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Is Beer Healthier than Booze? How the Change in Consumption Shares of Alcoholic Beverage Types Affects Mortality in Young People

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I. Introduction

"There is no doubt that beer is much less injurious to health than are spirituous liquors. Nor is there any doubt that the great change in the habits of the people in this country from consumption of spirits to malt liquors has been promotive of temperance…People who drink moderately of good beer are not likely to become drunkards or to injure their health."[1] So ran an editorial responding to strong claims by Mr. G. Thomann, chief statistician of the American Brewers' Association, of the health benefits of drinking beer versus drinking other forms of alcoholic beverages, namely spirits. The year of publication was 1887, but the same perception seems to hold today: that beer is a relatively low potency drink made from wholesome products like barley and hops, while spirits are a high-potency drink distilled from grain with little or no nutritional benefit. Wine, of course, also enjoys a salubrious aura, thanks to its association with scenic vineyards and the purported benefits of its antioxidants and resveratrol, a component of red wine.

From the standpoint of beverages as alcohol delivery system, however, it scarcely matters which beverage is consumed; a standard drink of any of the three—a twelve ounce beer, a 5 ounce glass of wine, or a one and one-half ounce "shot" of spirits—all contain the same amount of alcohol. What may matter are factors such as context, as in why people drink and the social environment in which drinking takes place; the effect of the beverage on appetite (beer being a filling beverage; wine being enjoyed often with food); or price, with wine and spirits (normally) associated with a wider range of prices, especially on an alcohol-equivalent basis.

It is clear that alcohol consumption (of any type) has health benefits and health costs, though from a public policy perspective the focus is usually on the costs, and mainly because the costs are not exclusively private. Excessive alcohol consumption results in traffic fatalities, increased crime and domestic violence, homelessness, and burdens on public health systems. The focus of this paper is on the social costs of excessive alcohol consumption, with particular

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[1] "Exaggerated Assertions of Prohibitionists," editorial in the *Philadelphia Record (Dem)*, as compiled by *Public Opinion* (May-Oct, 1887).

emphasis on how shifting shares of alcohol consumption across beverage types may or may not affect negative outcomes for young people below the legal drinking age.

Consumption patterns over the last forty years show that per capita beer consumption in the US peaked in 1981, fell throughout the 1980s & 1990s, then leveled out at about 1.2 gallons of ethanol equivalent per capita in 2009.[2] As a share of total consumption, however, because consumption of all alcoholic beverages was falling on a per capita basis during much of the period, beer gained share until 1994, at 57.3 percent of all alcoholic beverages consumed, before falling to its 2009 share of 51.1 percent. Wine and spirits have both gained in recent years, with wine making steady gains throughout the period, and spirits making a comeback from a low of 29 percent in 1998 to its 2009 share of 32.3 percent. Perhaps not coincidentally, the gain in spirits share has come during a period when the voluntary ban on television spirits advertising fell by the wayside.[3] The ban itself was evidence of the public's perception of spirits as a potentially more dangerous product, as wine and especially beer have been long time staples of television advertising.

Patterns of consumption among young people are following the national trends. Beginning around 2000, surveys from Monitoring the Future (2011) report more young people consuming spirits than beer during the past thirty days, and more young people binging (i.e., 5 or more drinks at a setting) on spirits.

What is interesting, moreover, is the variation in shares of beverage types across states of the US. For the two largest states, California and Texas, beer accounts for 46 percent of all alcohol in the former (and wine has a 24 share), while accounting for 62 percent in the latter. Drinkers in Colorado get 37 percent of their alcohol from spirits; people in Idaho in 25 percent. And so on. In addition to having differences in the levels, changes in the share patterns have also varied across states, with some states maintaining relative constant shares, and others experiencing sizable shifts.[4]

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[2] Sources: National Institute on Alcohol Abuse and Alcoholism, "Per capita ethanol consumption for states, census regions, and the United States, 1970-2007", at http://www.niaaa.nih.gov/Resources/DatabaseResources/QuickFacts/AlcoholSales/Documents/consum03.txt, and the Brewers Institute, "Brewers' Almanac, 2010" at http://www.beerinstitute.org/statistics.asp?bid=200.

