USING NLSY-GEOCODE DATA TO DETERMINE THE EFFECTS OF TAXES AND MINIMUM AGE LAWS ON THE ALCOHOLIC BEVERAGE DEMAND OF YOUNG ADULTS

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ABSTRACT

In the present study, OLS and logit regression analysis are used to determine the effect that minimum age laws and taxes have on alcohol consumption and binge drinking. NLSY-Geocode data are used in order to construct individual-level demand equations. The use of this data allows for the identification of the individual's state of residence and thus enables the researcher to properly match the individual to the appropriate state alcohol tax rate. Results indicate that taxes have a negative effect on alcohol consumption but no effect on binge drinking. Minimum age laws, however, are effective in reducing both the total quantity of alcohol consumed and binge drinking.

1. INTRODUCTION

There have been numerous attempts by both the Federal and state governments to curtail the consumption of alcoholic beverages by young adults. These efforts usually took the form of increases in the minimum legal ages and higher taxes on alcoholic beverages. For example, all state-level minimum legal drinking ages were raised to 21 in the 1980s, and, in 1991, the Federal excise taxes on beer and wine increased from 16 cents per six-pack of beer and 3 cents per 750 ml bottle of wine to 32 cents and 21 cents respectively. Even given these increases in taxes, however, the tax as a share of the price is still very low (less than one percent in some cases).

Much research has been devoted to the effect of these public policy changes on the consumption of alcoholic beverages (Mast, Benson, and Rasmussen, 1999; Pacula, 1998; Laixuthai and Chaloupka, 1993; Heien and Pompelli, 1989; Coate and Grossman, 1988).

Mast et al. (1999) conducted an extensive study on the effect of beer taxes on alcohol-related traffic fatalities. The authors find that prior studies employing reduced-form demand equations may have significant missing variable bias and that when additional public policy control variables are used or two-equation recursive models are employed, the statistical significance of taxes is reduced substantially. This result indicates that the relationship between beer taxes and alcohol-related traffic fatalities is debatable and may not be as robust as prior research would have suggested. Other public policy control measures may be more effective than taxes at reducing consumption and hence traffic fatalities.

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Pacula (1998) focused on the substitutability between alcohol and marijuana. The purpose of her study was to determine if increases in excise taxes on alcoholic beverages would result in consumers, primarily young adults, switching from alcoholic beverages to marijuana. Pacula begins with the premise that excise taxes reduce the demand for alcoholic beverages. Using data from the National Longitudinal Survey of Youth, she finds that alcohol and marijuana are complements rather than substitutes. Hence, increases in taxes on alcohol would not only reduce alcohol consumption but would also reduce the consumption of marijuana. Pacula used data from 1984 and used the real federal and state tax on a case of beer as a proxy for the price of alcohol.

Laixuthai and Chaloupka (1993) examined the effects of minimum legal drinking ages and excise taxes on alcohol consumption by teenagers. Using survey data from the years 1982 and 1989, the authors find that increasing excise taxes on alcoholic beverages and increasing the minimum legal drinking age both reduce teen consumption of alcoholic beverages.

Heien and Pompelli (1989) used data obtained from the 1977-78 Household Food Consumption Survey administered by the US Department of Agriculture. Creating demand structures for alcoholic beverages, the authors find that demand is price inelastic for all classes of alcoholic beverages. Given these results, the authors conclude that tax increases have little or no effect on the demand for alcoholic beverages.

Coate and Grossman (1988) used data from the National Health and Nutrition Examination Survey (1979-1980) in order to determine if public policy measures have any effect on alcohol consumption by youths ages 16 to 21. Their results indicate that both minimum age laws and excise taxes have negative effects on alcohol consumption by young adults. They conclude that increasing the minimum legal drinking age and the federal excise tax on beer would reduce alcohol consumption by those 16-21 years of age. Their results also suggest that tax policy may be somewhat more effective in deterring alcoholic beverage consumption than minimum age laws.

