Tax Rates on Alcohol:
Does it affect demand for particular states?

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Abstract:

In this paper, different variables will be tested to figure out whether or not different levels of tax have a determinant on the consumption or demand for alcohol. The study will examine several variables including the sales taxes in each state, the different taxes on beer, wine and spirits, along with GDP per capita, death rates and whether or not there is an advertising ban in a particular state. The results from the research and tests performed focus on the factors that are closely correlated to the consumption of alcohol, with GDP per capita proving to be the most influential factor when it comes to demand for alcohol.

JEL Classification: H25, H71, L66.

Keywords: Tax, Wine

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1.0 INTRODUCTION

Alcohol is a commodity that usually has a relatively inelastic demand with regards to how the economy is performing. Although during times of economic distress, demand can sometimes rise even higher, as some individuals use it as a relief from stress and anxiety. The United States does not have the world highest alcohol consumption, but it is certainly not the lowest either. It is a substance that is often associated with social outing, sporting events and college activities and is a highly demanded product within the United States.

This study aims to create a better understanding for factors that affect demand for alcohol. One may assume that a state with a higher tax would have a lower demand for alcohol because the alcohol would therefore be more expensive. However, there may be a relationship between different tax rates and other variables such as advertising restrictions or death rates, which will be shown later in this paper. From a policy perspective, the results of this study can help to figure out if certain tax rates are effective or ineffective in increasing or decreasing the demand for alcohol.

This paper was guided by several research objectives that differ from past studies. The model used is derived from a study performed by Henry Saffer in 1989 that focused on the consumption of alcohol in 14 different countries and only takes into account the national tax on alcohol. This is a narrower study in which each of the 50 states will be analyzed on a more detailed level. This study integrates data over a time series of 11 years and it is not just a snapshot in time, as Saffer's study was. The trends are easier to follow and there is a better margin of error than if I were to use data for a shorter period of time. Furthermore, this paper also investigates how an increase in other factors, such as GDP per capita or death rates for

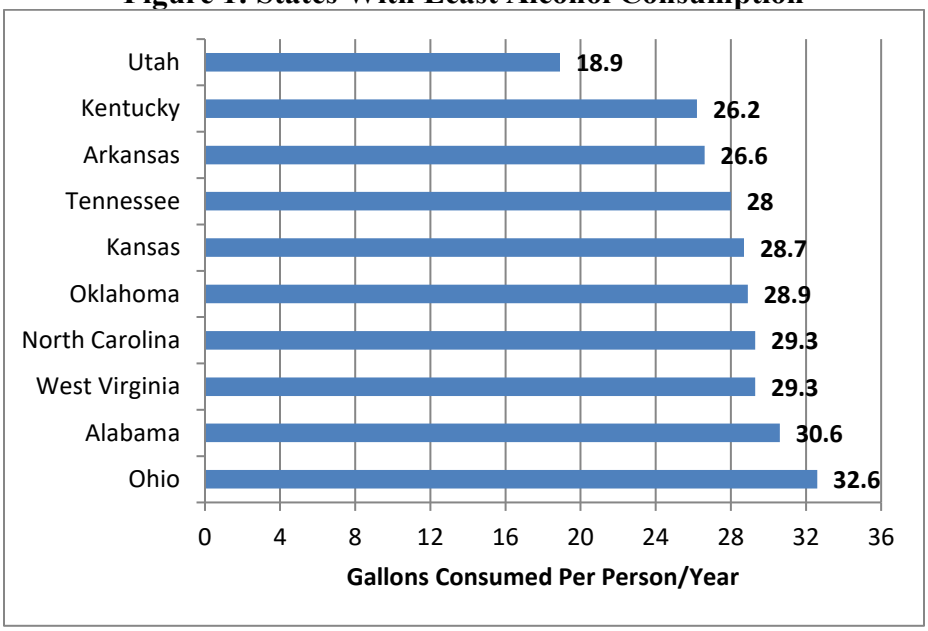
example, can affect the consumption, thus altering the demand for alcohol. This can potentially lead to positive effects such as a decreases in crime rates and death, as other studies have proven.