[3] In 1996 Seagram aired an ad for Crown Royal Canadian Whiskey on KRIS-TV, an ABC affiliate in Corpus Christi, Texas, breaking a long-standing, voluntary industry ban on broadcast liquor ads. The ban had been in effect for 60 years on radio (since 1936) and 48 years (since 1948) on television. Source: Alcohol Policies Project, Center for Science in the Public Interest, retrieved at http://www.cspinet.org/booze/liquor_chronology.htm.

[4] Some of the cross-state variation is due to cross-border sales to take advantage of lower taxes, less restrictive point of sale laws, internet sales, etc.

The plan of the paper is to use cross-state and cross-regional variation in both levels and growth rates of the shares of alcohol beverage types to ascertain the effect, if any of this variation on health outcomes related to excessive alcohol consumption, with particular focus on beer versus other types of beverages, and even more particularly on beer versus spirits. Health outcomes to be modeled include traffic fatalities and suicides for ages 15-19.[5]

One public policy question that this research hopes to address is the rationale for differential treatment of alcohol beverage types with respect to advertising, distribution requirements, wholesale price maintenance, and selling hours. The legal maxim "Absence of evidence is not evidence of absence" clearly applies here, but any evidence that can be adduced from the data can be useful in designing a more efficient system of alcohol beverage control.

The plan of the paper is as follows. In Section II, some evidence is presented on the "switch to spirits," along with a brief review of the literature on the effects of the switch. Section III describes the data and the proposed empirical tests. Section IV provides the results, and Section V contains some discussion and the conclusions.

II. Background and Previous Research

There are two noteworthy trends in the consumption of alcoholic beverages in young people, as least as recorded in self-reported surveys from Monitoring the Future (2010), an ongoing study of the behaviors, attitudes, and values of American secondary school students, college students, and young adults. Each year, a total of approximately 50,000 8th, 10th and 12th grade students are surveyed (12th graders since 1975, and 8th and 10th graders since 1991).[6] Because 12th graders are usually of driving age, our focus is on their responses to questions on alcohol use.

Two questions of special interest for the purposes of this paper deal with any use of alcohol during the past 30 days, and any "binge" drinking during the past 30 days. Figure 1 presents responses by census region for the any use question from 1979 to 2010.[7]

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[5] Some outcomes are self-reported and therefore subject to error or bias. These particular outcomes (with the possible exception of suicide, which may be subject to a different type of underreporting bias) are considered to be less subject to manipulation.

[6] For further details on the surveys, see the Monitoring the Future website (http://monitoringthefuture.org/).

[7] The four Census regions of the United States represent groups of States as follows: 1) Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; 2)Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota,

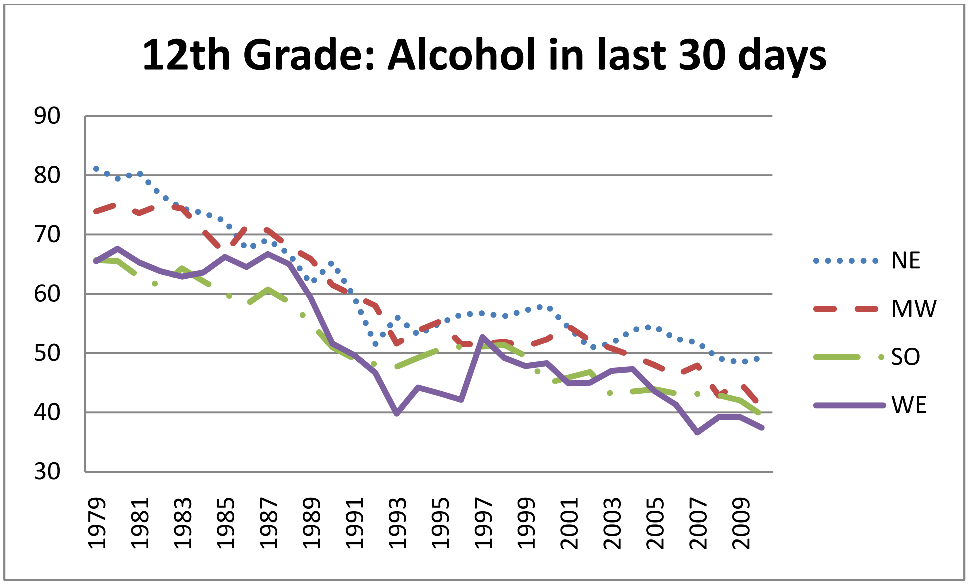

Figure 1. Self-reported alcohol use (any beverage, any amount) by percent of 12th graders, last 30 days.