The present study estimates alcohol demand functions at the individual level in order to determine the effect of taxes and minimum age laws on alcoholic beverage demand. A unique feature of the present study is that it combines two data sets: the National Longitudinal Survey of Youth and data on alcoholic beverage taxes at the state level. This combination of data sets improves the analysis of the effect of taxes on alcohol consumption because it allows the present study to capture the effect of taxes and minimum age laws on what is essentially an individual decision, the decision of whether or not to consume alcoholic beverages. In addition, the present study attempts to determine if taxes not only affect the consumption of alcohol, but also whether taxes affect destructive and risky behaviors, such as binge drinking.[1]

Using ordinary least squares and binomial logit regression analyses, results of the present study indicate that alcoholic beverage taxes have a negative effect on alcoholic beverage consumption but no effect on binge drinking. However, results indicate that minimum age laws are effective in reducing not only overall alcoholic beverage demand but also binge drinking. Hence, the results of the present study

corroborate the results of many prior studies in this area (Pacula, 1998; Laixuthai and Chaloupka, 1993; Coate and Grossman, 1988).

2. EMPIRICAL TECHNIQUE

In order to test the effect of taxes and minimum age laws on alcohol consumption, an individual-level demand function for alcoholic beverages is estimated. Guidance was obtained from several studies in the construction of this demand function (Pacula, 1998; Gao, Wailes, and Cramer, 1995; Thies and Register, 1993; Lee and Tremblay 1992; Adrian and Ferguson 1987; Uri 1986; McCornac and Filante 1984; Duffy 1981; Johnson and Oksanen 1974; Simon 1969).

The first empirical equation estimated in the present study is based on consumer theory models of utility maximization. Theory suggests that consumers maximize utility subject to prices and income.

$$\max U = U(A,C) \qquad s.t.\ P_A, I \qquad (1)$$

where A denotes the quantity of alcoholic beverages consumed, C denotes a composite good with a price of $1 per unit, P_A denotes the price of alcoholic beverages, and I is income. Obtaining first order conditions and solving for A and C, one obtains the following implicit individual-level demand function:

$$A = f(P_A, I, \mathrm{T}, \mathrm{X}) \qquad (2)$$

where **T** is a vector of taste-influencing variables, **X** is a vector of public policy variables (taxes and minimum age laws) and all other variables are as defined previously. Theory suggests that alcohol consumption is negatively related to its own price and any factor that increases the price of consuming alcohol, and positively related to income, tastes, and other socioeconomic variables. It is reasonable to assume that taxes and minimum age laws, at least for underage individuals, would be viewed as factors that increase the price of alcoholic beverages; hence both should be negatively related to alcohol consumption. This hypothesis will be tested in the present study.

In order to determine the effects of taxes and minimum age laws on binge drinking, the empirical technique must capture the probability that a person will drink an excessive number of alcoholic beverages in a limited period of time. In order to model that behavior, it is reasonable to assume that individuals view binge drinking as a risky behavior, similar to criminal activities or unprotected sex. Hence, there are returns, albeit sometimes rather implicit returns, from engaging in such risky behaviors. These returns may take the form of increased pleasure or admiration from one's peers. These positive returns from binge drinking may be reduced by a variety of factors, two of which may be the public policy

control variables of taxes and minimum age laws. Taxes may reduce the incidence of binge drinking because an increases in taxes increases the price of alcoholic beverages, thus reducing the net returns from drinking copious amounts of alcohol. Minimum age laws may also reduce the net return from binge drinking primarily because such laws impose fines and penalties on those underage individuals who engage in such behavior.

Using this theory as a guide, the binge drinking behavior of young adults may be modeled as follows:

$$Y = f(P_A, \mathrm{T}, \mathrm{Z}, \mathrm{X})$$

where Y denotes the number of times that a person binge drinks, **Z** is a vector of socioeconomic factors that influence binge-drinking, and all other variables are as defined previously. It is reasonable to assume that, for a certain segment of the population, binge drinking is desirable ; hence when there is a perception that binge drinking is desirable, an individual will binge drink more often. Certain socioeconomic and individual characteristics, such as being a male or being heavily influenced by one's peers, may increase the desirability of this risky behavior. It is reasonable to assume that taxes and minimum age laws reduce the desirability of binge drinking; hence the net return from binge drinking falls, and the individual binge drinks less as taxes and minimum ages increase.

