One Day at a Time:

Alcohol Taxation and the Impact on Alcoholism Treatment 2000-2007

Eric Dale
Senior Thesis in Economics
The College of New Jersey

Donka Mirtcheva, PhD
The College of New Jersey
School of Business: Department of Economics

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Abstract

Common government policy towards curbing unhealthy alcohol drinking behavior is to raise taxes thereby lowering consumption. This study examines how alcohol excise taxes (beer, spirits and wine) affect the number of individuals being treated for alcoholism in state facilities as well as effects on consumption on the state and regional levels in the United States. State-level data for the 50 states and the District of Columbia was drawn from 5 data sources and information on demographics, alcohol consumption and taxation was analyzed using OLS regressions. Individual regressions of each type of alcohol consumed were first run to check the predicting power of taxes relative to consumption. Then the main regressions for reported total treatment admissions showed statistically significant demographic, tax and regional effects. The sample was also divided into two types of admissions: those who suffered singularly from alcohol abuse and those who had an alcohol and drug abuse problem. Findings indicate increasing state beer taxes will reduce the number of admissions receiving alcohol treatment, but that, for alcohol, taxes pale in comparison to beverage price in predicting consumption patterns. The implications from the results of this study provide evidence of the general effectiveness of state taxation in deterring dangerous consumption behavior as well as the implied effectiveness of said excise taxes in curbing the amount of individuals requiring treatment leading to improved public health.

Keywords: alcohol taxation, alcohol treatment admissions, state excise taxes

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I. INTRODUCTION

Approximately 17.6 million adults in the United States currently abuse or are dependent upon alcohol. This translates to roughly one out of every 12 adults of at least 18 years of age (Bradley, 2004). Alcohol abuse constitutes heavy and dangerous drinking patterns that can lead to alcohol dependence. Alcohol dependence, known as alcoholism, has several components: a craving to drink, inability to control drinking once one has started, debilitating withdrawal symptoms in absence of alcohol, and the buildup of a tolerance to the effects of alcohol intoxication (NIAAA, 2007). The National Institute on Alcohol Abuse and Alcoholism (NIAAA) considers abusive drinking the consumption of more than two drinks per day for men (>24 oz. of beer) and more than one drink per day for women and the elderly (NIAAA, 2007).

Addicts and dependents drain the state's wallet through enrollment in government-funded treatment programs and pass their addictive burdens on to society. The average cost for residential alcohol or drug treatment in the United States is estimated at $3,840 per admission to a hospital or treatment facility (SAMHSA Media, 2004). The cost to treat such preventable maladies affects the efficiency of such treatment centers, such as hospital emergency rooms, and damages society as a whole due to collateral damage from the inebriated individuals' actions (Zarkin, Bray, Babor, & Higgins-Biddle, 2004). The state of New Jersey alone has over 300,000 problem drinkers and total alcohol-related health care costs soaring over $1.17 billion (Ensuring Solutions, 2003). Local state governments have utilized various preventative measures to discourage alcohol abuse in the form of blood alcohol content (BAC) laws, legal age limits, and related taxes.

The taxation approach to curb hazardous drinking works differently than the other restrictions

states employ by targeting the very desire to drink through the manipulation of price. By increasing the cost of the beverages, through an alcohol “sin” tax, the government reduces the financial ability or consumers' desire to purchase and consume alcohol. This effect reduces the number of those who abuse alcohol in the population which reduces the number of people admitted to alcohol treatment centers, and hence the costs to society.

The focus of this senior thesis is to investigate the links between state excise taxes on alcoholic beverages and admissions to alcohol abuse treatment facilities as a proportion of the population in the state. It is hypothesized that admissions for alcohol abuse treatment will decrease in light of increased state alcohol excise taxes due to reduced incentive to consume said alcoholic beverages. The foundation for this hypothesis lies on the well researched topic of alcohol taxation being used as a means to curb alcohol consumption. Even though state excise taxes only capture part of the changes in beverage price (Young & Bielińska-Kwapisz, 2002), a tax increase will lead to a decrease in consumer consumption (Wagenaar, Maldonado-Molina, & Wagenaar, 2009). The decrease in consumer willingness to purchase alcohol will spike treatment of alcohol abuse across all mediums (from AA to inpatient treatment) resulting in fewer alcoholics to treat in the long run. State-level data encompassing the years 2000 to 2007 were collected from different sources including NIAAA, TEDS, Census 2000, and the Tax Foundation. The variables in question consist of state excise tax rates which, through manipulation, result in decreased consumption of alcohol and a long-term decrease in admissions to treatment facilities.

This paper proceeds with a review the history of alcohol admissions and taxation as well as an examination of relevant literature in section II. Afterward, Section III describes the data assembly and Section IV the methodology of the study, followed by Section V on the results of the research and a discussion of its implications.

II. BACKGROUND AND LITERATURE REVIEW

Alcoholism Treatment

For a majority of United States history, there was no formal measure of treatment for alcoholism as common explanations for alcohol dependence ranged from the 18th century Morality Model, which reasoned the alcoholic chose to be addicted, to the Prohibition era Temperance Model, which sought (and achieved) an outright ban of the tempting substance (Seidlitz, 2010). The adoption of the American Disease Model in 1935 and subsequent classification in the Diagnostics and Statistical Manual of Mental Disorders (DSM), started to remove the stigma attached to alcoholism as it became clear that alcohol dependence was an illness and not a choice (Seidlitz, 2010).

The admissions to treatment centers range from privately owned treatment agencies and hospitals to state correctional facilities as so long as the treatment facility receives state government aid. Treatment programs include mostly detoxification through medicinal means, self-help groups such as Alcoholics Anonymous (AA), and formal inpatient treatment (for severe cases) that employ a variety of psychological and behavioral therapies (NIAAA, 2000). Inpatient rehab has the least chance of relapse at approximately 23% while AA has an estimated 63% chance of former addicts relapsing into abusive drinking patterns. Men drink more than women regardless of casual or heavy consumption which makes them more likely to meet the criteria for alcohol dependence than women (NIAAA, 2007). Namely, the estimated ratio of mild alcohol dependent problem drinkers to serious problem drinkers is approximately 4:1.5 with the former drinkers being the group that contributes the most damage to society in the form of drunk-driving, domestic violence, etc., while the latter composes the most dangerous and severe cases of alcoholism requiring in-patient admissions (Sobell, Cunningham, & Sobell, 1996). From 1979-1990, the male-to-female ratio in alcohol treatment programs shifted from 2.5:1 to 8:1 indicating a differential response by gender towards treatment (Weisner, Greenfield & Room,1995). Alcoholics between ages 30 to 49 were more likely to go and seek treatment for alcohol

abuse/dependence than any other age group.

Overall, Americans have had an increasing predilection towards entering some form of treatment as indicated by being three times more likely to have entered treatment in 1990 than in 1979; men were four times as likely as women to have entered treatment for alcohol abuse (Weisner et al., 1995). Currently, more than 700,000 people receive some form of alcohol abuse treatment (NIAAA, 2000) with treatment periods for in-patient rehabilitation lasting an average of 28 days in a highly controlled environment (Fuller & Hiller-Sturmhöfel, 1999).

Alcohol Taxation

Alcohol usage and taxation can be classified as a contentious issue in the United States. From their inception, taxes on various alcoholic beverages focused on wine, beer and select liquors (Thorndike, 2008). Alcohol taxation is present at both the federal and state levels with local alcohol taxation manifesting as a simple sales tax. Federal and state taxes are broken down into separate excise tax rates for each type of alcohol (beer, wine and spirits), and are imposed on either the domestic manufacturer (brewery, winery, etc.) or importer (liquor stores, etc.) of the alcohol, which trickles down to price increases for the consumer. As an example, a gallon of beer in New York City would currently be subject to a $0.21 federal tax, a $0.14 state tax, and an 8.875% combined local and state sales tax while across the country, that same gallon of beer in Los Angeles would be affected by a $0.21 federal tax, a $0.20 state alcohol tax, and 8.25% local/state sales tax (Tax Foundation, 2010).

