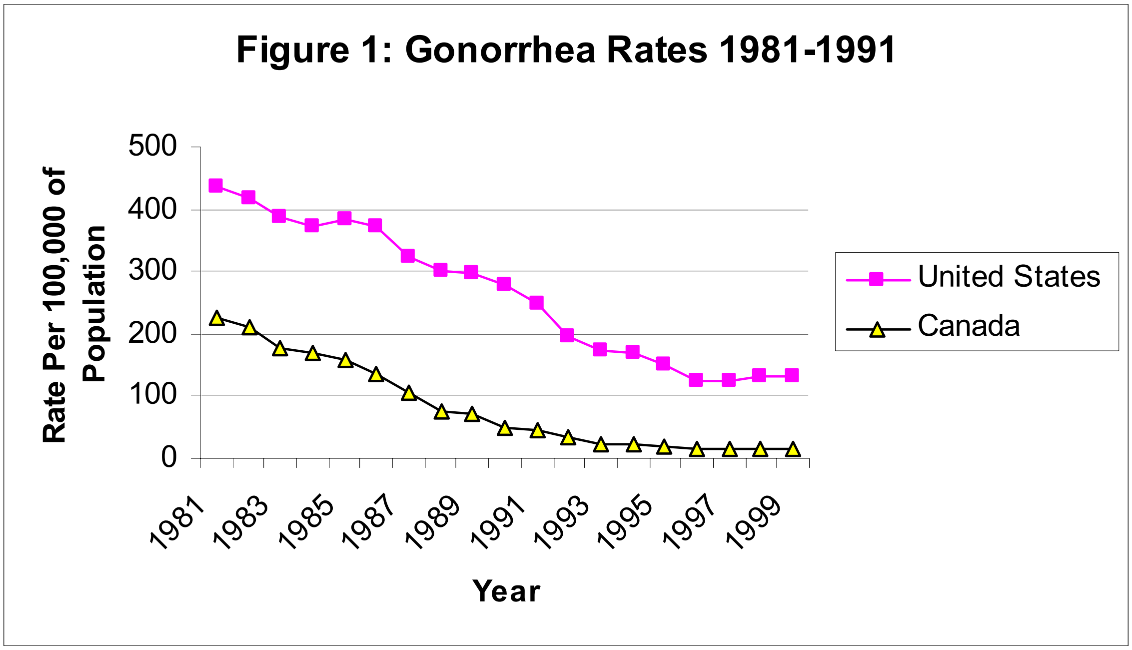
Figure 1: Gonorrhea Rates 1981-1991
Rate Per 100,000 of Population
500
400
300
200
100
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
Year
United States
Canada

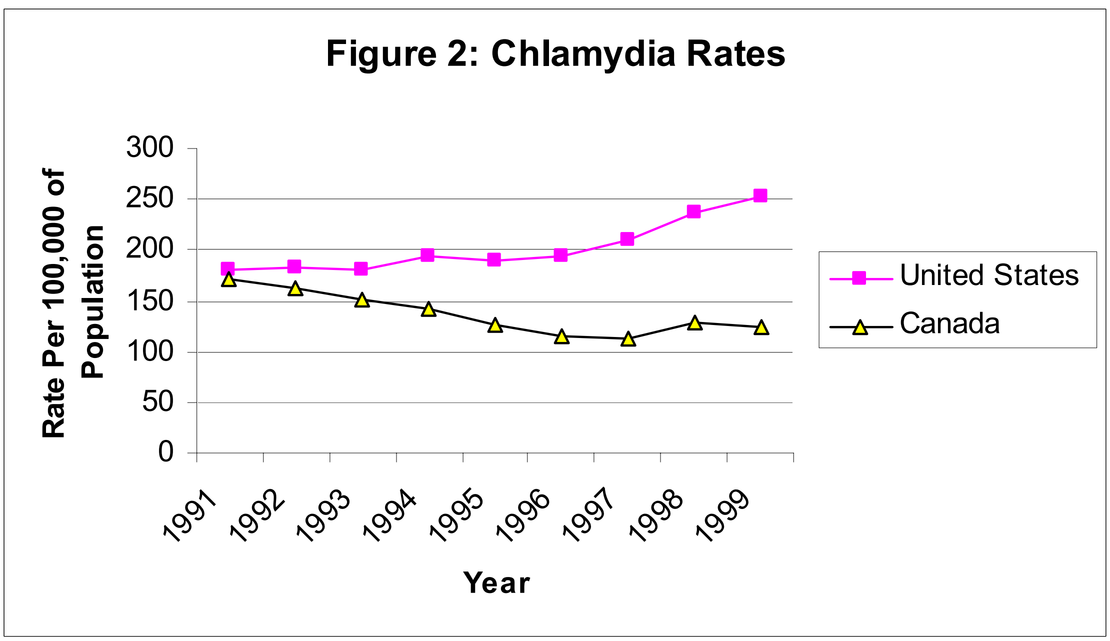
Figure 2: Chlamydia Rates
Rate Per 100,000 of Population
300
250
200
150
100
50
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
Year
United States
Canada