As is evident from the figure, alcohol use has declined among this age group, especially during the first half or so of the period. In the later years, the decline has continued, but at a slower pace. The earlier years were marked by increases in the Minimum Legal Drinking Age (MLDA) in many states (all were at 21 by 1988) and a widespread campaign against underage drinking by Mothers Against Drunk Driving (MADD), the insurance industry, and state and local governments. Though not shown, trends for binge drinking during the past 30 days have followed similar patterns.

Over the same period, however, the type of alcohol consumed by young people has changed, with spirits first falling out of fashion in the early years, then increasingly popular throughout the 1990s and 2000s and approaching parity today, as shown in Figure 2.

Wisconsin: 3) South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia; 4)West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

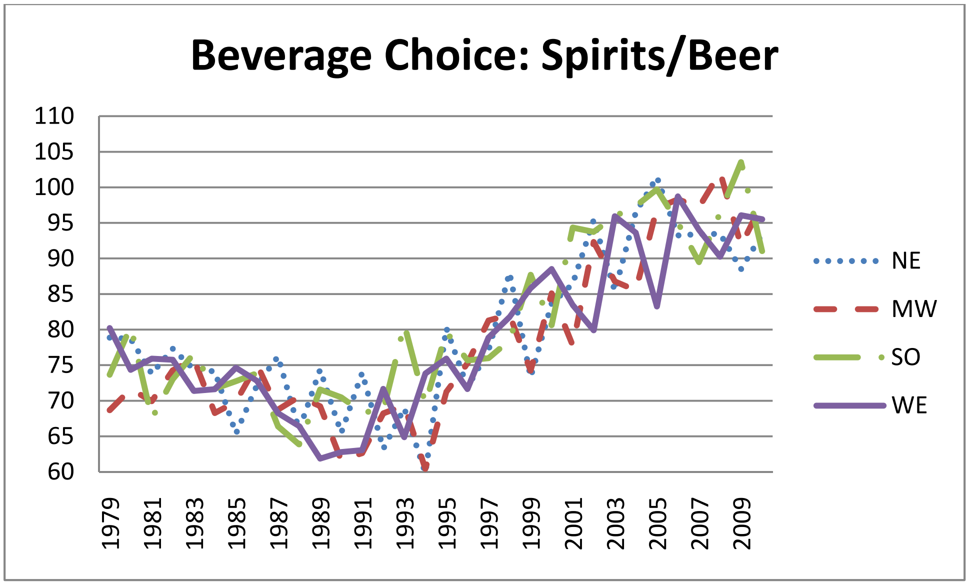

Figure 2. Self-reported alcohol use by 12th graders in the last 30 days, percent reporting use of spirits divided by percent reporting use of beer.

In fact, the percentage of high school seniors drinking spirits has remained more or less constant over the past 15 years, even as the use of beer and wine has steadily fallen. Reasons adduced for the increased preference of spirits over other forms of alcohol include ease of concealment, higher alcohol content, and more palatable taste when mixed with soft drinks (ABC News, 2007). These factors have always been present, however, so it is not clear that they are behind the increasing trend in relative use of spirits. Perhaps more compelling are explanations that include the relaxation of the self-imposed ban on TV advertising and the introduction of a wide variety of flavored alcoholic beverages aimed at the youth market (though for a contrary view on the role of advertising, see Nelson, 2001).

Trends in underage drinking are important because of the potential social costs involved. One study calculates the costs of underage drinking to be $68 million in 2007, mostly attributable to youth violence, including traffic fatalities, suicide, homicide, and aggravated assault, but also including fetal alcohol syndrome and high-risk sexual behavior (Pacific Institute, 2011), so the downward trend in alcohol use is good news.

The question remains, however, as to whether what young people drink has a bearing on total costs. Here there is not a great deal of research, but there are some recent papers that address this issue. Maldonado-Molina, et al. (2010) tested the effect of beverage type at age 13 on drinking behaviors at age 14 and found that use of spirits was associated with increased drunkenness and subsequent alcohol use. The study was limited by its small sample, the age of its participants (under driving age, and therefore not predictive of driving outcomes), and its focus on urban youth. Still, as a study of early habit formation, it may shed light on how easier availability of spirits may lead to explain drinking behaviors later in adolescence. Siegel, et al. (2011) found that riskier patterns of drinking and other negative behaviors were found among users of spirits and beer versus users of wine beverages, but as wine prevalence is already relatively low (20% or less among 12th graders), it would be most unlikely for wine to account for a significant share of the social costs attributable to underage drinking. Siegel, et al. did however note that among the sample of public school students in eight states, spirits was the strong preference (44%) as the beverage of choice, followed by beer (19%) and malt beverages (17%), with wine or wine coolers trailing at 7%. If these preferences are indicative of the nation as a whole, it suggests that what adolescents actually drink, with self-reported consumption about equally split between beer and spirits, is different from what they would prefer to drink. Presumably, adolescent choice is constrained by beverage availability.