Finally, the paper is organized as follows: Section 2 will focus on current trends of alcohol consumption and will discuss states that have different consumption levels. Section 3 will give a brief literature review and will discuss past studies on this topic. Section 4 will explain the empirical model and the data and regression analysis will also be discussed. Section 5 will present the empirical results and explain the results of the tests performed. A conclusion in section 6 will close the paper.

2.0 TRENDS

When looking at trends with regards to alcohol consumption, Figure 1 displays the ten states with the least alcohol consumption. Different demographics for each state are one factor that affects the consumption for each state. For example, Utah has a low consumption due to a high Mormon population that does not allow for the consumption of alcohol. Kentucky is ranked with second lowest consumption and it can be blamed because of state regulations on selling wine in grocery stores. This data is based on gallons of alcohol consumed per person, per year and comes from the National Institute on Alcohol Abuse and Alcoholism.

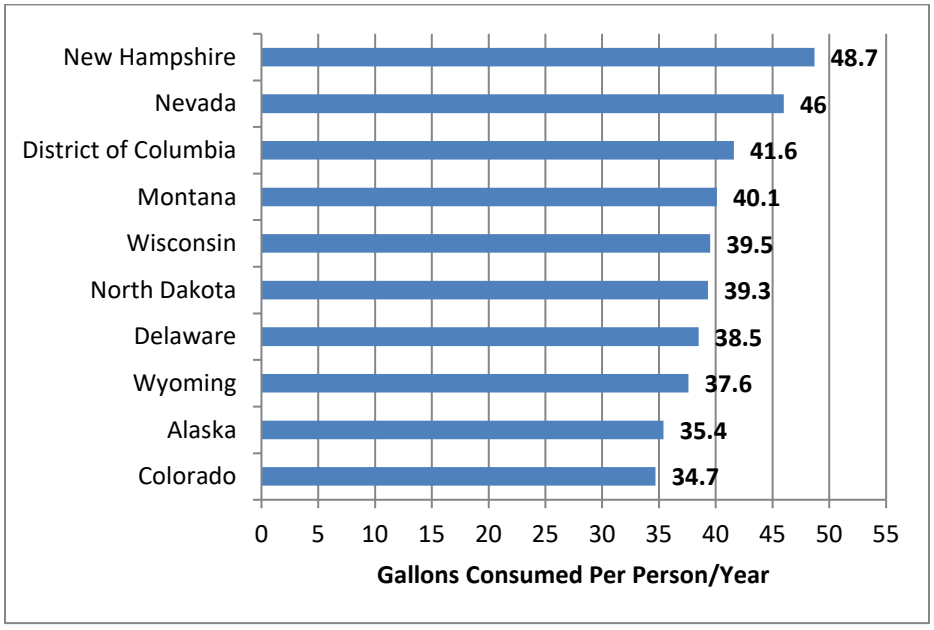
Figure 1: States With Least Alcohol Consumption



Source: NIAAA (National Institute On Alcohol Abuse and Alcoholism)

On the other hand, Figure 2 displays the states with the most alcohol consumption. As said earlier, the demographics and regulations from state to state have a strong reasoning for the raking of states from highest to lowest consumption. The state consuming the most alcohol would be New Hampshire, which can be explained because the state does not have a sales tax or a tax on alcohol. This drives up state sales as individuals from surrounding states will also contribute to the consumption for New Hampshire (as these numbers are based on the state that the alcohol was purchased in). Nevada places second in consumption and can be related to the recent recession, as the state was one of the hardest hit with foreclosures and unemployment. The positive relationship between an economic stress or recession and alcohol can explain why Nevada is number 2 on the list.