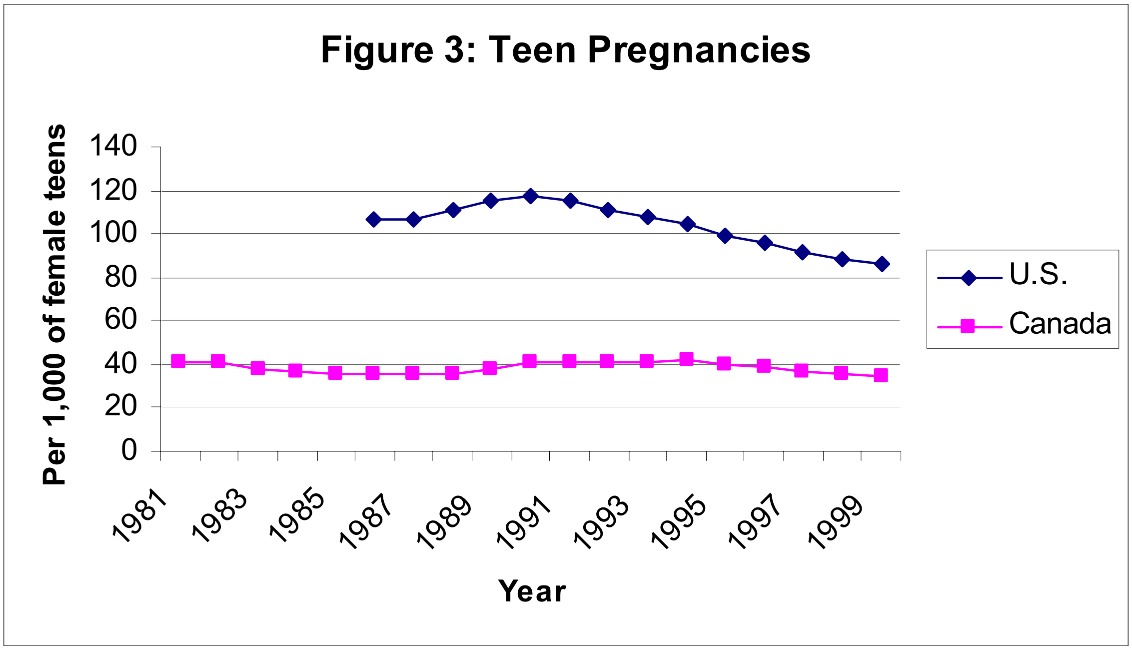
Figure 3: Teen Pregnancies
Per 1,000 of female teens
140
120
100
80
60
40
20
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
Year
U.S.
Canada