As a matter of chemistry and physiology, it matters not to the body what type of beverage is consumed: alcohol is alcohol, and one standard drink of any beverage contains roughly the same amount of ethanol.[8] However, it may well be that if taste is secondary to effect, the choice of spirits may reflect its advantages of convenience and palatability (when mixed with masking substances like soft drinks, juice, etc.). If this is the case, then spirits is a more "efficient" form of alcohol delivery, and thus its results will come at a lower cost to the user. Given the presumption that underage drinking imposes social costs, this only exacerbates the public policy problem by widening the wedge between private and social costs.

The following section describes the data and lays out the empirical approach to testing the hypothesis that the choice of beverage matters to the social costs of underage drinking.

III. Data and Empirical Approach

For the empiricist, alcohol conveys the enormous advantage of being taxed at both the federal and state level, and therefore alcohol sales data are followed quite closely by government

[8] That is, a 12-ounce beer, a 5-ounce glass of wine, and a 1.5 ounce drink of 80-proof spirits have about 0.6 ounce of ethyl alcohol.

agencies. Annual data for apparent consumption at the state level is readily available by major type of beverage: spirits, beer, and wine.[9] These data are compiled by the National Institute for Alcohol Abuse and Alcoholism (NIAAA), and published on their website (LaVallee, R.A. and Yi, H., 2010). Supplemental data on annual consumption is also available from the Brewers Almanac (Beer Institute, 2011), a trade publication.

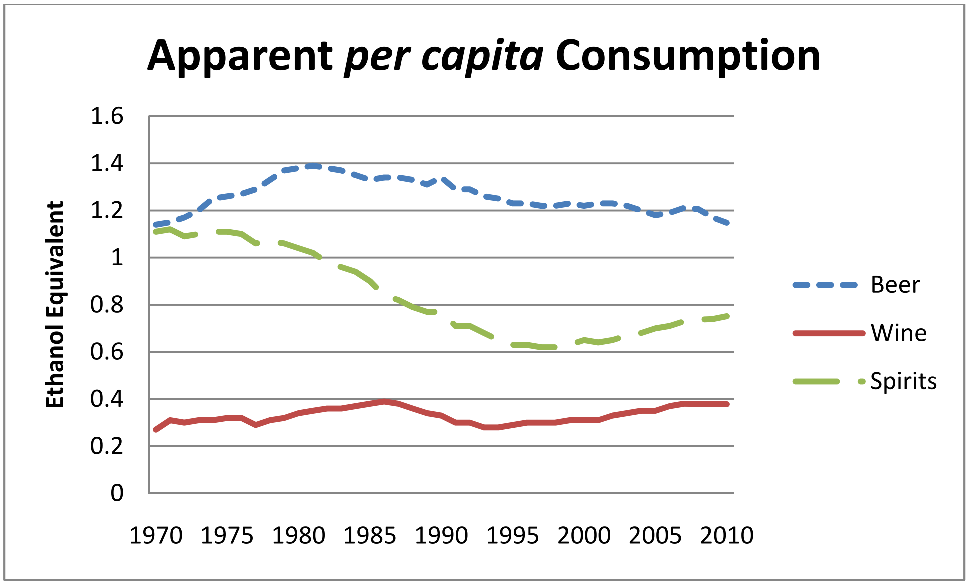

Figure 3. Annual *per capita* consumption of alcoholic beverages in the U.S., in gallons of ethanol equivalent.