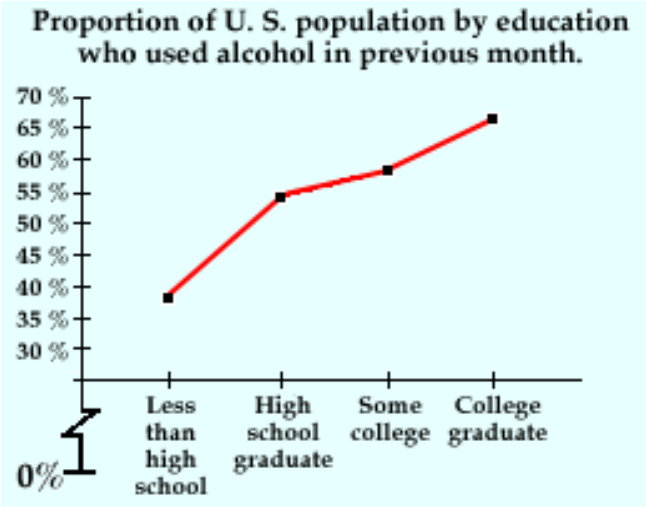
Figure 2: States With Most Alcohol Consumption



Source: NIAAA (National Institute On Alcohol Abuse and Alcoholism)

An interesting statistic below in Figure 3 shows that there is a positive relationship between education and alcohol consumption. The more educated an individual is, the more likely they are to consume alcohol according to a study composed by David Hanson at the State University of New York Potsdam. This could be explained because individuals with a higher education typically earn more income than those who have not, allowing for a higher amount of disposable income to spend on alcohol consumption.

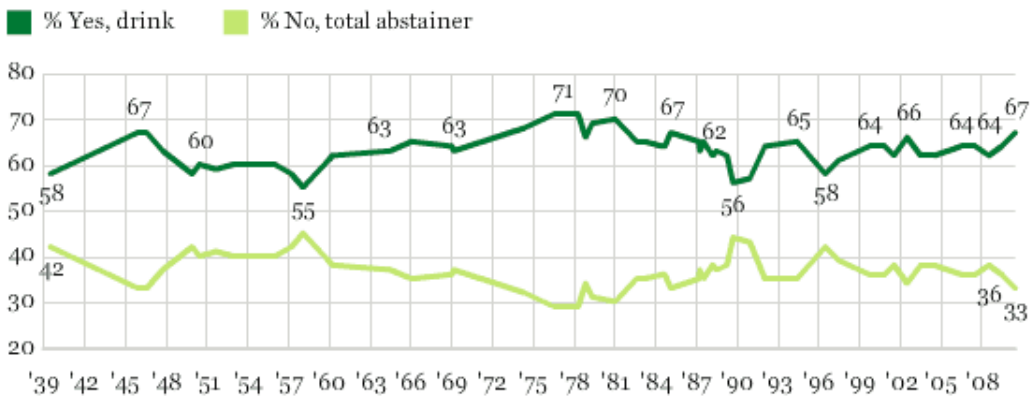
Figure 3: Alcohol Consumption and Education



Source: Alcoholic Beverage Consumption in the U.S.: Patterns and Trends (SUNY Potsdam)

Figure 4 below shows the percentage of Americans who consume alcohol compared to the amount who are abstinence from drinking. It is trending positive in the years during this study, meaning that there has been an increase in the amount of people consuming alcohol in the United States. This can possibly due to the recent economic downturn, as consumption of alcohol historically has risen during difficult economic times.

Figure 4: Percent of Americans Consuming Alcohol



3.0 LITERATURE REVIEW

Beer, wine and spirits are all taxed differently on both state and federal levels. The level of tax decided on the state level varies from year to year and is regulated separately from the national tax. One major change to the tax on alcohol occurred in 1991 when President George Bush doubled the federal excise tax on beer and increased the tax rates on wine and liquor (Cook and Durrance, 2011). This heavy increase in federal taxes was an attempt to further diminish alcohol abuse and its consequences, as this change was larger than the typical state-level changes that had previously been implemented. Cook and Durrance (2001) completed a study that concluded that the federal tax increase was negatively related to average alcohol consumption and a high significance was found when testing the injury death rate, violent crime rate and property crime rate. They estimated that the federal tax increase decreased injury death by 4.7% in 1991, the year the tax was implemented in.