Most early uses of alcohol taxation were imposed to pay for federal or state debts, predominately caused by warfare. Frequent hikes in liquor taxes resulted in violent opposition by some, such as the Whiskey Rebellion 1793, and welcomed by others, teetotalers, in favor of ending Americans heavy alcohol usage (History, 2002). By the dawn of the 20th century, many Americans came to see alcohol as a detrimental influence on society due to its close associations with domestic violence and unhealthy living (Kerr & Shelton, 2010). Nationwide Prohibition in 1917 criminalized the

creation and selling of alcohol while the corollary Volstead Act criminalized the possession of the substance. Prohibition did see a decline in the consumption of alcohol by nearly 30% compared to pre-Prohibition levels, but mass ignorance of the law by both civilians and law enforcers heavily undercut the goal of a temperate America (Kerr & Shelton, 2010). After 16 years rife with black market sales, speakeasies, and large scale smuggling of the illicit substance, the 21st Amendment repealed the ban on alcohol in the United States and left it up to states to decide if they would pursue strong temperance policies. In the wake of Prohibition, taxes shifted from being exclusively used for fiscal gain to being used predominately as a behavior control mechanism. Pockets of individual towns and counties, mostly in the southern United States, instituted local statutes that keep the populace dry to this day despite being surrounded by wet counties.

As a result of the provisions of the 21st amendment, the federal government rarely increased the alcohol taxation with the last tax increase on beer and wine in 1991 (to $0.21 and $1.07 per gallon respectively) nearly 40 years after adjustment in 1951 (Henke, 2010). Liquor taxes experienced more frequent changes with a rate of $10.50 per proof-gallon from 1951-1985, $12.50 per proof-gallon from 1985-1991, and a final increase to $13.50 per 100-proof gallon (Manfreda, 2010). The federal alcoholic beverage tax alone exceeded $7.7 billion in 2001, which demonstrates the revenue generating power of the tax (Miller, 2004).

The transfer of alcohol regulation to the states manifested in the form of state alcohol control boards which imposed taxes on alcohol to appease the prohibitionist minority within the state (Miller, 2004). This would sometime result in state-run monopolies on the distribution of certain types of alcohol (usually liquor or wine) which negated the need for a tax with occasional price increases. No state has monopoly control on malt beverages, but approximately 17 states contain liquor monopolies with Pennsylvania, Utah, New Hampshire and Wyoming also controlling the sale of wine (Tax Foundation, 2010).

States which allow commercial vendors to sell and distribute alcoholic beverages do so by issuing a fixed number of licenses through their control board. Excise tax rates vary between “license states” and see sporadic increases in alcohol taxes with some states more conservative than others when raising the rate. The federal and state “sin” taxes on alcohol do not automatically adjust with inflation which causes both their revenue generating and behavioral deterrence capabilities to diminish over time (Miller, 2004). To counteract this, state excise taxes are manually adjusted by a few cents every few years to account for the inflationary pressure or increase the deterrence effect the tax has on drinking.

Mechanism for Admissions

Alcohol taxation is the gear in a larger social control mechanism that reaches beyond merely limiting consumption. The main political function of alcohol taxes is to reduce “unsavory” consumption of alcohol through inflation of the price of alcoholic beverages (Young & Bielińska-Kwapisz, 2002). Increasing taxes on beer in particular reduces added social costs in the forms of medical expenses (Zarkin et al., 2004), mortality (Wagenaar, Tobler, & Komro, 2010) and drunk driving (Sen & Campbell, 2010) while wine and spirit taxes most predominately are tied to a reduction alcohol-related mortality (Wagenaar, Maldonado-Mollna, & Wagenaar, 2009).

As a result from the tax increase and consumption decline, treatment of alcohol abuse and dependence, of both the self-help and inpatient variety, become more prevalent (Weisner et al., 1995). Sobell et al. (1996) suggest that many individuals would seek light treatment from AA or initiate their own form of natural recovery while the more severe (or borderline) dependency cases would receive inpatient treatment. This spike in treatment is not caused by a lack of available alcohol (Smart and Mann, 1998), but rather social or economic pressures that require adjusting alcohol consumption habits (Dave & Saffer, 2008). This increase in treatment decreases the externalities imposed on society by reducing the percentage of dangerous drinkers in society.

This results in the tail-end of the mechanism in which inpatient admissions to treatment centers

fall. The decline is not a resurgence of anti-treatment sentiment, but rather the result of post-tax surge in treatment: there are fewer severe cases of alcoholism left to treat. Implications stemming from this reduction of treatment could result in numerous opportunities to save state and federal funding as well as improve social health and reduce avoidable costs (Wagenaar, Tobler, & Komro, 2010). It is the purpose of this paper to capture this effect on the state-level where alcohol taxes are more subject to more frequent changes compared to the federal-level (Henke, 2010).

Proxy for Beverage Price

In the absence of actual beverage price data for the years of this study (2000-2007), state excise tax rates have been substituted. State excise taxes vary widely from state-to-state and no single type of alcohol tax, such as the commonly used beer tax, can account for some of the variation in the price of all alcoholic beverages (Young & Bielińska-Kwapisz, 2002). To estimate adequately the effects of an alcohol tax on price, each individual state tax on beer, wine, and spirits was factored into the analysis. Even then, Young and Bielińska-Kwapisz (2002) found state excise taxes made up only a small portion of the actual retail price of the beverage with beer taxes only constituting 3% of beer prices, spirit taxes captured 4% and wine 5% of their respective prices. Additionally, these state-excise taxes did not account for individual state effects or time effects when taken as a cross-section.

However, by correlating taxes and prices of beer, spirits and wine, the subsequent regression with fixed effects highlighted two important factors which validate the use of taxes: an over-shifting in state excise taxes to retail prices and the relatively short implementation period. Over-shifting is observable by the taxation coefficient exceeding one which means the consumer is forced to pay a greater amount than just the pure tax for an alcoholic beverage. Theoretically, this occurs because of both the initial tax itself and the increased per-unit cost of the beverage due to the decline in quantity demanded (Young & Bielińska-Kwapisz, 2002). The full effect of the taxation was estimated, from the regression, to occur within a three month span of activation meaning relatively fast impact upon market

forces and consumer preference (Young & Bielińska-Kwapisz, 2002). Even though the taxes are not perfect proxies for alcohol beverage prices, the quick influence on market prices and the amplifying effects of a tax increase will provide the approximate changes in consumer behavior (decreased consumption) as would be seen in a hike in actual beverage price.

Alcohol Tax Effectiveness

An important aspect to this study is consumer reactivity to changes in the price of alcoholic beverages. Age-related risk taking and intensity of alcohol consumption bare less on the overall reaction to increases in alcohol, specifically beer, taxes. Risk preference in alcohol demand was controlled in a study by Dave and Saffer (2008) who sought to separate differential effects from beer price and related policies across several demographic groups. The longitudinal 1968-1996 Panel Study of Income Dynamics (PSID) and the 1992-2005 Health and Retirement Study (HRS) were merged with state-level beer tax and consumption data to adjust for state-level effects among the participants. The study combined 107,000 person observations on adults belonging to two groups: ages 21-54 (PSID) and ages 55 and over (HRS). To quantify risky behavior, each participant's general risk tolerance, defined as willingness to gamble on future lifetime earnings as well as data on drinking habits and physical wellness were assessed. The different risk levels were consolidated into two groups, the most risk-averse and everyone else. Among the group with the highest levels of risk-tolerance lie the problematic drinkers who consume 30% more alcohol and are 32% more likely to binge drink relative to the more risk-averse participants (Dave & Saffer, 2008).

Predictably, risk-tolerant individuals are more likely to consume more beer than their risk-averse counterparts with white males being the most risk tolerant group. Tax elasticity for the participants age 21-54 was significantly negative (–0.04) with increases in beer taxes decreasing consumption between 5.5% to 8.6% (Dave & Saffer, 2008). The older participants (55+) had a much larger tax elasticity ranging from -0.17 to -0.22 indicating more price-sensitivity among the elderly in

addition to a lower drinking prevalence (-5.4%) compared to the younger participants. Dave and Saffer (2008) note that binge drinking has increased from 14.4% in 1992 to 16.1% in 2002 with an upshot in instances of chronic drinking from 3% to 5.9% over the same span. Despite greater instances of problematic drinking behavior, state beer taxes will impact consumption for individuals across different demographics, eliminating possible population bias, and supports the validity of using alcohol taxes in substitute for beverage prices.

The socially beneficially results that stem from the consumption decline and treatment spike span further beyond saving money for the tax-payer and state. To examine the possible social savings from a 10% increase in alcohol prices, which produce a 5% reduction in consumption of alcohol beverages, Wagenaar, Tobler, and Komro (2010) conducted a meta-analysis of 50 papers across 12 databases. This was used to determine the aggregate effect of a higher tax rate on the public health. After adjusting the various datasets so that there would be only a single meta-estimate of the effect for each outcome, the data was sorted according to the measure reported in the original literature (cirrhosis mortality, morbidity, traffic fatalities, etc.). Doubling the alcohol tax rate would result in an average reduction of 35% in alcohol-related mortality, 11% reduction in traffic fatalities, 6% reduction in the spread of sexually transmitted infections, 2% reduction in violence and a 1.2% reduction in crime (Wagenaar et al., 2010). The analysis did not factor in rates of inpatient or outpatient admissions as a result of the tax increase, but concentrated on the negative health and social aspects of alcoholism and abuse. The social benefits from a healthier society are broadly indicated from the collection of studies, but do not provide thorough coverage of the positive (or detrimental) effects on admittance to treatment facilities.