Unfortunately, Y is not observed. A binary variable that takes the value of one if a person has engaged in binge drinking during the past month and zero otherwise is instead used as a proxy for the unobservable variable Y. In order to estimate equation (4), assuming a binary dependent variable, the following logit regression is employed:

$$Prob(Y = 1) = \frac{e^{\mathrm{B}'\mathrm{X}}}{1 + \mathrm{e}^{\mathrm{B}'\mathrm{X}}}$$

where Y is the dependent variable that equals one if the person binge drinks and zero otherwise, **X** is a vector of explanatory variables, and B is a vector of parameters.

Given the above theoretical foundations, the following equations are estimated in the present study:

$$DRINKS = \alpha_0 + \alpha_1 LTAX + \alpha_2 MARITAL + \alpha_3 LINCOME +$$

$$\alpha_4 WHITE + \alpha_5 MALE + \alpha_6 LAGE +$$

$$\alpha_7 URBAN + \alpha_8 SOUTH + \alpha_9 PEER + \alpha_{10} FAMILY +$$

$$\alpha_{11} LPRICE + \alpha_{12} LMINAGE + u$$

$$BINGE = \alpha_0 + \alpha_1 TAX + \alpha_2 MARITAL + \alpha_3 INCOME +$$

$$\alpha_4 WHITE + \alpha_5 MALE + \alpha_6 AGE + \alpha_7 AGE2 + \alpha_8 GRADE +$$

$$\alpha_9 URBAN + \alpha_{10} SOUTH + \alpha_{11} PEER + \alpha_{12} FIRST + \alpha_{13} FAMILY +$$

$$\alpha_{14} PRICE + \alpha_{15} MINAGE + u$$

Variables are defined as follows: DRINKS is the log of the number of alcoholic drinks consumed during the past month; BINGE takes a value of one if person drank more than six drinks at least one time in the past month and zero otherwise; TAX is the weighted average tax rate in percentage terms on alcoholic beverages[2]; INCOME is the respondent's income[3]; MARITAL denotes marital status where a value of one indicates that the person is married and a value of zero indicates otherwise; WHITE denotes the race of the individual where a value of one indicates that the person is white and zero otherwise; MALE denotes sex; AGE is the age of the individual; AGE2 is age squared; GRADE denotes years of education; URBAN has a value of one if the person lives in an urban area and zero otherwise; SOUTH takes a value of one if person lives in the South and zero otherwise; PEER indicates if the person was most influenced as a child by a peer; FIRST is the age at which the individual first started drinking; FAMILY takes a value of one if the person has a family member who has a drinking problem; PRICE is the price of alcoholic beverages[4]; MINAGE is the minimum legal drinking age in the respondent's state of residence; and u denotes a normally-distributed random error term. The variables in equation (5) prefixed by "L" are the logs of the respective variables; hence, equation (5) is estimated as a log-log model.

The equations were estimated using the National Longitudinal Survey of Youth - Geocode (NLSY) data set. Two years of data were examined: 1982 and 1994. The use of these two different data sets allows us to determine if the factors that affect alcohol consumption differ by age; the average age of the 1982 data set is 19, while the average age of the 1994 data set is 31. In addition, since in 1982 minimum legal drinking ages differed by state, the use of these two years of data allow us to determine if minimum age drinking laws have any effect on alcohol consumption. These two data sets were combined

in order to obtain a pooled data set with 2067 observations. Equation (5) was estimated using ordinary least squares; equation (6) was estimated using a logit regression analysis.

3. Data and Results

Data for the present study was obtained from a variety of sources. State-level, alcoholic beverage tax rates were obtained from The Book of the State, The Brewer's Almanac, and the Tax Administrator's web-site.[5]

Most of the data used in the present study was obtained from the National Longitudinal Survey of Youth - Geocode (NLSY). The NLSY was constructed to be a nationally representative sample of the civilian non-institutionalized population at the time of the initial survey in 1979. The NLSY consisted of 12,686 young men and women who were between the ages of 14 and 22 when they were first surveyed in 1979. Interviews with NLSY respondents have been conducted annually since 1979, and retention rates have been relatively high, averaging over 90 percent. Each age-sex cohort is represented by a multi-stage probability sample drawn by the Bureau of the Census from a list of sampling areas that had been constructed for the Monthly Labor Survey. The NLSY employed extensive household interviews in the selected sampling areas in order to obtain as random and as representative a sample as possible.