Saffer (1989) conducted a study prior to the federal tax increase in 1991 that examined what different tax differentials have on total alcohol consumption. He took data from 14 different countries and attempted to find the greatest decrease in consumption due to different federal tax rates on beer, wine and spirits. He was able to conclude that an increase in the tax on spirits, a lower tax on beer, and the lowest tax on wine would create the greatest decrease in the consumption of alcohol (Saffer, 1989). Grossman (2004) concluded in his study that changes in price can justify a change in consumption for harmfully addictive substances. His study includes tests on binge alcohol drinking, cigarette smoking, and marijuana use. Grossman was able to conclude that "a 7 percent increase in the real price of beer between 1990 and 1992 due to the Federal excise tax hike on that beverage in 1991 accounts for almost 90 percent of the 4 percentage point decline in binge drinking" (2004). This can relate to the 4.7% decrease in the

injury death rate that Cook and Durrance (2011) concluded in their study discussed above. Grossman (2004) believes that a high tax policy is an easy and conclusive way to reduce the negative impacts that alcohol and other substances have.

A study conducted on the relationship between alcohol and violence by Markowitz (2001) found that price significantly impacts the consumption of alcohol, regardless or not if there is a tax involved. The tax is simply one way of raising the price that can be used to reduce consumption of alcohol, but the manufacturers or distributors could also be the ones increasing the price. It also reduces negative outcomes, such as motor vehicle crashes, workplace accidents, cirrhosis of the liver, alcohol-related deaths and crime (Markowitz, 2001). Grossman and Markowitz (1998) conducted a study that focused on violence with regards to alcohol regulation and were able to find that raising the price of beer was an effective tool in reducing violence and concluded that laws making beer more difficult to obtain may be effective in reducing violence and furthermore found that advertising restrictions had no effect. Grossman and Markowitz (1999) conducted a different study that focused on the relationship that violence is negatively related to the price of alcohol. They were able to conclude that acts of violence are inversely related to the price of alcohol which furthermore proves that the price of alcohol (whether it be taxes or other methods of raising the price) can affect the consumption or demand.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data

This study uses panel data over an eleven year time period from 2000-2010. The data on each individual tax rate were generated from the Tax Foudation's website and data for other variables were generated from websites such as CIA World Factbook and the Center for Disease

Control (CDC), as well as other websites for the different independent variables. Appendix I provides a full description on information regarding where each variable's data was generated from. From this data, summary statistics are provided below in Table 1:

Table 1: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
salestax	561	4.824777	1.859972	0	8.25
spiritstax	561	4.048271	4.157184	0	26.45
winetax	561	0.718957	0.551177	0	2.5
beertax	561	0.254055	0.215533	0.019	1.07
adban	561	0.235294	0.424561	0	1
death	561	759.0549	81.48406	619.8	949.6
gdp	561	41772.73	4179.652	36200	47200
cons	561	2.260909	0.065765	2.18	2.37

4.2 Empirical Model

Using the model from Saffer (1989) and modifying it to adapt this study, the model is seen below in Figure 5. It is derived from an analysis that studied the tax levels of different countries to understand demand for alcohol. See Figure 5 below:

Figure 5: Empirical Model

$$CONS_{it} = \beta_0 + \beta_1 SALESTAX_{it} + \beta_2 SPIRITSTAX_{it} + \beta_3 WINETAX_{it} +$$

$$\beta_4 BEERTAX_{it} + \beta_5 ADBAN_{it} + \beta_6 DEATH_{it} + \beta_7 GDP_{it} + \varepsilon_{it}$$