A specific, historical example of increased alcohol taxation both lowering consumption and reducing the byproducts of alcohol dependence is observable in Alaska. An increase in the alcohol tax on beer in Alaska was correlated to a drop in the number if alcohol-related mortality over time

(Wagenaar et al., 2009). Alcohol-related mortality stems from complications of problematic and abusive drinking in which medical complications arise such as lethal cirrhosis of the liver. Tracking the rate of mortality in Alaska by obtaining annual death certificate records, Wagenaar et al. (2009) sorted the deaths into quarterly measures arranged by cause of death from 1976-2004. US Census data was used to estimate deaths per 100,000 people aged 15 and over. Tax records on the price of spirits were obtained through archival data. The period covered two significant changes in regards to Alaska's alcohol taxes which occurred approximately 20 years apart. The analysis used a Box-Jenkins autoregressive integrated moving average, modified with certain structural parameters due to the large amount of repeated observations. Four models were developed to determine the effects of the tax rate on mortality: frequency, rate per 100,000 of the populace aged 15 years and older, rate per 100,000 population (including a comparison against all other states), and natural logs of rate per 100,000 population including the comparison against the other states. The study found that the increases in the tax had decreased consumption of alcoholic products as predicted by the price elasticity on alcoholic beverages. As a result of the consumption decrease, the mortality rates in Alaska produced a noticeable and sustained drop. The research conducted by Wagenaar et al. (2009) confirms that alcohol taxation will produce the decreased consumption of alcoholic beverages as part of the alcohol tax mechanism.

The effectiveness in alcohol taxes extends beyond individual mortality into protecting the lives of other members of society. On the roadway, BAC laws and speed laws serve to stifle dangerous driving behavior from intoxicated individuals while seat belt laws attempt to defend victims of the crashes from injury. Only ALR (administrative license revocation) laws and beer tax rates proved most effective against mitigating fatalities caused by drunk drivers. Sen and Campbell (2010) studied a large range of methods used to reduce the rate of child mortality due to alcohol related driving incidents. Using cross-sectional data from all U.S. states, alcohol prevalence was found to be very significantly associated with daytime and nighttime fatalities and the introduction of a beer tax correlated with a

reduction of child deaths in all of the age groups within the study. Data was collected from the Fatality Analysis Reporting System (FARS) that keeps track of all the vehicle collisions on public roadways that result in a fatality within 30 days after the accident. The data focused on child deaths in alcohol-related motor vehicle accidents segmented into ages 0-4, 5-9, and 10-15. Data on teenagers older than 15 was excluded since the focus of the study was on the deaths of individuals who would not be drinking themselves or driving their peers when on the roadways. The sample included 1,122 state-year observations over a period of 21 years (1982-2002). The study employs a conditional fixed-effects Poisson model in which the relationship between alcohol policies and fatal injuries is estimated. A one gallon increase in per capita alcohol use would increase the mortality rates in each age group significantly, especially for children ages 0-4 with a 64% increase in car accident mortality (Sen & Campbell, 2010). However, ALR laws and an increase in beer taxes were the two policies that effectively lowered the mortality rate amongst children since the first restriction removes the tool (the car) and the second removes the reason (consumed alcohol) from a reckless driver. The beer tax was used as a stand in for the price of all alcoholic beverages. Even though discouraged by Young and Bielińska-Kwapisz (2002), the usage of a beer tax likely stems traditional empirical use of beer taxes as a proxy for alcohol prices, and, in terms of national consumption of pure alcohol, beer represents 56.7% of the total consumption while spirits compose 30% and wine more than 10%. While causation cannot be confirmed, the higher beer taxes may be responsible for the decrease in child fatalities because of decreased beer consumption.

Patterns of Treatment

As dictated by the alcohol taxation mechanism, following the decrease in consumption of beverages, a spike in the number of admissions to alcohol abuse treatment institutions will occur. Weisner et al. (1995) found that, during a time of decreasing per capita alcohol consumption, there was an increase in the utilization and expansion of AA. The study took measures of usage of alcohol and

AA attendance by participants in the 48 contiguous states at three different time periods: 1979, 1984, and 1990. A Mantel-Haenszel chi-square test and logistic regression analysis were used to interpolate the data across the years. Interestingly, the amount of men reporting that they received any type of alcohol abuse treatment increased significantly while women experienced no significant change in treatment. This study acknowledges that expansion of national substance abuse treatment and increased usage of alcohol and drugs by certain population segments might contribute to the rise in the treatment rate overall during this period as well as alcohol awareness campaigns decreasing the consumption of alcohol. The study does not provide state taxation policy at the time nor attempts to even broach the possibility. Regardless, an observable increase in treatment does seem to occur after decreased per capita alcohol consumption.

To refute the claim that a decreased quantity of available alcohol causes decreased consumption, a Canadian study examined treatment admissions and declining alcohol consumption during a period of increased alcohol availability. Smart and Mann (1998) observed a similar treatment phenomenon to Weisner et al. (1995) in both Alberta and Ontario, Canada, between 1975 and 1993. Their study found that when per capita consumption of alcohol declined in both provinces there were notable declines in alcohol-related mortality (liver cirrhosis), increases in alcohol abuse treatment (33.8%), increase in AA membership (56.6%) and increases in the availability of alcohol (135.6%). The study noted that there is a very close relationship between the number of alcohol related problems and the consumption level as observed in Ontario when an increase in taxes decreased consumption and caused alcohol related problems to drop dramatically. The Alberta study displayed the initial boost in AA and formal treatment admissions (56.6% and 33.8%, respectively) during the measured time period, but did not explore the long-term effects of the treatment increase and isolated the number of treatment cases to only admissions, not factoring in demographics or the presence of any substance beyond alcohol. The trend in Alberta matched the results observed in Ontario with a positive relationship confirmed between

alcohol related problems (traffic fatalities, etc.) and the level of alcohol consumption. Smart and Mann (1998) indicate that their findings bear some semblance to data found in the United States but they lack a completed series of data. Smart and Mann (1998) not only support the increase in treatment following a period of decreased consumption, but rule out reverse causality by establishing decreased consumption and increased treatment during a period of time with increasing alcohol availability.

Alcohol treatment facilities only grab the most severe cases of alcohol abuse that contribute to increased health and social costs, but a large number of problematic drinkers go untreated. Sobell et al. (1996) conducted two telephone surveys of Canadians in regards to the drinking habits of 11,634 individuals age 15 or older. Problem drinkers were classified as those men with seven or more drinks a day and women with five or more. The survey took note of any source of formal aid the individual received during their period of drinking (if they had an issue) and the types of issues they may have encountered because of their drinking. Seventy-seven percent of respondents reported recovering from an alcohol problem without any aid at all. AA was the primary source of aid for those who did require it, but these participants composed only 22.4% of the total sample. Even among the self-recovered abusers, there was an average of two alcohol related problems. The study was unable to differentiate whether natural alcohol recovery and aided (AA or inpatient treatment) recovery constituted two ways of treating the same problem or represented two different issues all together.

The research by Fuller and Hiller-Sturmhöfel (1999) indicates that, while AA does effective, treatment administered by residential facilities ranked higher in terms of overall sobriety and preventable relapse. Sobriety and relapse measures were taken over a period of two years from three groups: in-patient rehabilitation with follow up AA, AA-only, and treatment choice. Of the three groups, in-patient participants were more sober than the other groups at 37% while 17% of the choice group and 16% of the AA group remained sober (Fuller & Hiller-Sturmhöfel, 1999). This indicates that inpatient facilities are more likely to reduce the reoccurrence of severe alcoholism cases which lends to

the idea that the long-term effect of the tax mechanism is a reduction in the number of alcoholics requiring inpatient treatment.

III. DATA

Data Sources

This study utilizes 2000-2007 state-level data from TEDS combined with external data from The Tax Foundation, National Institute of Alcohol Abuse and Alcoholism, and United States Census. Selections from TEDS and Census data were formatted and combined into a single Excel data file before use with analytical software.