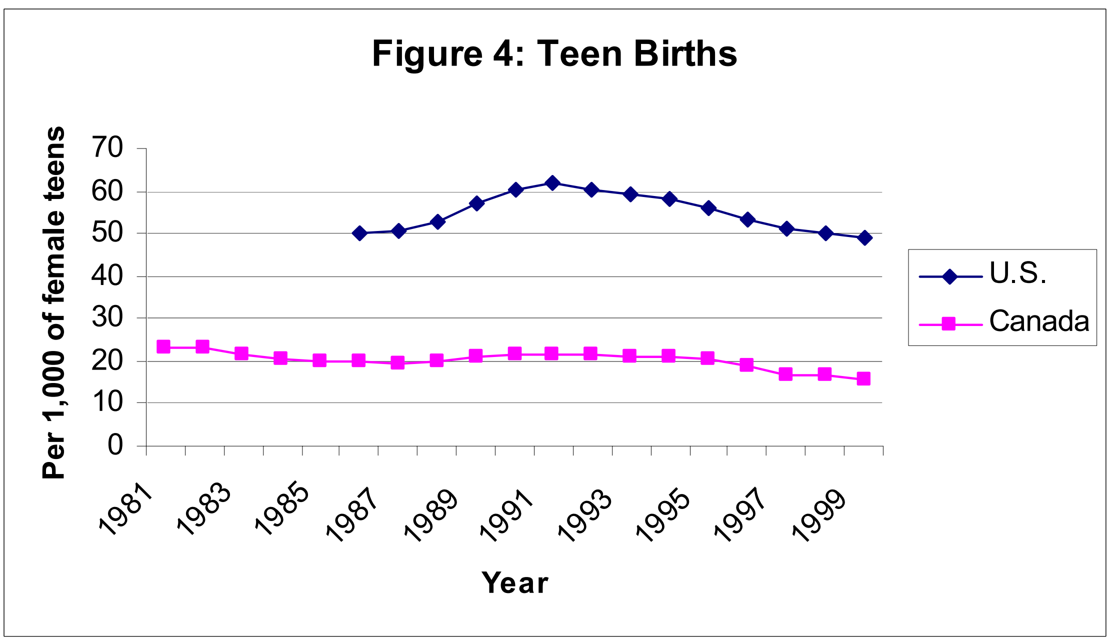
Figure 4: Teen Births
Per 1,000 of female teens
70
60
50
40
30
20
10
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
Year
U.S.
Canada

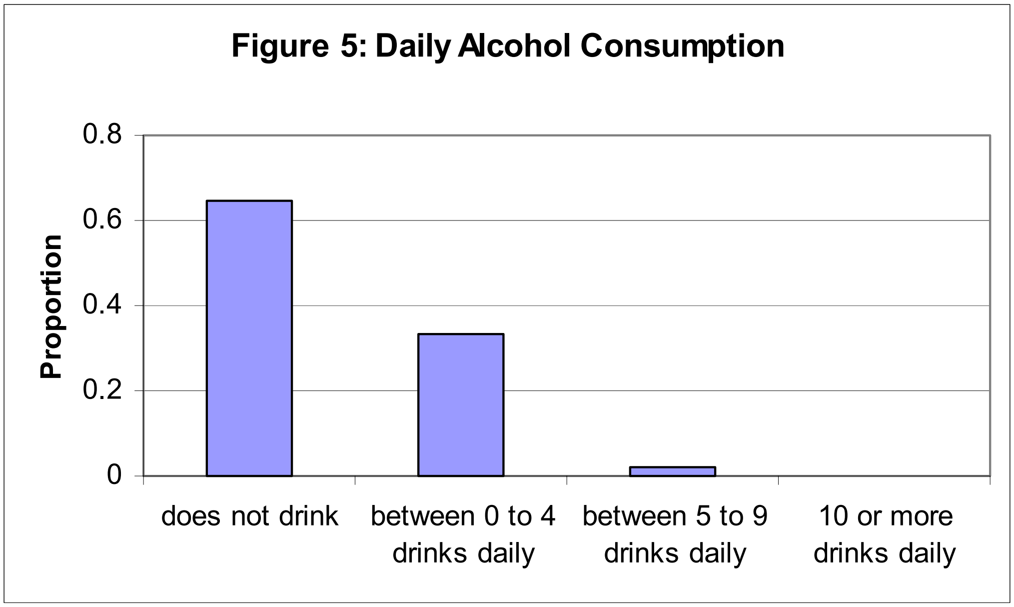
Figure 5: Daily Alcohol Consumption
0.8
0.6
0.4
0.2
0
Proportion
does not drink
between 0 to 4 drinks daily
between 5 to 9 drinks daily
10 or more drinks daily