As shown in Figure 3, trends in the amount and type of alcohol consumed reflect changing tastes and mores of the American drinking public. Beer consumption peaked in 1981, declined to a steady plateau in 1995, and then resumed a slower decline through 2010. Spirits consumption declined from the beginning of the sample until 1998, then began to rise to level in 2010 not seen since 1990. Wine consumption peaked in the mid-1980s with the wine-cooler phenomenon, troughed in 1994, and then began to increase before leveling off starting in 2006. Demographics undoubtedly plays a role in the evolution of consumption behavior; the percent of the population ages 20-35 peaked in 1981 and has declined steadily since. The effect of the age distribution on beer consumption has been documented elsewhere; see Freeman (2011).

[9] "Apparent" consumption because cross-border sales to arbitrage tax differentials or to evade local restrictions on sales of alcoholic beverages are not captured. Because we are focused more on changes over time than absolute differentials across jurisdictions, these sales are of minor consequence.

Consumption data for underage drinking, on the other hand, is not so easily documented. Here the only data available are self-reported surveys, with all the attendant issues of under-reporting, self-serving bias, and misrepresentation. Still, these data can be useful in measuring trends, so long as the reporting issues stay more or less constant over time. One of the longer running surveys of teen alcohol use is Monitoring The Future (MTF) which has asked questions regarding alcohol since 1975, and is the source of the data presented in Figures 1 & 2.

MTF asks twelfth graders several questions regarding alcohol and other substance use; we focus on two: use of alcohol in the last 30 days and consumption of 5 or more drinks on a single occasion within the last two weeks, often characterized as "binge drinking". Each question is asked regarding use of alcohol generally and use of specific beverage types as well. The idea is to capture both recent use and heavy use of alcohol and specific beverages to measure their effects on outcomes. Responses are reported by Census region (not every state is represented in MTF), which has the effect of enlarging the sample and accounting for heterogeneity across regions by using region-specific indicator variables.

Our approach is to regress negative outcomes for young people – traffic fatalities and suicides[10] – on alcohol use and other control variables, both at the state and the regional levels. NIAAA data on alcohol consumption and beverage choice will be used for the state-level regressions under the assumption that teen use mirrors use for the general population. Use of state-level data has the advantage of a larger sample and better controls for heterogeneity. Monitoring the Future data will be used for the region-level analysis.

The basic model for estimation can be expressed as:

$$y_{it} = \boldsymbol{\alpha}_i' \boldsymbol{d}_t + \beta_{\boldsymbol{i}}' x_{\boldsymbol{it}} + e_{it}, \qquad \textbf{(1.0)}$$

where y_{it} is a negative outcome for region or state i at time t; $\boldsymbol{d_t}$ is a vector of observed deterministic effects; $\boldsymbol{x_{it}}$ is a $k \times 1$ vector of regressors, including alcohol use; and the errors, e_{it}, have the multifactor structure

[10] Fatality rates for motor vehicle accidents and suicides are taken from the Center for Disease Control (CDC) compressed mortality files at http://wonder.cdc.gov/mortsql.html.

$$e_{it} = \gamma_i' f_t + \epsilon_{it}, \qquad \textbf{(2.0)}$$

with $\boldsymbol{f_t}$ a vector of unobserved common factors, and ε_{it} an idiosyncratic error term uncorrelated with $\boldsymbol{f_t}$ or $\boldsymbol{x_{it}}$. We note that $\boldsymbol{d}_t$ = 1 and $\boldsymbol{f}_t$ =1, $\gamma_i = \gamma$ and $\beta i = \beta$ is the traditional two-way fixed effects model.

The structure encompassed by system (1.0) and (2.0) provides significant flexibility in dealing with unit and time specific effects, as well as controlling for cross-correlation in the error matrix. The following section reports results using various assumptions regarding the error structure (2.0).

IV. Empirical Results

The empirical results are grouped according to the dependent variable, the negative outcome being measured.

A. Traffic Fatalities

1. Monitoring the Future and Regional Data

Figure 4 shows traffic fatality rates per 100,000 population for both 15-19 year olds and for the rest of the population in the four census regions. Both have been falling over time as a result of advances in automotive engineering, traffic safety, and legal sanctions and social opprobrium against drunk driving, though rates for the younger population remain higher. Fatality rates for young drivers have fallen faster than those of the general population, in part due to programs aimed specifically at this group, including stricter standards for alcohol consumption and lengthier probation prior to unrestricted driver's licensing.