Treatment Episode Data Set (TEDS)

The main data used came from TEDS, which provides state-level information on admissions to alcohol treatment centers including basic demographic data on admitted patients. The Substance Abuse and Mental Health Services Agency (SAMHSA), a federal agency under the United States Department of Health, has compiled yearly state-level data since 1992 on all state-funded substance abuse treatment facilities in the country. Technically, it is the state agencies that monitor the admissions of their treatment centers within each state that report to SAMHSA. In addition to the total number of admissions by state, admissions were also reported by type of abused substance and demographic group. In particular, the classification of alcohol-only abuse and alcohol with secondary drug abuse were the categories of choice for the experiment.

Fourteen age brackets capture admissions from ages <1 to 66+ along with accounting for admissions with an unknown age, and decisively separating the age profiles at the 21 year old mark. Six distinct racial categories include White, Black, American Indian/Alaskan Native, Asian/Native Hawaiian/Pacific Islander, Other, and a category for admissions of an unknown racial background. Ethnicity distinguishes between the percentage of admissions who are Latino, not Latino, or of unknown Hispanic lineage. Variables originally intended to code for Spanish ethnicity were removed

due to the inability to include Latino within the race variable category. Latino, as a race, is captured principally by the Other category while Hispanic as an ethnicity is composed of several different race variables. Each state report is chosen from a graphical map interface which, after selecting a year, tabulates the aforementioned data into an HTML file display.

The Tax Foundation

State excise tax data for 2000-2007 was used to establish the relationship between per capita consumption of alcohol and taxation. The Tax Foundation provides historical yearly data on state excise taxes for beer, wine, and spirits. The time period covered by the data set ranged from 2000-2010. The data gave the tax on alcohol in US dollars per gallon as well as other information concerning the taxation such as state-specific tax policies, control states (state-run alcohol monopoly), and estimated excise tax portion of price using methods developed by the Distilled Spirits Council of the United States (DISCUS). Control states do not have externally levied excise taxes on alcohol products. The price of alcoholic beverages in these states is internally influenced by the state government and subject to various ad valorem taxes. The data on control states originally included estimations to determine what part of the beverage price of control states would be consistent with an excise tax in a license state. This resulted in inconsistent and incomplete estimations across the 2000 to 2007 span for control states.

National Institute of Alcohol Abuse and Alcoholism (NIAAA)

The NIAAA 2000-2007 data sets concerning alcohol consumption were used to establish the relationship between tax rates and per capita alcohol consumption. The two data sets provide national ethanol consumption by the gallon and state ethanol consumption by the gallon. NIAAA uses an Alcohol Epidemiologic Data System to compile a data set with the average amount of ethanol consumed by the gallon per capita at the national level (years: 1850-2007) and state level (years: 1970-2007). Beer, wine, and spirits composed the beverage classes amongst both sets with an additional

category for total consumption of all beverages. The population for both studies includes people 14 years old and older. Each set is displayed in a table in HTML format, and converted for the purpose of this study in Excel format.

Census Bureau

Data from the 2000 United States Census was used to scale appropriately the demographic and admissions variables according to proportion of each state population. The 2000 Census provided the estimated population for the years 2000-2007 based on previous growth trends throughout the country. The actual population data is rounded to better fit the state's portion of the national population average which produces a slight error in forming the population base for 2000. These estimates are consistent with state-level growth patterns and the national-level growth patterns. Variables drawn from the Census include total state population and total male and female population per state. Each state is contained in a separate Excel file and select data was merged, by state and year indicators, with the primary data from TEDS. The Census Bureau's breakdown of the four regions of the United States from the Economic Census was consulted in developing the regions for the state data.

Missing Data

Several observations are incomplete as a result of no TEDS data being reported for state during a certain time period and have been omitted from this study. The missing observations are as follows: Alabama (2007), Alaska (2004-2006), Arizona (2000), Arkansas (2004), Washington, D.C. (2004-2006), Georgia (2006, 2007) and West Virginia (2000,2001). Since Arizona was only partially missing data for 2000, the alcohol with secondary drug data, estimations were made averaging 1999 and 2001 data to create a complete set.

The data from these sources were collected and formatted for usage in Microsoft Excel 2007 and transferred to the analytical software Stata v. 10/11 for data analysis. Using Stata, all demographic and admissions variables were modified further through the transformation into a proportion of state

population. The resulting standardized proportions and the consumption data were modified for size by multiplication by one thousand units.

Variables

The categorization of the data as either Alcohol Only (O) or Alcohol with Secondary Drug (D) added a depth to the analysis by distinguishing between admissions that had sole abuse pathology (O) and those with complex pathology (D) theoretically capturing different risk levels. The alcohol consumption variables were transformed from gallons of ethanol consumed per capita for each state to thousands of gallons consumed per state population in order to improve the size of regression coefficients and to maintain the same scale as other demographic variables in the full admissions model. This led all averages and coefficients to be interpreted as the number of admissions in each state population per one thousand people of that state. The total admissions were composed or two partial components: alcohol only admissions (O) and alcohol with secondary drug admissions (D).

Tax was coded as beer, spirit, and wine variables in dollars per gallon. Each variable represents a levied state excise tax on alcohol as would be seen in license states. A tax amount of zero would be indicative of either no tax on the product or, if the appropriate control state indicator was present, the state government controlled distribution of alcohol. Control state indicators are coded for spirits and wine. No state government distributes beer beverages so all states are beer license states. A state is a license state, private distribution, if both control indicators are zero.

Variables that account for gallons of ethanol consumed by a state population per one thousand residents include beer, spirits, and wine. Ethanol is used as the consumption measure since it is the type of alcohol most commonly present in alcoholic beverages. This means that study uses pure alcohol content and understates consumption as one gallon of ethanol is present in approximately 25 gallons of beer, 8.7 gallons of wine, and 2.63 gallons of spirits. These variables were included in the full tax-treatment model in order to verify that consumption was positively correlated with treatment

admissions and consistent with the directionality in the tax-consumption model.

Gender was coded as male, female and unknown for each admission type (O or D) upon receiving treatment. Gender unknown may be a result if the gender of the person is unreported or unclear. Gender variables were transformed similarly to admissions and consumption through standardizing the gender variables by dividing gender by state population and multiplying by one thousand. Male (O) was used as the reference variable for regression analyses.

The race variables of admitted persons were condensed down to White, Black, American Indian/Alaska Native, and Other race. Due to the small number of admissions of a particular racial category, Asian/Hawaiian/Pacific Islander, other race and race unknown were merged into the single variable of Other. Like gender, race was also subdivided by admission type. After condensation, each variable was subjected to division by state population and multiplication by one thousand. For reference, White (O) was chosen for the full regression while each respective White variable was used as reference in the partial models.

Age variables were compacted into four variable categories for simplicity: underage drinker admissions, adult admissions, post middle age admissions, and age unknown. This was done to capture the effects of variables which explain changes in the number of admissions of selected drinking classes. Underage drinkers were a condensation of all variable categories under the age of 21 (legal drinking age) and spanning from age 11 to 20. The post middle age variable was a condensed of smaller categories of reported alcohol admissions at the top of the age range spanning from 61 years old and older. The middle age group of adult admissions captures young adulthood until middle age and is the most generalized age variable from merging admissions between the age ranges of 21 years to 60 years. The age unknown variable captures admissions where the age of the admitted either failed to be recorded or was not given, and, like gender unknown, it represents a small fraction of the overall admissions. The compacted age variables underwent the division of state population and multiplication

by one thousand as on par with other demographic variables. Adult (O) was used as the reference variable for the full model.

Location variables were classified according to the subdivisions outlined in the United States Census Bureau's Economic Census. Four regions (North, South, Central and West) were coded as indicators with Central being the reference group in each regression due to its greater mean value. Nine divisional regions were also coded for regression, but the four region variables were used as they provided a more meaningful interpretation. Regions, capturing a more national overview, appear in most of the regressions while the nine regions were used as a rough check of the consistency of the results. The time variable, Year, was attached to each observation for a particular state. The time spanned from 2000 to 2007. **Appendix A** lists the variables used in the following regressions with interpretative details on how they were constructed including the U.S. states that compose each region.

IV. METHODS

In order to explore the effects of taxes upon alcohol abuse treatment admissions, this study uses Ordinary Least Squares models to relate admissions with excise tax variables, beverage consumption with tax variables and track differences between two types of admissions.