Table 1: Summary Statistics

	N	MEAN	STD DEV	MIN	MAX
A. Cross Province Time-Series Data					
Total Gonorrhea Rate	180	71.448	86.653	1.00E-08	467.3
Male Gonorrhea Rate	180	78.453	101.92	1.00E-08	554.6
Female Gonorrhea Rate	180	61.154	73.792	1.00E-08	384.5
Real Beer Price (per Litre)	180	2.6305	0.40993	1.5292	3.5774
Real Per Capita Income	180	14407	3025.7	7452	20987
Real Per Capita Government Health Expenditures	180	14.94	1.4997	11.212	17.986
Number of Physicians Per 100,000 of Population	180	165.12	25.287	115.08	209.58
Real Excise Taxes Per 2 Cigarettes	180	0.21961	8.78E-02	5.31E-02	0.42905
Minimum Legal Drinking Age	180	0.66667	0.47272	0	1
Teen Pregnancies Per 1,000 of women 15-19	180	39.392	8.8381	22.2	59
Teen Fertility Per 1,000 of women 15-19	180	29.699	9.0294	14.2	50.2
Total Chlamydia Rate	90	151.86	72.245	1.00E-08	410.2
Male Chlamydia Rate	90	73.069	43.529	0	220.5
Female Chlamydia Rate	90	220.91	107.39	0	596.7
B. 1996 NPHS Survey					
Male	11431	0.511941	0.499879	0	1
age 20-24;	11431	0.135246	0.342001	0	1
age 25-29	11431	0.240574	0.427451	0	1
age 30-34	11431	0.183711	0.387265	0	1
age 35-39	11431	0.145307	0.352425	0	1
age 40-44	11431	0.127198	0.333209	0	1
age 45-49	11431	0.097542	0.296707	0	1
age 50-54	11431	0.070423	0.255869	0	1
high school	11431	0.190272	0.392533	0	1
college	11431	0.172688	0.377994	0	1
Some college	11431	0.186598	0.389605	0	1

undergraduate	11431	0.191059	0.393153	0	1
graduate	11431	0.256408	0.436669	0	1
Income less than 5000	11431	0.01006	0.0998	0	1
Income 5,000-9999	11431	0.051264	0.220546	0	1
Income 10000-14999	11431	0.088881	0.284585	0	1
Income 15000-19999	11431	0.076109	0.265184	0	1
Income 20000-29999	11431	0.121687	0.326938	0	1
Income 30000-39999	11431	0.131572	0.33804	0	1
Income 40-49999	11431	0.131572	0.33804	0	1
Income 50-5999	11431	0.101216	0.301628	0	1
Income 60-7999	11431	0.085294	0.279332	0	1
Income greater than 80000	11431	0.073047	0.260225	0	1
Have you broken speed limit	11431	0.589275	0.491987	0	1
Number of times driven while impaired in past year	11431	0.465664	2.570719	0	99
Number of average daily drinks	11431	0.657773	1.340506	0	24
Number of average daily drinks Squared	11431	2.229464	13.02277	0	576
Had more than one sexual partner in past year	11431	0.204444	0.403312	0	1
Has a sexually transmitted disease	11431	0.028869	0.167445	0	1
Number of years been a daily smoker	11431	6.825387	9.038846	0	42
Number of years been a daily smoker squared	11431	128.2795	238.6729	0	1764

Table 2: OLS estimates of the impact of beer prices on gonorrhea rates (1981-99) [34]