[Figure 4 about here]

Alcohol is a significant problem for young drivers; about 2,000 fatalities per year involve an underage drinking driver. In our initial set of regression estimates, we use the self-reported drinking measures from Monitoring the Future to control for young driver alcohol use. We also use fatality rates for non-15-19 year olds to control for the aforementioned improvements in engineering and safety, the regional unemployment rate to control for young people's greater sensitivity to macroeconomic conditions, and the percentage of 15-19 year olds in the population to control for the greater risk associated with a larger population of young drivers (and the increased opportunity for socialization). Also included are laws specifically aimed at young drivers, the zero-tolerance measure that makes any measurable alcohol a driving offense; and the graduated driver's license that increases the probationary time and the requirements for unrestricted licensing. The zero tolerance variable is expressed as the percentage of states in the region that have the law on the books during a year; the graduated driver's license variable is the average regional across states that can have a value of 0 to 3, depending on how many stages of graduated licensing are in effect. The stages are those set forth by the Insurance Institute for Highway Safety (IIHS), as set forth in NHTSA (2008).

The results of the regression of 15-19 year old fatality rates are displayed in Table 1. Each regression comprises the pooled regions, with fixed effects (regional "dummies") to control for region-specific effects. The exception is the last column, which uses the 20-24 year old fatality rate as a robustness check.

[Table 1 about here]

The signs of most of the variables in most of the regressions are what we would expect *a priori*. The 15-19 year old rate tracks the rest of the population quite closely, and without the influence of the other variables in the model, would be about twice the national rate. The unemployment rate is negatively signed, though statistically significant in only one case, indicating that higher unemployment, controlling for the general trend decline in traffic deaths, results in lower fatalities. This finding is consistent with the recent literature on "recessions are good for your health", exemplified by Ruhm (2000).

The laws specific to young people also have the expected signs, and both have sizable effects, with each provision lowering the fatality rate by about 2 fatalities per 100,000 in mots specifications. Cohort size also matters, with each percentage point larger cohort of young people raising the risk of fatalities by about 2 per million population. Finally, alcohol matters, but the type of alcohol consumed does not. Whether the response is for any alcohol, for spirits, or for beer, binge drinking has about the same effect on the fatality rate in all cases. And when the proportion of those responding "yes" to the question on binge drinking with spirits versus beer is included, that coefficient is insignificant and the other coefficients are unchanged.

As a check on the validity of the results, we first add the lagged dependent variable to test for persistence. We find that the coefficient of the lagged fatality rate is not significant, nor do the coefficients of the other variables change in a measurable way. Secondly, we estimate a similar model using the fatality rates for 20-24 year olds. If the results for the 15-19 year olds are simply a result of common trends, we should see similar results for the older group. In fact, the results for the older group tend to confirm the validity of the estimates for the younger group. The coefficients for the alcohol use variable and for unemployment are smaller and insignificant, and the non-20-24 fatality rate is larger. The coefficient for the graduated driver's license variable is significant and of the opposite sign, confirming the "shifting" effect of postponed driving noted in previous research (Kiraca-Mandic& Ridgeway, 2010). The zero tolerance law is still negative and significant, suggesting that the presence of this law signals enhanced enforcement of all alcohol-related traffic laws.

2. NIAAA and State-level Data

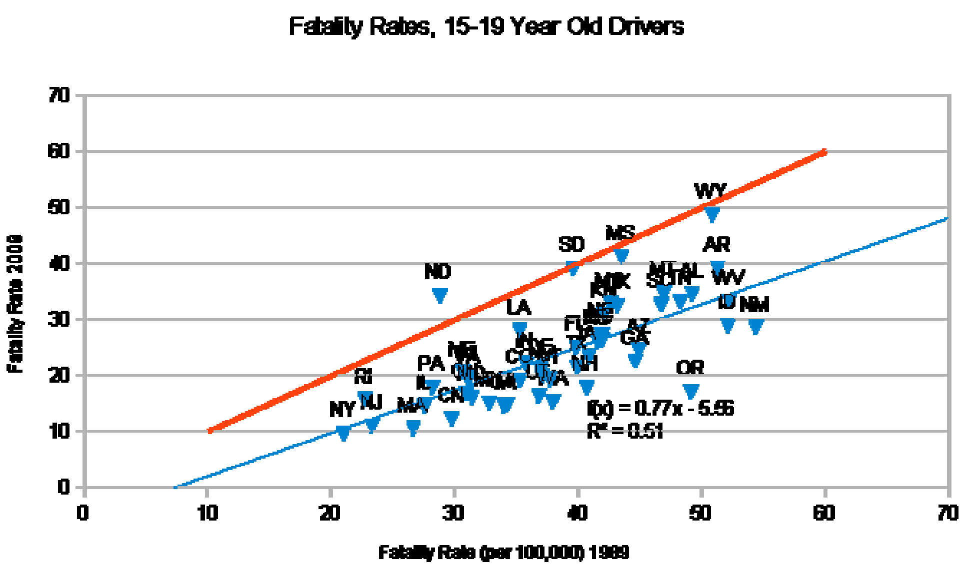

Figure 4. Persistence of Fatality Rates at the state level (upper line is 45 degree, lower line is fitted regression).