The Geocode data set used in the present study is especially important because it provides detailed geographic information concerning the residences of the respondents. This detailed residential information is not available on the regular NLSY and allows one to identify the particular state of residence for each respondent. Hence, one is able to match the appropriate state tax rate to the respondents who reside in that state. To my knowledge, no other study employs this approach.

Although the NLSY-Geocode surveys over 12,000 individual every year, due to a variety of problems, there are sometimes missing responses. After eliminating all of the observations with missing responses, the 1982 sample had 1174 observations, and the 1994 sample had 893 observations; the total number of observations is 2067.

In addition, not all states in the US are examined in the present study. Some states in the US are known as "control" states; in these states, the state governments have monopolized some or all of the alcoholic beverage retail market or have imposed price controls on alcoholic beverage products. Given the difficulty in determining the true tax rates in these states, the control states have been eliminated from the present study. For the 1994 sample, 32 states were included; for the 1982 sample, 31 states were included. Due to data constraints, Hawaii was excluded from the 1982 sample. See Table 1 for a list of those states included in the present study.

Descriptive statistics for all variables used in the present study are presented on Table 2. Regression results are shown on Tables 3 and 4.

Given that equation (5) is estimated as a log-log model, the coefficients in table 3 can be interpreted as elasticities. Hence, according to the results, a one percent increase in the tax rate would result in a 2.75 percent decline in alcohol consumption. This is a rather elastic demand relationship, much more elastic than many other studies have found (Pacula, 1998; Laixuthai and Chaloupka, 1993;

Coate and Grossman, 1988). Regarding minimum age laws, results also indicate that increases in minimum ages reduces alcohol consumption; once again, this result may be interpreted as an elasticity. Hence, a one percent increase in the minimum age would reduce alcohol consumption by 1.6 percent, not as robust as the tax result, but still a rather elastic relationship.

Regarding the other variables in equation (5), price is significant and positive although inelastic; MARITAL and SOUTH are significant and negative; WHITE and MALE are significant and positive. Hence, single, white males living in areas outside the South are more likely to drink than others.

Concerning the binge drinking results presented on Table 4, it is important to note that the coefficients are interpreted as follows: If a logit coefficient is 0.4, then for a unit increase in the value of that explanatory variable, the log of the odds of engaging in binge drinking increase by 0.4. Given that, results indicate that taxes have no statistically-significant effect on binge drinking, but minimum age laws do reduce the incidence of binge drinking. In fact, a one year increase in the minimum age would reduce the log of the odds of binge drinking by 0.11. This result also corroborates those of earlier works (Laixuthai and Chaloupka, 1993; Coate and Grossman, 1988). This result suggests that increases in the minimum age laws enacted in the 1980's were significant in curbing alcohol consumption. It is reasonable to assume that if minimum ages were rolled back, holding all other factors constant, binge drinking would increase at a statistically-significant and substantial rate.

Regarding other variables that have effects on binge drinking, WHITE, MALE, AGE, PEER and FIRST are positively and significantly related to binge drinking, while MARITAL and GRADE are negatively related to binge drinking. Two noteworthy results are as follows: First, it appears that if a person starts drinking later in life then that actually increases the probability that a person will engage in binge drinking; there is no a priori reason for this result. Second, the influence of peers, while having no statistically-significant effect on an individual's decision about drinking alcoholic beverages, does have a very significant effect on an individual's decision about whether or not to binge drink. This result is even more interesting given the fact that the average age of the sample used in the present study is 24, with a minimum age of 17 and a maximum age of 33. This result indicates that teens are not the only individuals subject to peer pressure in alcohol-laden environments.

4. CONCLUDING REMARKS

The present study extends the work of earlier researchers examining the role of taxes and minimum legal ages on the consumption of alcoholic beverages. The purpose of the present study was to determine the effect that taxes and minimum age laws have on alcoholic beverage demand and binge drinking. Using NLSY-Geocode and state-level tax data, the present study is one of the first studies to link individual-level data with the appropriate state-level alcohol tax rate. OLS and logit regression analyses were used to estimate individual-level alcoholic beverage demand equations. Results of the present study indicate that taxes have a negative effect on alcohol consumption but no effect on binge drinking. In fact, results suggest that alcohol demand is relatively elastic with regards to taxes. In addition, minimum age laws, by reducing the net return of risky behaviors, reduce both the total quantity

of alcohol consumed and the incidence of binge drinking. These results corroborate the results of earlier studies.