	(1)	(2)	(3)	(4)
A. Total				
Beer prices	-21.076	-28.444	-22.705	-24.589
	(8.8056) [a] [35]	(9.2404) [a]	(7.8518) [a]	(8.6683) [a]
Elasticity	[-0.776]	[-1.0472]	[-0.8359]	[-0.90529]
Lagged Gonorrhea Rate	0.74494	0.40503	0.40954	0.38819
	(0.06717) [a]	(0.07931) [a]	(0.0789) [a]	(0.08350) [a]
Minimum Legal Drinking Age			3.4096	1.7477
			(11.013)	(11.766)
Unemployment Rate and Per Capita Income	Yes	Yes	Yes	Yes
Cigarette Prices, Real Per Capita Government Health Expenditures, Number of Physicians Per Capita of Population	No	No	No	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes	Yes
Province Quadratic Trends	No	Yes	Yes	Yes
Adjusted R Square	0.9798	0.9826	0.9828	0.9827
Observations	180	180	180	180
B. Male				
Beer prices	-23.942	-29.014	-23.447	-26.135
	(10.384) [a]	(10.268) [a]	(9.4129) [a]	(10.167) [a]
Elasticity	[-0.803]	[-0.9728]	[-0.7861]	[-0.8763]
Lagged Gonorrhea Rate	0.77750	0.52908	0.52426	0.51151
	(0.0600) [a]	(0.08616) [a]	(0.0858) [a]	(0.08640) [a]
Minimum Legal Drinking Age			5.1527	-0.93617
			(11.812)	(13.388)
Unemployment Rate and Per Capita Income	Yes	Yes	Yes	Yes
Cigarette Prices, Real Per Capita Government Health Expenditures, Number of Physicians Per Capita of Population	No	No	No	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes	Yes
Province Quadratic Trends	No	Yes	No	Yes
Adjusted R Square	0.9827	0.9844	0.9845	0.9844
Observations	180	180	180	180
B. Female				
Beer prices	-15.777	-23.694	-20.023	-19.593
	(8.1044) [c]	(8.3031) [a]	(7.8094) [a]	(8.2348) [a]
Elasticity	[-0.679]	[-1.0192]	[-0.8613]	[-0.8428]
Lagged Gonorrhea Rate	0.74902	0.34520	0.36046	0.35817
	(0.05718) [a]	(0.06936) [a]	(0.0725) [a]	(0.07568) [a]

[34] The data are for 10 provinces between 1981 and 1999. Standard errors are White corrected for heterosckedasticity and Newey – West corrected for autocorrelation. Standard errors are in parentheses and elasticities in square brackets.

[35] a, b, c refers to statistical significance at 1%, 5%, and 10%, respectively.

Minimum Legal Drinking Age			6.5469 (11.964)	7.5622 (13.014)
Unemployment Rate and Per Capita Income	Yes	Yes	Yes	Yes
Cigarette Prices, Real Per Capita Government Health Expenditures, Number of Physicians Per Capita of Population	No	No	No	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes	Yes
Province Quadratic Trends	No	Yes	No	Yes
Adjusted R Square	0.9742	0.9794	0.9177	0.9788
Observations	180	180	180	180

Table 3: OLS estimates of the impact of beer prices on Chlamydia rates (1991-99)[36]

	OLS (1)	OLS (2)	OLS (3)
A. Total			
Beer prices	-39.615	-44.195	-62.417
	(15.912) [b]	(16.561)[a]	(15.950) [a] [37]
Elasticity	[-0.7235]	[-0.807]	[-1.1400]
Lagged Chlamydia Rate	-0.42501	-0.46187	-0.43082
	(0.07475) [a]	(0.06445) [a]	(0.05331) [a]
Unemployment Rate and Per Capita Income	No	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes
Province Quadratic Trends	No	Yes	Yes
Adjusted R Square	0.9179	0.9325	0.9541
Observations	90	90	90
B. Male			
Beer prices	-20.685	-18.347	-36.924
	(11.325) [c]	(11.338)	(11.403) [a]
Elasticity	[-0.7850]	[-0.6964]	[-1.4015]
Lagged Chlamydia Rate	-0.39049	-0.42603	-0.39408
	(0.0766) [a]	(0.08105) [a]	(0.05931) [a]
Unemployment Rate and Per Capita Income	No	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes
Province Quadratic Trends	No	No	Yes
Adjusted R Square	0.8821	0.8851	0.9344
Observations	90	90	90
B. Female			
Beer prices	-63.424	-65.392	-76.985
	(33.525) [c]	(32.407) [b]	(28.647) [a]
Elasticity	[-0.7962]	[-0.821]	[-0.96654]
Lagged Chlamydia Rate	-0.38470	-0.43010	-0.49723
	(0.08372) [a]	(0.08392) [a]	(0.05570) [a]
Unemployment Rate and Per Capita Income	No	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes
Province Quadratic Trends	No	No	Yes
Adjusted R Square	0.7785	0.8006	0.9009
Observations	90	90	90