Initially, alcohol consumption was regressed on alcohol taxes to examine how closely taxes approximate prices using the following model:

$$Consumption = f\,(Tax, Control\ State, Region, Year) \qquad \textbf{(Equation 1)}$$

$$Consumption = \beta_0 + \beta_1*(T_{BEER}) + \beta_2*(T_{WINE}) + \beta_3*(T_{SPIRIT}) + \beta_4*(CS_{WINE}) + \beta_5*(CS_{SPIRIT}) + \beta_6*(R_{NORTH}) + \beta_7*(R_{SOUTH}) + \beta_8*(R_{WEST}) + \beta_9*(Year) + \varepsilon \qquad \textbf{(Equation 2)}$$

where *Consumption* is the dependent variable for either beer, spirit or wine consumption, *Taxes* are the excise tax variables for beer, spirits and wine, *Control State* is the indicator variables for spirit and wine control states, and *Region* is a vector of the dummy variables for regional location.

The hypothesis contends that the taxes lower consumption of alcohol; it is expected that each specific excise tax will have a negative correlation with its corresponding beverage consumption. All excise taxes and control state indicators were included in each of the three estimations. Due to the larger number of "dry" counties and control states in the southern United States, the expectation was that the South would have the lowest alcohol consumption level compared to the other regions. The time variable (years) tracks yearly effects and regional dummies account for regional consumption differences across the United States.

The admissions models examine the relationship between the excise taxes on alcohol and their influence upon the number of those admitted for alcohol abuse treatment. The theory behind this relationship would be that taxes reduce consumption which, in turn, reduces the number of abusers resulting in fewer admissions. Next, treatment admissions, the primary division of interest, were regressed on the three alcohol excise taxes, control state indicators, the three types of alcohol consumption, and region to estimate the following reduced tax-treatment model:

$$\textit{Total Admissions} = f(\textit{Tax, Control State, Consumption, Region, Year}) \quad \textbf{(Equation 3)}$$

$$\textit{Total Admissions} = \beta_0 + \beta_1*(T_{BEER}) + \beta_2*(T_{WINE}) + \beta_3*(T_{SPIRIT}) + \beta_4*(CS_{WINE}) + \beta_5*(CS_{SPIRIT}) + \beta_6*(C_{BEER}) + \beta_7*(C_{WINE}) + \beta_8*(C_{SPIRIT}) + \beta_9*(R_{NORTH}) + \beta_{10}*(R_{SOUTH}) + \beta_{11}*(R_{WEST}) + \beta_{12}*(year) + \varepsilon$$

(Equation 4)

where *Total Admissions* are the combined number of alcohol abuse treatment admissions specific to each state for a given year in time and *C* represents the three consumption variables. In this model, it was hypothesized that the tax variables would be negatively correlated with total admissions indicating higher taxes reducing admissions. Additionally, the consumption variables would be expected to be positively correlated with admissions since greater indulgence in alcohol would lead to increased incidence of abuse which required treatment.

Additional demographic variables, gender, race and age, were applied to the model to create a

better fit for the model and explore the differences between the various admitted groups. To increase the size of the coefficients, demographic, consumption and admissions variables were multiplied by one thousand. As on par with the literature, it was expected that men would be the largest group being treated (Weisner et al., 1995), American Indian/Alaska Native would be significant for race (Rhoades, 2003), and underage admissions would be more likely to seek treatment due to the benefits of rehabilitation (Holder, 1998). The total admissions relationship was estimated:

Total Admissions = f (Tax, Control State, Consumption, Gender O, Gender D, Race O, Race D, Age O, Age D, Region, Year) **(Equation 5)**

where *Total Admissions* is the total alcohol treatment admissions, *Gender O* are the variables for female and unknown gendered admissions that were alcohol only (O) admissions, *Gender D* are the male, female and gender unknown admissions for alcohol with secondary drug admissions (D), *Race O* are the race variables for Black, American Indian/Alaska Native and Other (O), *Race D* are the race variables White, Black, American Indian/Alaska Native and Other (D), *Age O* are admissions less than 21 years of age, post 60 years of age and of unknown age (O), and *Age D* are the variables for admissions less than 21 years of age, between 21 through 60, post 60 years and of age unknown (D).

The third set of regressions consisted of breaking the data into the two exclusive classifications of admissions (O and D) to see how the relationships in determining admissions to alcohol treatment were impacted. The full admissions model was divided into two models which kept the non-specific explanatory variables (excise taxes, location) but removed either the O or D variables. Reference variables were changed appropriately. The relationships in these partial tax-treatment models were estimated as:

Admissions O = f (Tax, Control State, Consumption, Gender O, Race O, Age O, Region , Year) **(Eq. 6)**

Admissions D = f (Tax, Control State, Consumption, Gender D, Race D, Age D, Region , Year) **(Eq. 7)**

where *O* is the variable for alcohol only admissions while *D* is the variable for alcohol with secondary

drug admissions.

V. RESULTS & DISCUSSION

The contents of **Tables 1 and 2** include a brief summary of the variables used in the study. The total alcohol treatment admissions averaged 3.32 admissions (SD = 2.48) per 1,000 state residents. For example, Alabama had an estimated total population of 4,451,887 residents in 2000, which means the total number of alcohol treatment admissions in that population was about 14,781 admissions if the average number admittance per 1000 Alabama citizens was 3.32 admissions. **Table 1** includes a complete set of variables form all admissions for alcohol abuse. The tax imposed on a beverage makes up a portion of the price of the alcoholic drink. The average dollar amount of each tax indicates that spirits are taxed the heaviest of the three beverages at $2.41 per gallon, wine straddles the middle at $0.68 per gallon, and beer receives he lighter taxation at $0.24 per gallon but is produced in greater quantities. Beer is consumed in much greater quantities averaging 1,265.66 gallons per 1,000 state residents whereas spirits and wine are consumed at an average of 736.03 and 335.53 gallons respectively.

Table 2 is broken down into the two types of treatment: alcohol only and alcohol with secondary drug admissions. Total treatment admissions were slightly more common for single pathology (alcohol only) issues rather than multiple pathologies (alcohol with drug) with mean averages of 1.97 and 1.35 admissions respectively. The summary statistics for each demographic factor shows that on average more admissions tend to be male, White-American, age 21-60 years old living in the Central region (**Table 1**) of the United States and have only a single abuse problem. Most alcohol only admissions categories, most predominately the reference variables, contain greater means than their alcohol with drug counterparts with the exceptions of African-American admissions (O: 0.17 versus D: 0.22 admissions) and admissions under 21 years old (O: 0.16 versus D: 0.21).

Tax-Consumption Models

Table 3 reports the effectiveness of excise taxes in predicting changes in overall alcohol consumption (Column 1), and by beer (Column 2), wine (Column 3), and spirits (Column 4). The beer tax variable was found to be significant in increasing beer consumption while decreasing wine consumption. Similarly, a one dollar increase in the wine tax results in a 108.27 gallon per 1,000 resident (Column 1) increase of in total alcohol consumption, which, when analyzed by specific types of alcohol, is attributed to an increase in beer consumption (Column 2). This finding suggests that wine and beer are substitute products, but the inverse relationship does not seem clear. Raising the beer tax by one dollar increases beer consumption by 179.44 gallons per 1,000 state residents while lowering wine consumption by 96.33 gallons, but the wine tax does not affect wine consumption while increasing beer (Column 2). Spirit taxes correlated most accurately with its intended beverage consumption with a decrease in spirit consumption of 27.75 gallons of ethanol consumed per 1,000 state residents. It also decreased beer consumption by 47.57 gallons of ethanol per 1,000 state residents as well. These findings suggest spirits and beer might be complementary products.

Examining the effect of taxation on its own consumption, the tax-consumption diagonal, found that taxes were not as strong predictors of consumption as was expected. The results from these regressions were consistent with Young and Bielińska-Kwapisz (2002) in finding that taxes pale in comparison to price as predictors of consumption patterns with taxes being poor proxies for tracking changes in alcohol consumption overall.

Since the state government influences the prices of alcohol in some states, such control state indicators would be reflective not only of the lack of an excise tax, but also more clearly mirror price effects making them more efficient predictors of consumption. Due to control states do not have excise taxes but only a government mandated price on alcoholic beverages, beer, wine and spirits were all reduced when compared to license (non-control) states by, 189.00, 57.42, and 253.75 gallons of ethanol consumed per 1,000 state residents respectively. Considering all state governments that control wine

distribution also control spirits, the wine control state effects on consumption must be added to the spirit control state changes. By taking this factor into account, the increase in spirit consumption of 107.65 gallons per 1,000 state residents due to the wine control state indicator would be negated by the larger decrease in spirit consumption due to the spirit control state indicator of 253.75 gallons per 1,000 state residents resulting in an overall decrease in spirit consumption relative to license states by 146.1 gallons (Column 4). The complementary nature of beer and spirits explains why their tax coefficients indicated a much greater reduction compared to wine in a spirit control state. The wine control state, independently, would decrease consumption of wine but increase the consumption of wine's substitute, spirits.