In order to better understand the model, the dependent variable *CONS* is the annual consumption per capita in the United States and is the dependent variable run in this regression. It represents the annual alcohol consumed per capita, or in simpler terms, the amount of beer, wine and spirits each person consumes annually. The independent variables are as described: *SALESTAX* is the state sales tax level in the given state. It has been noted that sales taxes have risen for the majority of the states over the time period tested, 2000-2010. *SPIRITSTAX* is the tax that is applicable to hard alcohol, and it has been taxed higher than other types of alcohol. *WINETAX* is the state tax on wine, whereas *BEERTAX* is the state tax on beer. If a state did not have a wine or beer tax, it was marked a $0.00 tax on the particular beverage, as states such as New Hampshire do not have a state sales tax or tax on alcohol. *ADBAN* is the variable that looks at the restrictions on advertising of alcohol and focused on 12 different factors of advertising. If a state had at least 4 methods of restrictions, a 1 was given to that state, and if the state had less than 4 methods of restrictions, a 0 was given to the state. *DEATH* is the annual death rate per state and takes into account states that have higher or lower death rates than the nationwide average. There is a positive relationship between states with higher alcohol consumption and death rates, as states consuming more alcohol tend to have higher death rates. Finally, *GDP* is the GDP per capita per year for each state. This variable separates the richest and poorest states, as states with a lower GDP per capita can often be seen to have higher consumption rates.

5.0 EMPIRICAL RESULTS

Given that the data used in this study is panel data, there are two possible ways to run the regression for the data set, either the fixed effects method or the random effects method. Table 2 gives the regression results for both methods below:

Table 2: Regression results for consumption of alcohol per capita

Consumption		
	Fixed Effect	Random Effect
CONSTANT	1.5928 (0.0135)	1.6317 (0.0105)
SALESTAX	0.0113 (0.0029)	0.00032** (0.00041)
SPIRITSTAX	0.00059** (0.00027)	0.00044** (0.00021)
WINETAX	0.00051 (0.0081)	-0.00088 (0.0018)
BEERTAX	0.00798 (0.0152)	0.00113 (0.00439)
ADBAN	dropped	-0.00059 (0.00183)
DEATH	dropped	0.00000092 (0.00000931)
GDP	0.000015 (0.00000027)	0.000015*** (0.00000012)
R^2	0.8447	0.9291
Number of observations	561	561

*Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively. Coefficients are the first number and standard errors are in parenthesis.*

In order to figure out which method should be used, the Hausman test was performed. This test helps to evaluate how closely correlated the unique errors are. The null hypothesis is the favored one and if accepted, it would favor the random effects method. On the other hand, the alternative hypothesis supports the fixed effects method. The random effects method accounts for changing variables over time, where the fixed effects method does not. After running both the fixed and random methods and saving the results, we are able to perform the Hausman test to determine that we would accept the null hypothesis and use the random effects model. Because the Hausman test statistic is such a small number of 0.0016, (see Appendix III

for full Hausman Test) we would accept the null and use the random effects method. Adversely, if the result of the test were to be over 0.05 (which would be significant at the 95% confidence level), we would do the opposite and reject the null and accept the alternative.

The results from the regression using the random effects model yield better results, as there are three variables that are statistically significant when using the random effects method as compared to only one variable when using the fixed effects method. Furthermore, the fixed effect method omitted two variables because of the high correlation between two or more predictor variables, also known as multicollinearity. Appendix II has the correlation matrix for the data set and there is no apparent multicollinerarity in the table. This is because the fixed effects method does not allow for each variable to change over time. When using the random effect method, it accounts for the change in each independent variable over the time series, whereas with the fixed effect method, it does not account for changes in the data which is why the random effects method would be the better model to use in this situation. Even though the fixed effects method produces more consistent results, more efficient and realistic numbers are produced when running the random effects regression, especially with a data set with more than 500 observations.

The variable that had the largest impact on consumption of alcohol can be seen as *GDP*. It is significant at the 99% confidence level and proves to be the variable that is most influential on consumption of alcohol. The positive relationship between GDP per capita and total consumption of alcohol is shown accurately in the regression; as GDP per capita increases, so does consumption. *SPIRITSTAX* and *SALESTAX* are two other variables that are statistically significant and are significant at the 95% confidence level. They also are a large determinant on the consumption of alcohol and based on the tax rates in individual states. States with a higher

sales tax rate and/or a higher tax on spirits can expect to see a negative relationship between that and consumption.

Furthermore, the coefficient of determination (R^2), also known as the proportion of variability is very strong for this model. With an R^2 of 0.9291, we can expect future outcomes predicted by this model to have a very high chance of being accurately predicted. The helps to prove that the model used was a strong one and would be a good model to modify and use in future studies to predict future variables.