[36] The data are for 10 provinces between 1991 and 1999. Standard errors are in parentheses and elasticities in square brackets. Standard errors of OLS estimates are White corrected for heterosckedasticity and Newey – West corrected for autocorrelation.

[37] a, b, c refers to statistical significance at 1%, 5%, and 10%, respectively.

Table 4: OLS estimates of the impact of beer taxes on gonorrhea and chlamydia rates[38]

	Total (1)	Male (2)	Female (3)
A. Gonorrhea			
Beer Taxes	86.521	121.57	56.152
	(51.290) [c] [39]	(60.395) [b]	(48.752)
Lagged Gonorrhea Rate	0.40149	0.49747	0.38658
	(0.08618) [a]	(0.10195) [a]	(0.07207) [a]
Minimum Legal Drinking Age	4.3172	-5.7543	14.308
	(11.668)	(14.794)	(11.992)
Unemployment Rate and Per Capita Income	Yes	Yes	Yes
Cigarette Prices, Real Per Capita Government Health Expenditures, Number of Physicians Per Capita of Population	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes
Province Quadratic Trends	Yes	Yes	Yes
Adjusted R Square	0.9822	0.9818	0.9795
Observations	180	180	180
B. Chlamydia			
Beer Taxes	-174.94	-228.43	-544.47
	(111.08) [c]	(73.700) [a]	(225.61) [b]
Elasticity	[-3.195]	[-8.6607]	[-6.8347]
Lagged Gonorrhea Rate	-0.44778	-0.40898	-0.50531
	(0.05315) [a]	(0.05565) [a]	(0.05324) [a]
Unemployment Rate and Per Capita Income	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Province Linear Trends	Yes	Yes	Yes
Province Quadratic Trends	Yes	Yes	Yes
Adjusted R Square	0.9489	0.9337	0.9017
Observations	90	90	90

[38] The data are for 10 provinces between 1981 and 1999. Standard errors are White corrected for heterosckedasticity and Newey – West corrected for autocorrelation. Standard errors are in parentheses and elasticities in square brackets.

[39] a, b, c refers to statistical significance at 1%, 5%, and 10%, respectively.

Table 5: IV estimates of the impact of beer prices on gonorrhea and chlamydia rates (1986-99)[40]

	First Stage- dependent variables are lagged total gonorrhea and chlamydia rates in panels A and B, respectively (1)	Second Stage – dependent variables are total gonorrhea and chlamydia rates in panels A and B, respectively (2)	First Stage- dependent variables are lagged male gonorrhea and chlamydia rates in panels A and B, respectively (3)	Second Stage – dependent variables are male gonorrhea and chlamydia rates in panels A and B, respectively (4)	First Stage- dependent variables are lagged female gonorrhea and chlamydia rates in panels A and B, respectively (5)	Second Stage – dependent variables are female gonorrhea and chlamydia rates in panels A and B, respectively (6)
A. Gonorrhea						
Beer prices		-11.645 (16.959)		-22.067 (15.070) [c]		-11.136 (12.778)
Elasticity		[-0.7402]		[-1.323]		[-0.7725]
Lagged Gonorrhea Rate		1.3349 (0.66243) [a41]		0.99755 (0.46990)[b]		0.88682 (0.61840) [b]
Minimum Legal Drinking Age		21.266 (27.094)		8.5929 (23.028)		7.5183 (22.635)
Lagged Beer Tax (in $)	-23.245 (36.723)		-61.525 (52.005)		-50.776 (45.713)	
Lagged Beer Tax (in $) * Liberal Party	0.11426 (14.687)		16.160 (20.141)		12.497 (16.695)	
Lagged Beer Tax (in $) * New Democratic Party	-45.167 (24.344) [c]		-46.685 (26.873) [c]		-27.819 (23.354)	
P Value of *F*- Test of joint significance of Lagged Beer Tax, Lagged Beer Tax * Liberal Party, Lagged Beer Tax * New Democratic Party	0.27488		0.14234		0.22887	
Minimum Legal Drinking Age, Real Beer Prices, Unemployment Rate and Per Capita Income	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects, Province Linear Trends, Province Quadratic Trends	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R Square	0.9767	0.9594	0.9722	0.9486	0.9701	0.9438
Observations	140	140	140	140	140	140