Examining the total consumption of alcohol, both North and West had greater consumption of alcohol compared to the Central region (Column1). When analyzing the alcohol consumption by specific beverage (Columns 2-4), the heavier consumption of alcohol in the North region can be explained by higher consumption of wine and spirits compared to the Central region (234.51 and 167.43 more gallons of consumed ethanol respectively). The West region, being composed of a heterogeneous sample of states, had greater consumption of all alcoholic beverages over Central. Possible explanations for these differences include weather and number of dry counties in the states within each region. North had heightened consumption of temperature increasing wine and spirits and occupies typically colder latitudes while the South had the greatest consumption of temperature cooling beer in typically warmer latitudes. West straddles both climates which explain its overall increase in consumption of all beverages compared to Central. Additionally, dry counties exist primarily in the South region with only a couple of dry towns per state in the North region explaining heavier spirit and wine consumption in the North and less consumption in the South.

The positive time coefficient, Year (20.33 gallons per 1,000 state residents), suggests a positive trend of alcohol consumption over the 2000 to 2007 time span despite changes in state taxation. More

specifically, Year positively correlated to both spirits and wine consumption suggesting that more of these beverages were consumed across the time period.

The relatively low explanatory power of the model (adj. $R^2 = 0.11$; Column1) suggests that taxes probably do not correlate strongly with prices so including both consumption and taxes variables as predictors of admissions is justified. The beer consumption model had the poorest fit explaining only 9% in the variation of beer consumption (adj. $R^2 = 0.09$) while spirit consumption (adj. $R^2 = 0.14$) and wine consumption (adj. $R^2 = 0.40$) models were a better for accounting for consumption changes.

Admissions Models

Table 4 presents the coefficient estimations from the four regression models: a reduced admissions model (Column 1), a full admissions model which includes demographics (Column 2) and two partial admissions models by type of admittance (Columns 3 and 4).

The beer tax was the only statistically significant negative tax variable in both Columns 1 and 2; each dollar increase in the beer tax results in 2.13 and 0.70 fewer admissions per 1,000 state residents respectively. This finding supports the predicted hypothesis by the beer tax reducing the number of admissions. Column 2 had a noticeably weaker coefficient possibly due to the presence of demographic factors more accurately explaining the changes in admissions. Regardless, this would suggest that, on the surface, increasing beer taxes would be ideal for reducing the number of abusers, but, as observed in the tax-consumption relationship, still fall short of being accurate predictors of consumption compared to control state indicators.

The indicator for wine control states and the variable wine consumption across both regressions also correlate to a reduced number of admissions. However, the wine and spirit consumption is so close to zero (i.e. 6.1 admissions per 1 million and 4 admissions per 10 million state residents respectively) that, while statistically significant, is economically insignificant.

The significance of all three location dummies in Column 1 but no statistical significance in

Column 2 signifies that the demographic variables added in the second regression capture some of the regional differences of the first regression and more fully explain treatment admissions changes.

The analysis by type of admissions reveals some interesting findings. The beer tax reduced alcohol abuse admissions in the full model (Column 2), which was due to reducing alcohol with secondary drug admissions (Column 4). In other words, beer taxes reduce the number of treatment admissions with multiple pathologies. Spirit taxes and spirit control indicators are negatively correlated with both alcohol only and alcohol with drug admissions for Columns 3 and 4, which is consistent with the hypothesis. The wine tax is significant and positive in both partial models against the hypothesized inverse correlation along with the wine control state indicator in Column 3.

Alcohol with secondary drug admissions were more common in the North (0.08 more D admissions in a state population per 1,000 people relative to Central) and less common in the South (-0.04 less D admissions in a state population per 1,000 people relative to Central). Year correlated negatively, but economically insignificantly, with D admissions suggesting a decrease in multiple pathology admissions from 2000 to 2007.

Women and unknown gender admissions were more likely to receive treatment relative to men when their admittance was only for alcohol abuse. Specifically, women correlated positively to admissions in all three models with stronger coefficients for the respective variable of women in Columns 3 and 4 than that of Column 2 possibly due to the presence of both in the full model. The positive correlation between women and treatment (1.66 more O admissions in a state population per 1,000 people relative to male O admissions) is somewhat supported through Weisner, Greenfield, and Room (1995) who tracked larger utilization of alcohol treatment sources by women from 1979-1990. The more intensive type of treatment observed in this study, and, theoretically, changes in post-millennial drinking trends might have reversed the ratio of men to women in abuse treatment.

African-American admissions were positively correlated with treatment admissions in all three

regressions indicating greater African-American utilization of intensive alcohol treatment than the White-American reference group (2.28 more African-American O admissions in a state population per 1,000 people relative to White-American O admissions). American Indian/Alaskan Native, predicted to be significant, were only significant for Column 2 (1.31 more American Indian/Alaska Native admissions in a state population per 1,000 people relative to White-American admissions) whereas Other race admissions were significant and positive for Columns 3 and 4. This disagreement between the full and partial models could be suggestive that the use of only White-American O admissions as the reference group instead of an undifferentiated category of White-American admissions might be distorting the significance of the variables.

Abusers under 21 years old were more likely to seek alcohol abuse treatment compared to the adult population (0.99 more underage O admissions in a state population per 1,000 people relative to adult O admissions) in Column 2. Only Column 4 was significant for underage drinker admissions (0.69 more underage D admissions in a state population per 1,000 people relative to adult D admissions) possibly related to teenagers' willingness to experiment with drugs and alcohol. Although, this result can be supported by Holder (1998) in that younger people have more to gain from early treatment, this conclusion does not support the result of post-middle age admissions being significantly greater than adult admissions (10.23 more O admissions relative to adult O admissions).

Interestingly, post-middle age admissions having multiple pathologies (alcohol with secondary drug) will be less likely than adults with a single pathology to seek treatment (-17.99 senior D admissions relative to adult O admissions). This is reversed in Column 4 with post-middle age admissions positively correlating to treatment (10.26 more post-middle age D admissions in a state population per 1,000 people relative to adult D admissions). This is another hint at a possible bias from using a single differentiated reference variable among two different types of admissions.

Though the model does not specify why alcohol abusing adults greater than 60 years old do get

admitted more frequently, theoretically, it could stem from the decline in health endemic to old age forcing seniors to change their consumption patterns by seeking treatment for unhealthy habits. The seniors with multiple pathologies may be suffering as a result of prescription drug abuse or may be in such poor health that seeking treatment would have limited benefits (Holder, 1998).

VI. CONCLUSION

This research examines the effect alcohol excise taxes have in reducing the number of people seeking in-patient treatment for alcohol abuse via consumption using 2000-2007 state-level data compiled by the federal government from state funded treatment facilities. Using OLS regressions, models relating tax with each type of ethanol consumption, tax with admissions, and tax with admissions by type were constructed. Even though taxes were found to be suboptimal predictors of consumption, alcohol excise taxes do play a role in influencing the number of admissions for alcohol abuse treatment. Beer and spirits tended to show similar movement and opposition to wine leading to a theoretical conclusion that beer is a complement to spirits while wine is a substitute for spirits. The reduced and full models for admissions accounted for taxes, control state indicators, consumption, regions, and time with the full admissions model adding other demographic factors. Both suggest that heightening of beer excise taxes would correlate to a drop in the number of admissions for alcohol abuse.

While a beer tax does reduce admissions for treatment, it does not conform to the hypothesized notion of taxes decreasing consumption. The fact that the reduced, full, and alcohol with drugs models indicates a decrease in the number of admissions when beer taxes increase implies that taxes do indeed play a role in determining admissions but that role is still unclear. Other factors such as price (which would include the tax) may play a more significant role in consumption tracking.

Spirit taxes, as expected, conform nearly perfectly to both the reduction of spirit consumption and subsequent reduction of alcohol abuse admissions. Spirit control states also operate very close to

the hypothesis compared to license states. Factors unaccounted for within this study may contribute to the lack of concurrence between the partial models and the full treatment model in the overall significance of the effectiveness of the spirit tax.

Regional variables highlighted the difference in types of pathologies afflicting the citizens of each region. The North region of the United States is a much greater source of alcohol with drug admissions as well as having the greatest level of consumption of spirits and wine relative to the Central reference region while the South consumes the most beer relative to Central. Climate differences and the presence of alcohol free areas have been theorized as possible causes of the differences in regional consumption. The higher incidents of multiple pathologies may hint at the destination of many illegal drugs that enter the country.