Table 1

States Included in Sample

Alaska	Arizona	Arkansas
California	Colorado	Connecticut
Delaware	Florida	Georgia
Hawaii*	Illinois	Indiana
Kansas	Kentucky	Louisiana
Maryland	Massachusetts	Minnesota
Missouri	Nebraska	Nevada
New Jersey	New Mexico	New York
North Dakota	Oklahoma	Rhode Island
South Carolina	South Dakota	Tennessee
Texas	Wisconsin	

*Hawaii was excluded from youth sample

Table 2

Descriptive Statistics

Variable	Mean	Standard Deviation
BINGE	0.509	0.5
MARITAL	0.3091	0.4623
WHITE	0.7417	0.4378
MALE	0.5239	0.4995
INCOME	8644	10256
AGE	24	6
GRADE	12	2
URBAN	0.8495	0.3576
SOUTH	0.3096	0.4625
PEER	0.1659	0.3721
FAMILY	0.4306	0.4953
FIRST	14.6	5.3
MINAGE	20	1.2
TAX	0.0563	0.0336
PRICE	120.37	27.152

N = 2067

Table 3

Alcoholic Beverage Demand Regression Results

Variable	Coefficient	Test Statistic
CONSTANT	18.595	9.538**
MARITAL	-0.277	-4.004**
WHITE	0.403	6.292**
MALE	0.718	12.67**
LINCOME	0.0212	2.316**
LAGE	0.209	0.325
URBAN	-0.308	-0.409
SOUTH	-0.127	-2.128**
PEER	-0.101	-0.14
FAMILY	0.0747	1.334
LMINAGE	-1.59	-2.67**
LTAX	-2.751	-3.798**
LPRICE	0.163	2.987**

Note:
R^2 = .342
F=89.00
* = denotes variable is significant at 95% level
** = denotes variable is significant at 99% level

Table 4

Binge Drinking Regression Results

Variable	Coefficient	Test Statistic
CONSTANT	-1.016	-0.375
MARITAL	-0.664	-5.146**
WHITE	0.4169	3.499**
MALE	1.0705	10.323**
INCOME	0.0000083	1.347
AGE	0.4135	1.879
AGE2	-0.00844	-1.988*
GRADE	-0.1368	-4.705**
URBAN	-0.0427	-0.305
SOUTH	-0.2027	-1.438
PEER	0.4489	3.293**
FAMILY	0.1206	1.15
FIRST	0.0569	5.17**
MINAGE	-0.112	-1.984*
TAX	-0.717	-0.383
PRICE	-0.0112	-0.947

Note:
Chi-Squared = 502.08
* = denotes variable is significant at 95% level
** = denotes variable is significant at 99% level

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ENDNOTES

1. Binge drinking is defined as having 6 or more drinks on one occasion.
2. TAX was calculated in the following fashion. First, the state-level tax per gallon for the three types of alcoholic beverages (beer, wine, and liquor) were obtained from a variety of sources. Second, average price data for each of the three types of alcoholic beverages were obtained from the Bureau of Labor Statistics. These data were only available on a regional level. It was assumed that this would be a suitable proxy for the state-level average prices of alcoholic

beverages. The earliest year for which this data is available is 1995. Since the focus of the present study is on the years 1994 and 1982, the 1995 average price data was deflated to 1994 and 1982 prices using the appropriate CPI for alcoholic beverages. Third, in order to obtain the state-level tax rate in percentage terms, the state-level tax per gallon is divided by the state-level price; this procedure results in a tax rate in percentage terms for liquor, beer, and wine. In order to obtain a single tax rate for alcoholic beverages, a weighted average is then taken of the three tax rates, with the weights being their share of consumption.

3. Income was deflated using the CPI - All Urban Consumers, base year 1982-1984.
4. The Consumer Price Index for alcoholic beverages is used as a proxy for the price of alcoholic beverages.
5. Wine tax rates for 1982 and 1995 were extrapolated from 1994 data.