[40] The data are for 10 provinces between 1986 and 1999 for panel A and from 1991 to 1999 for panel B. Standard errors are in parentheses and elasticities in square brackets.

[41] a, b, c refers to statistical significance at 1%, 5%, and 10%, respectively.

B. Chlamydia						
Beer prices		-68.576 (28.902) [b]		-34.318 (18.891) [c]		-110.79 (78.308) [c]
Elasticity		[-1.252]		[-1.303]		[-1.391]
Lagged Chlamydia Rate		-0.31229 (0.28766)		-0.48802 (0.26417) [c]		-0.09235 (0.46261)
Lagged Beer Tax (in $)	-572.41 (217.30)[b]		-455.38 (141.01)[a]		-1009.3 (340.87))[a]	
Lagged Beer Tax (in $) * Liberal Party	36.291 (67.395)		53.851 (43.287)		74.186 (120.81)	
Lagged Beer Tax (in $) * New Democratic Party	41.791 (150.43)		-0.51625 (98.381)		27.525 (297.02)	
P Value of *F*- Test of joint significance of Lagged Beer Tax, Lagged Beer Tax * Liberal Party, Lagged Beer Tax * New Democratic Party	0.01819		0.00438		0.01601	
Real Beer Prices, Unemployment Rate and Per Capita Income	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects, Province Linear Trends, Province Quadratic Trends	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R Square	0.7759	0.9498	0.7223	0.9315	0.6704	0.8276
Observations	90	90	90	90	90	90

Table 6: OLS and IV estimates of beer prices on teen pregnancy and birth rates (1981-99)[42]

	OLS (1)	OLS (2)	IV (4)	IV (5)
A. Teen Pregnancies Per 1,000 women under 20 years				
Beer prices	8.4859	1.7928	8.7979	-1.8442
	(1.9703) [a]	(1.1123)	(3.1333) [b 1]	(2.4300)
Minimum Legal Drinking Age	-9.0556	-3.2924	-7.2183	-0.76792
	(1.7866) [a]	(1.7202) [b]	(2.6033) [a]	(2.2711)
Average Government Transfers to Female Lone Parent Families	-0.000004 (0.00021)	0.00034 (0.00012) [a]	-0.002299 (0.001825)	0.00203 (0.00101) [b]
Unemployment Rate and Per Capita Income	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Specific Linear Trends	No	Yes	No	No
Adjusted R Square	0.9034	0.9709	0.9221	0.9396
Observations	180	180	140	140
B. Teen Births Per 1,000 women under 20 years				
Lagged Beer prices	5.6982	1.1278	5.3670	-0.24536
	(1.0489) [a]	(0.97193)	(1.4625) [a]	(1.6286)
Lagged Minimum Legal Drinking Age	-10.407	-4.8584	-7.0458	-2.8227
	(1.3120) [a]	(1.6653) [a]	(1.3730) [a]	(1.6292) [c]
Lagged Average Government Transfers to Female Lone Parent Families	0.0001521 (0.000123)	0.0000983 (0.000098) [a]	-0.00024 (0.00088)	0.000683 (0.00061)
Unemployment Rate and Per Capita Income	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Specific Trends	Yes	Yes	Yes	Yes
Adjusted R Square	0.9527	0.9767	0.9485	0.9618
Observations	180	180	140	140

[42] The data are for 10 provinces between 1981 and 1999. Standard errors are in parentheses and elasticities in square brackets. Standard errors of OLS estimates are White corrected for heterosckedasticity and Newey – West corrected for autocorrelation.