Demographic differences between the types of admissions were mostly identical with each other and supported previous research. Women were more likely than men to seek treatment as were African-Americans. The elderly were more likely than the rest of the age range to seek treatment for alcohol abuse though the reasoning for this may be the decline in health associated with old age requiring greater personal care. Overall, there are more admissions for only alcohol abuse than alcohol coupled with another abuse issue plaguing the nation.

The data used for this study should be interpreted with some caution. The data is based on admissions rather than individuals which mean the same people may be counted as receiving multiple treatment admissions. The accuracy of each measure of data was subject to the state facility reporting the admissions.

Public policy makers would be justified in levying a beer tax if they desired to see a reduction in the number of alcohol abuse admissions. The benefits of reducing admissions means less overcrowding at facilities and more economic freedom for the state (and federal government by extension) to direct funding from new facilities to other public service projects. However, to avoid

potentially increasing the overall consumption of alcohol, a spirit tax would be ideal in reducing consumption in areas of high alcohol abuse as well as reducing treatment. Changing to government controlled distribution of alcohol from a license-based distribution system would be especially effective in reducing consumption if a more dynamic policy would be required.

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Table 1. Summary Statistics of Total Alcohol Treatment Admissions

	Mean	Std. Dev.	Min	Max
Total Alcohol Admissions	3.3178	(2.4752)	0.0833	15.4632
Beer Excise Tax	0.2407	(0.1874)	0.0200	1.0700
Wine Excise Tax	0.6887	(0.5193)	0.0000	2.5000
Spirits Excise Tax	2.4074	(2.2168)	0.0000	12.8000
Wine Control State Indicator	0.0556	(0.2294)	0	1
Spirit Control State Indicator	0.3510	(0.4779)	0	1
Beer Consumption	1265.6570	(209.1461)	690	1810
Spirit Consumption	736.0354	(243.0433)	380	1760
Wine Consumption	335.5303	(167.4030)	90	990
Male Admissions	2.4588	(1.8984)	0.0629	11.4105
Female Admissions	0.8549	(0.6031)	0.0170	4.0877
Gender Unknown Admissions	0.0040	(0.0320)	0.0000	0.4122
White-American Admissions	2.4345	(1.8852)	0.0017	10.2702
African-American Admissions	0.3886	(0.4425)	0.0034	2.9745
American Indian/Alaska Native Admissions	0.2513	(0.7109)	0.0000	7.4594
Other Race Admissions	0.2432	(0.3382)	0.0084	3.2919
Admissions 20 years old or younger	0.3623	(0.4024)	0.0000	2.5267
Admissions 21 to 60 years old	2.8717	(2.1156)	0.0612	12.8629
Admissions 60 years old or older	0.0745	(0.0676)	0.0017	0.3963
Admissions with Age Unknown	0.0088	(0.0408)	0.0000	0.4977
North United States	0.1818	(0.3862)	0	1
South United States	0.2424	(0.4291)	0	1
Central United States	0.3207	(0.4673)	0	1
West United States	0.2551	(0.4364)	0	1
Year	2003.4670	(2.2917)	2000	2007
N	396			

Source: The Tax Foundation supplemented with the Census Bureau's Economic Census and National Institute on Alcohol Abuse and Alcoholism (NIAAA). All data span from 2000 to 2007.

Table 2. Summary Statistics by Type of Admission: Alcohol Only and Alcohol with Secondary Drug

	Alcohol Only				Alcohol with Drug			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Total Alcohol Treatment Admissions	1.969	(1.7524)	0.0408	10.9063	1.349	(0.9743)	0.0194	5.8316
Male Admissions	1.4734	(1.3842)	0.0340	9.3358	0.9854	(0.7276)	0.0133	4.1229
Female Admissions	0.4924	(0.3889)	0.0051	2.4086	0.3625	(0.2542)	0.0061	1.7087
Gender Unknown Admissions	0.0032	(0.0279)	0.0000	0.3871	0.0009	(0.0053)	0.0000	0.0881
White-American Admissions	1.4980	(1.3654)	0.0017	8.7734	0.9364	(0.6610)	0.0000	3.0718
African-American Admissions	0.1699	(0.1816)	0.0028	0.9125	0.2187	(0.3045)	0.0000	2.2390
American Indian/Alaska Native Admissions	0.1527	(0.4468)	0.0000	4.8076	0.0986	(0.2775)	0.0000	2.6518
Other Race Admissions	0.1483	(0.2462)	0.0029	2.9037	0.0949	(0.1351)	0.0014	0.7833
Admissions 20 years old or younger	0.1553	(0.2005)	0.0000	1.3930	0.2070	(0.2216)	0.0000	1.6212
Admissions 21 to 60 years old	1.7410	(1.5540)	0.0306	10.1429	1.1307	(0.8049)	0.0167	4.8205
Admissions 60 years old or older	0.0678	(0.0625)	0.0017	0.3873	0.0067	(0.0081)	0.0000	0.0611
Admissions with Age Unknown	0.0046	(0.0233)	0.0000	0.3097	0.0041	(0.0186)	0.0000	0.2365
N	396				396			

Source: The Tax Foundation supplemented with the Census Bureau's Economic Census and National Institute on Alcohol Abuse and Alcoholism (NIAAA). All data span from 2000 to 2007.

Table 3. Regression Analysis of the Taxation-Consumption Models

	All Beverage Consumption	Beer Consumption	Wine Consumption	Spirits Consumption
	(1)	**(2)**	**(3)**	**(4)**
Beer Tax	46.1966	**179.4433** ***	**-96.3275** **	-34.5761
	(159.6003)	(69.2779)	(44.9383)	(78.5904)
Wine Tax	**108.265** *	**75.4028** ***	18.7334	13.8657
	(63.4786)	(27.5542)	(17.8735)	(31.2582)
Spirits Tax	**-81.3659** ***	**-47.5688** ***	-6.6015	**-27.4727** **
	(24.1351)	(10.4763)	(6.7957)	(11.8846)
Wine Control State	25.0993	65.7327	**-147.2587** ***	**107.6524** *
	(117.3352)	(50.9318)	(33.0378)	(57.7782)
Spirit Control State	**-498.54** ***	**-189.0035** ***	**-57.4159** *	**-253.7477** ***
	(107.7267)	(46.7611)	(30.3324)	(53.0468)
North	**424.315** ***	22.8791	**234.5106** ***	**167.4344** ***
	(81.1954)	(35.2446)	(22.8620)	(39.9823)
South	91.3954	**125.8603** ***	**-55.0944** ***	21.7955
	(66.8900)	(29.0350)	(18.8341)	(32.9380)
West	**362.896** ***	**97.1669** ***	**161.2267** ***	**105.0197** ***
	(66.2839)	(28.7719)	(18.6634)	(32.6395)
Year	**20.3277** **	-2.2423	**7.4838** ***	**15.2841** ***
	(10.1376)	(4.4004)	(2.8544)	(4.9919)
Adj. R^2	0.1126	0.0938	0.4048	0.1364
N	396	396	396	396

Source: The Tax Foundation supplemented with the Census Bureau's Economic Census and National Institute on Alcohol Abuse and Alcoholism (NIAAA). All data span from 2000 to 2007.

Notes: 1. The OLS regression coefficients are provided with standard error shown in parentheses.
2. The symbols (***), (**), and (*) represent statistical significance at p<.01, p<.05, and p<.1 respectively.