Using state level data offers more detail and a larger sample size for estimation, but the consequence is the greater heterogeneity across states. As shown is figure 4, state-level fatality rates tend to be persistent across a broad range. With the exception of North Dakota, fatality rates in all states have improved over the past twenty years, and there has been some "regression to the mean," as the slope of the 2009 rate regressed on the 1989 rate is less than one. Still, a good predictor of how a state's fatality rates in 2009 rank nationally is that state's ranking in 1989, with the implication that fixed effects will be essential in pooled estimation.

The states also differ greatly in headcount, and because the 15-19 year old population is a small fraction (around six percent) of any state population, year-to-year fatality rates can vary greatly, especially in smaller states. For this reason, and to mitigate the possibility of autocorrelation in the data, we use five-year averages of fatality rates in state-level regressions.[11] With thirty years of data grouped into six half-decades and 48 states (Alaska, Hawaii and the District of Columbia are excluded, as they are in most of the literature on fatalities) the sample size is still 288 state-half-decades, so there are ample degrees of freedom for fixed effects, etc.

Table 2 reports the results of these state-level regressions in the same format as the regional regressions above. All variables are the same with the important exceptions of the alcohol variables. The estimations in Table 2 use apparent consumption data for the state population as reported by the NIAAA. The two variables included in the models are the total consumption of ethanol, whether beer, wine, or spirits; and the share of beer in total consumption. The (strong) assumption being made is that consumption habits of young people mirror those of the rest of the population.

[Table 2 about here]

Model (1) in the first column of Table 2 reports results using time-varying regressors with no fixed effects and the unemployment rate as the cyclical indicator. Controlling for movements in overall fatality rate, the fatality rate for 15-19 year olds is procyclical, and the coefficients for the alcohol control laws are large and significant. Total alcohol consumption does not affect fatalities, but an increase in the share of beer in total consumption adds to the fatality rate.

[11] The same regressions were run with annual data, with very similar results in coefficient sign and magnitude, but with less precision and more autocorrelation in the residuals. These results are available on request.

Model (2) is very similar to Model (1), with the exception that the employment/population ratio is used as the cyclical indicator. The employment population ratio may better capture the level of economic activity as a measure of the proportion of the population directly engaged in the economy. As seen in the results, the level of significance is higher for this variable, and the R^2 is marginally improved. Results for the other variables are mostly the same.

Model (3) introduces state fixed effects to the model. As suggested by Figure 4, the state fixed effects have a dramatic effect on the results. Only the overall fatality rate and the zero tolerance variables have a significant effect, while the goodness of fit is improved. Neither of the alcohol variables now has any bearing on the results.

Adding year fixed effects in Model (4) further dilutes the results of the time-varying regressors. Only the overall fatality rate has an expected sign and a significant effect, with a smaller *t*-statistic than in the other models. The R^2 is again improved, and the Durbin Watson indicates that autocorrelation is not an issue. Admittedly, the use of overall alcohol consumption may not be a suitable proxy for alcohol abuse by younger population, but these results suggest that fatality rates in young people are not much influenced either by the measures of alcohol herein employed, or by control laws specific to this age group.