Table 7: Means according to alcohol consumption– NPHS 1996

	does not drink	between 0 to 4 drinks daily	between 5 to 9 drinks daily	10 or more drinks daily
multiple partners	0.158931	0.278564	0.412844	0.448276
has a STD	0.026737	0.032233	0.04128	0.034483
has broken speed limits	0.608442	0.562631	0.426606	0.448276
number of times driven impaired	0.163409	0.87631	3.385321	1.275862
number of years as daily smoker	6.388029	7.566562	8.105505	10.7931

Table 8: OLS estimates of the impact of alcohol consumption on possessing multiple partners and having a STD[43]

	Dependent variable- possessing multiple partners (OLS) (1)	Dependent variable- possessing multiple partners (OLS) (2)	Dependent variable- possessing multiple partners (OLS) (3)	Dependent variable – having a sexually transmitted disease (OLS) (4)	Dependent variable – having a sexually transmitted disease (IV) (5)
A. All ages					
Possessing multiple partners				0.02856 (0.00418) [a]	0.02844 (0.00401) [b]
Alcohol consumption	0.07126 (0.01406) [a] [44]	0.06463 0.01363) [a]	0.06181 (0.01296) [a]		
Alcohol Consumption squared	-0.00327 (0.00061)[a]	-0.002947 (0.000583) [a]	-0.00280 (0.00053) [a]		
Number of years as daily smoker			0.00513 (0.00136) [a]		
Number of years as daily smoker-squared			-0.00012 (0.00005) [b]		
If regularly breaks speed limits		-0.04059 (0.0072) [a]	-0.03970 (0.00720) [a]		
Drinks and drives		0.009035 (0.00128) [a]	0.009 (0.00130) [a]		
Male	0.07777 (0.0202) [a]	0.07435 (0.02044) [a]	0.07588 (0.02067) [a]	-0.01316 (0.00158) [a]	-0.0121 (0.00323) [a]
P Value of *F*- Test of joint significance of Number of years as daily smoker, Number of years as daily smoker-squared, If regularly breaks speed limits, Drinks and drives					0.00000
Income fixed effects	Yes	Yes	Yes	Yes	Yes
Education fixed effects	Yes	Yes	Yes	Yes	Yes
Age fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R Square	0.09679	0.1024	0.1044	0.01165	0.01165
Observations	11,431	11,431	11,431	11,431	11,431

[43] The data are for 10 provinces and consists of 11,431 observations for all ages and 1,546 observations with respect to teens. Standard errors are clustered by province and are in parentheses.

[44] a, b, c refers to statistical significance at 1%, 5%, and 10%, respectively.

B. Teen					
Possessing multiple partners				0.02248 (0.00957) [a]	0.02248 (0.00912) [a]
Alcohol consumption	0.07022 (0.01760) [a]	0.06264 (0.01660) [a]	0.05245 (0.01447) [a]		
Alcohol Consumption squared	-0.00311 (0.00077)	-0.00277 (0.00077)	-0.00241 (0.000680) [a]		
Number of years as daily smoker			0.05239 (0.012982)		
Number of years as daily smoker-squared			-0.0049861 (0.00158)		
If regularly breaks speed limits		-0.0020 (0.02692)	0.00954 (0.02557)		
Drinks and drives		0.01080 (0.00153)	0.01048 (0.00158)		
Male	0.0430838 (0.015819)	0.04143 (0.016496)	0.050687 (0.01736)	-0.011620 (0.00820)	-0.01162 (0.00745)
P Value of *F*- Test of joint significance of Number of years as daily smoker, Number of years as daily smoker-squared, If regularly breaks speed limits, Drinks and drives					0.00000
Income fixed effects	Yes	Yes	Yes	Yes	Yes
Education fixed effects	Yes	Yes	Yes	Yes	Yes
Adjusted R Square	0.1146	0.1190	0.1343	0.0217	0.02172
Observations	1,546	1,546	1,546	1,546	1,546

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