6.0 CONCLUSION

In summary, GDP per capita, sales tax rates and spirits tax rates are the most relevant and significant determinants when looking at consumption of alcohol in the United States. Results from this paper show that a certain state's GDP per capita affects the alcohol consumption per capita more than any other variable tested in the regression. With an increasing GDP per capita in the United States from 2000-2010, we see that there is a relative increase in alcohol consumption and the two are definitely positively related. Because alcohol is a common good and GDP is directly related to the amount of goods and products sold, it is easy to understand the relationship. Nevertheless, this paper shows that there are also other important variables and an increase in the tax rates, more specifically spirit and sales taxes, lead to a decrease in consumption or demand for alcohol.

When looking at policy implementation with regards to the taxation of alcohol, we can conclude that an increase in the tax on spirits and wine will result in a decrease in the consumption of alcohol. If a particular state is attempting to adjust the use of alcohol, they may look to implement a policy that either raises or lowers the tax rate in order to better control

consumption. The high correlation between wine and spirit tax and consumption would allow for a policy of this nature to be effective.

In order to have a better understanding for the relationship between tax rates and alcohol and to answer the primary question proposed in the title of the paper, different tax rates do affect the demand for alcohol. Taxes on beer and wine were not seen as being statistically significant; therefore they do not affect the demand for alcohol as much as state sales taxes and taxes on spirits, which are statistically significant.

7.0 APPENDIX

Appendix I: Description of Variables and Data Sources

Acronym	Description	Data source	Expected Sign
CONS	Annual consumption per capita of alcohol	NIAAA	+/-
SALESTAX	Fixed rate of sales tax per state for all goods sold within that state (adjusts annually)	Tax Foundation	+/-
SPIRITSTAX	State tax level on distributed spirits and hard alcohol (adjusted annually)	Tax Foundation	+/-
WINETAX	State tax level on distributed wine (adjusted annually)	Tax Foundation	+/-
BEERTAX	State tax level on beer distributed (adjusted annually)	Tax Foundation	+/-
ADBAN	Amount of advertising that is allowed for alcohol within the state; monitoring restrictions	Center on Alcohol Marketing	-
DEATH	Death rate of each state	CDC	+/-
GDP	Annual GDP per capita on a state basis	CIA World Factbook	+

Appendix II: Correlation Matrix

	year	state	salestax	spiritax	winetax	beertax	adban	death	gdp	conspergdp
year	1.0000									
state	0.0000	1.0000								
salestax	0.0702	0.1460	1.0000							
spiritstax	0.3859	-0.0726	-0.0845	1.0000						
winetax	0.0462	-0.2824	-0.1667	0.3378	1.0000					
beertax	0.0850	-0.2482	-0.1811	0.2981	0.5951	1.0000				
adban	0.0000	0.2701	-0.0369	0.1075	-0.1774	-0.0105	1.0000			
death	0.0000	0.0721	0.1074	-0.0777	0.0646	0.0545	-0.0928	1.0000		
gdp	0.9748	0.0000	0.0650	0.3939	0.0428	0.0804	0.0000	0.0000	1.0000	
conspercap	0.9800	0.0000	0.0692	0.4005	0.0445	0.0828	0.0000	0.0000	0.9636	1.0000

Appendix III: Hausman Test

Coefficients				
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed	Random	Difference	S.E.
gdp	1.46E-05	0.000015	-4.10E-07	1.11E-07
beertax	0.007972	0.001131	0.006841	0.0145296
winetax	0.000515	-0.000869	0.001384	0.0078845
spiritstax	0.000585	0.000444	0.00014	0.0001494
salestax	0.011338	0.000315	0.011023	0.0028467
b = consistent under Ho and Ha; obtained from xtreg				
B = inconsistent under Ha, efficient under Ho; obtained from xtreg				
Test: Ho: difference in coefficients not systematic				
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)				
	17.44			
Prob>chi2 = 0.0016				

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