Table 4. Regression Analysis of Alcohol Treatment Admissions: Model Summaries

	All Alcohol Admissions		All Alcohol Admissions		Alcohol Only Admissions		Alcohol with Drug Admissions	
	(1)		(2)		(3)		(4)	
Beer Tax	**-2.1330**	***	**-0.6961**	***	-0.1253		**-0.2553**	***
	(0.7769)		(0.1218)		(0.1373)		(0.0484)	
Wine Tax	0.1968		-0.0421		**0.1638**	***	**0.0792**	***
	(0.3087)		(0.0365)		**(0.0517)**		(0.0184)	
Spirits Tax	0.1137		**0.0253**	*	**-0.1063**	***	**-0.0147**	**
	(0.1184)		(0.0173)		**(0.0200)**		(0.0075)	
Wine Control State	**-1.9822**	***	**-0.1093**	*	**0.3878**	***	0.0229	
	(0.6092)		(0.0742)		(0.1075)		(0.0368)	
Spirit Control State	**0.7932**	*	**0.1175**	*	**-0.5077**	***	**-0.0552**	*
	(0.5325)		(0.0709)		(0.0902)		(0.0314)	
Beer Consumption	-0.0009		-0.0001		**0.0002**	*	0.0000	
	(0.0007)		(0.0001)		(0.0001)		(0.0000)	
Wine Consumption	**-0.0061**	***	**-0.0004**	**	-0.0001		**-0.0002**	***
	(0.0012)		(0.0002)		(0.0002)		(0.0001)	
Spirit Consumption	**0.0035**	***	0.0000		**-0.0002**	*	**0.0001**	**
	(0.0009)		(0.0001)		(0.0002)		(0.0001)	
North	**3.3766**	***	0.0281		-0.0594		**0.0835**	***
	(0.4444)		(0.0618)		(0.0870)		(0.0301)	
South	**1.3359**	***	0.0137		0.0426		**-0.0350**	*
	(0.3335)		(0.0421)		(0.0585)		(0.0213)	
West	**2.5153**	***	0.0374		**0.2325**	***	0.0030	
	(0.3596)		(0.0530)		(0.0716)		(0.0269)	
Year	-0.0274		0.0033		-0.0014		**-0.0075**	**
	(0.0495)		(0.0061)		(0.0084)		(0.0030)	
Female O			**1.6555**	***	**2.9163**	***		
			(0.1839)		(0.1939)			
Gender Unknown O			**2.7451**	**	**3.3260**	***		
			(1.1348)		(1.0469)			
African-American O			**2.2843**	***	**1.3180**	***		
			(0.1838)		(0.1550)			
AI/AN O			**1.3056**	***	0.0835			
			(0.1078)		(0.0629)			
Other O			0.1622		**0.3122**	**		
			(0.1383)		(0.1416)			
< 20 years old O			**0.9880**	***	0.0351			
			(0.1962)		(0.1893)			
61 years or older O			**10.2314**	***	**7.3440**	***		
			(0.7899)		(0.9738)			
Age Unknown O			1.7276		**-1.9676**	**		
			(1.2435)		(0.8669)			
Male D			8.4749					
			(13.4767)					
Female D			6.0645				**2.7363**	***
			(13.5101)				(0.0840)	
Gender Unknown D			1.6279				-1.3483	
			(14.0550)				(1.2591)	
White-American D			2.3553					
			(11.5329)					
African-American D			0.6021				**0.5122**	***
			(11.5427)				(0.0443)	
AI/AN D			0.3283				-0.0160	
			(11.5447)				(0.0414)	
Other D			3.1620				**0.1807**	**
			(11.5138)				(0.0886)	
< 20 years old D			-9.2809				**0.6883**	***
			(7.6361)				(0.0789)	
21 to 60 years D			-8.9364					
			(7.6251)					
61 years or older D			**-17.9850**	**			**10.2554**	***
			(7.6605)				(1.5439)	
Age Unknown D			-10.9675				-0.2361	
			(7.8138)				(0.3724)	
Adjusted R^2	0.2163		0.9912		0.9584		0.9839	
N	396		396		396		396	

Source: The Tax Foundation supplemented with the Census Bureau's Economic Census and National Institute on Alcohol Abuse and Alcoholism (NIAAA). All data span from 2000 to 2007.

Notes: 1. The OLS regression coefficients are provided with standard error shown in parentheses.
2. The symbols (***), (**), and (*) represent statistical significance at p<.01, p<.05, and p<.1 respectively.
3. AI/AN stands for American Indian/Alaska Native.

Appendix A. Variable Definitions

	Variable	Definition
Total Alcohol Admissions	tot_aladmp	total number of alcohol abuse treatment admissions recorded by state-funded facilities within the span of the study
Alcohol Only (O) Admissions	o_admp	total number of alcohol only treatment admissions recorded by state-funded facilities within the span of the study
Alcohol with Secondary Drug (D) Admissions	d_admp	total number of alcohol coupled with drug abuse admissions recorded by state-funded facilities within the span of the study
Beer Excise Tax	t_beer	state levied tax on the distribution of malt/beer alcoholic beverages in license states
Wine Excise Tax	t_wfix	state levied tax on the distribution of table wine beverages in license states
Spirits Excise Tax	t_spfix	state levied tax on the distribution of spirit alcoholic beverages in license states
Wine Control State Indicator	t_wmiss	indicates when a state is a control state for wine distribution; no excise tax on wine beverages
Spirit Control State Indicator	t_spmiss	indicates when a state is a control state for spirits distribution; no excise tax on spirit beverages
Beer Consumption	realbeer	gallons of beer ethanol consumed amongst a specific state population per 1000 of state residents
Wine Consumption	realwine	gallons of wine ethanol consumed amongst a specific state population per 1000 of state residents
Spirit Consumption	realspirits	gallons of spirit ethanol consumed amongst a specific state population per 1000 of state residents
Male Admissions (O)	o_malep	male O admissions within the state population per 1000 of state residents; reference variable for full and partial O admissions models
Male Admissions (D)	d_malep	male D admissions within the state population per 1000 of state residents; reference variable for partial D admissions model
Female Admissions (O)	o_femalep	female O admissions within the state population per 1000 of state residents
Female Admissions (D)	d_femalep	female D admissions within the state population per 1000 of state residents
Gender Unknown Admissions (O)	o_genderup	gender unknown O admissions within the state population per 1000 of state populace
Gender Unknown Admissions (D)	d_genderup	gender unknown D admissions within the state population per 1000 of state populace
White Admissions (O)	o_whitep	White-American O admissions within the state population per 1000 of state residents; reference variable for full and partial O admissions models
White Admissions (D)	d_whitep	White-American D admissions within the state population per 1000 of state residents; reference variable for partial D admissions model
Black Admissions (O)	o_blackp	African-American O admissions within the state population per 1000 of state residents
Black Admissions (D)	d_blackp	African-American D admissions within the state population per 1000 of state residents
American Indian/Alaska Native Admissions (O)	o_AIANp	American Indian/Alaskan Native O admissions within the state population per 1000 of state residents
American Indian/Alaska Native Admissions (D)	d_AIANp	American Indian/Alaskan Native D admissions within the state population per 1000 of state residents
Other Race Admissions (O)	o_otherp	Other non-specified race O admissions within the state population per 1000 of state residents
Other Race Admissions (D)	d_otherp	Other non-specified race D admissions within the state population per 1000 of state residents
Admissions 20 years old or younger (O)	o_underp	underage drinker O admissions below the age of 21 within the state population per 1000 of state populace
Admissions 20 years old or younger (D)	d_underp	underage drinker D admissions below the age of 21 within the state population per 1000 of state populace
Admissions 21 to 60 years old (O)	o_adultp	adult O admissions between the age of 21 and 60 within the state population per 1000 of state populace; reference variable for full and partial O admissions models
Admissions 21 to 60 years old (D)	d_adultp	adult D admissions between the age of 21 and 60 within the state population per 1000 of state populace; reference variable for partial D admissions model
Admissions 60 years old or older (O)	o_post60p	post-middle age O admissions above the age of 60 within the state population per 1000 of state populace
Admissions 60 years old or older (D)	d_post60p	post-middle age D admissions above the age of 60 within the state population per 1000 of state populace
Admissions with Age Unknown (O)	o_ageup	age unknown O admissions within the state population per 1000 of state populace
Admissions with Age Unknown (D)	d_ageup	age unknown D admissions within the state population per 1000 of state populace
North United States	reg4_1	regional division which includes states with the FIPS codes 9=CT, 23=ME, 25=MA, 33=NH, 34=NJ, 36=NY, 42=PA, 44=RI and 50=VT
South United States	reg4_2	regional division which includes states with the FIPS codes 1=AL, 5=AR, 10=DE, 11=DC, 12=FL, 13=GA, 21=KY, 22=LA, 24=MD, 28=MS, 37=NC, 40=OK, 45=SC, 47=TN, 48=TX, 51=VA and 54=WV
Central United States	reg4_3	regional division which includes states with the FIPS codes 17=IL, 18=IN, 19=IA, 20=KS, 26=MI, 27=MN, 29=MO, 31=NE, 38=ND, 39=OH, 46=SD and 55=WI
West United States	reg4_4	regional division which includes states with the FIPS codes 2=AK, 4=AZ, 6=CA, 8=CO, 15=HI, 16=ID, 30=MT, 32=NV, 35=NM, 41=OR, 49=UT, 53=WA and 56=WY
Year	year	time variable accounting for the span of the data from 2000 to 2007