3. Looking at the long-term change in fatalities

Given that the state fixed effects model provides very little confirmation of any of the proposed regressors on traffic fatalities (perhaps because the regressors themselves have limited time variation), we take a longer view of the change in youth traffic fatalities at the state level in order to exploit the cumulative variation over time. Essentially the model becomes a cross-section of long-term changes in fatalities expressed as:

$$\Delta_{20} lfat_{i,2009} = \alpha + \beta lfat_{i,1989} + \boldsymbol{X_i \gamma} + \Delta_{20} \boldsymbol{Z_i \delta} + \epsilon_i. \qquad (\mathbf{3.0})$$

The "Δ_{20}" denotes "twenty year change in" a variable, "*lfat*" is the natural logarithm of the 15-19 fatality rate, $\boldsymbol{X}$ is a vector of initial conditions, and $\boldsymbol{Z}$ is a vector of laws, alcohol consumption, etc. If β is negative, then so-called "β convergence" is said to characterize fatality rates: states with higher fatalities initially will have larger declines in subsequent years.[12] To measure the effect of traffic laws, we adopt the convention of summing the number of years that the laws have been in place in the states over the twenty-year period. Thus the coefficient of a traffic law can be interpreted as the percent change in fatalities in this age group due to an additional year of the law being in effect.

The analysis begins in 1989 to obviate the effects of the increase in the Minimum Legal Drinking Age (MLDA), which took place in the various states at different times during the mid-1980s. The early 1980s also marked the initial big push by groups like Mothers Against Drunk Driving (MADD) and the Insurance Institute for Highway Safety (IIHS) to raise the awareness of the problem of drunk driving. These changes in social pressures and societal attitudes are not easy to capture in regression estimates, but undoubtedly had real effects on patterns of traffic fatalities.[13]

[Table 3 about here]

Table 3 presents the results of the analysis of growth rates in state 15-19 year old fatalities. Column 1 presents the results of a "pure" convergence test, using only the fatality rate at the 1989 origin as a regressor. The positive and insignificant coefficient suggests no convergence in rates across states, a not surprising result considering Figure 4, above. In column 2 we add the logarithm of state median household income in 1989 as a regressor. Income controls for the resources available in the state for upgrading roads, the capability to provide adequate enforcement, willingness to sponsor educational messages, and in general to support efforts to reduce traffic fatalities for young and old. The evidence is quite strong that initial income explains much of the progress in reducing traffic fatalities over the subsequent two decades; the coefficient indicates that a one percent increase in state median income will reduce traffic deaths by 1.25 percent. Initial income alone explains about 40% of the variation in the growth of fatalities across states.

We also note that fatality rates converge when income is held constant. Thus it may well be that efforts to reduce fatality rates would have resulted in more similar rates across states, if

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[12] Of course, a negative β will also result from simple regression to the mean, as pointed out by Friedman (   ) in the context of convergence in economic growth. A finding of a non-negative β, on the other hand, is a strong indicator of persistence.

[13] Prior to these efforts, alcoholic characters (the title character in the movie "Arthur", the singer Dean Martin) were often portrayed as lovable or funny; having "one for the road" was encouraged! In addition, enforcement of alcohol control laws was uneven.

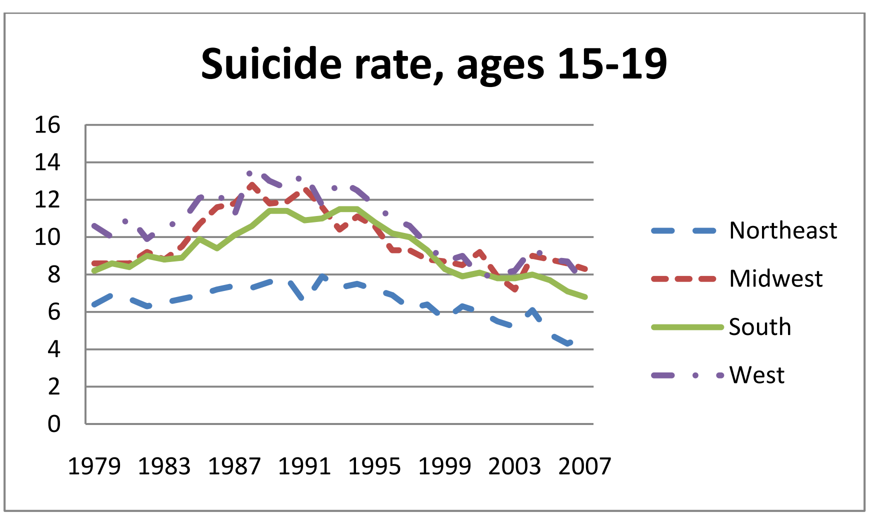
resource availability had been the same. Alcohol consumption and traffic control laws are added to column 3. Increases in total alcohol consumption over the sample period are associated with increases in traffic fatalities. Changing the composition of that consumption, however, as shown by the share of beer in the total, appears to have had no effect. Of the control laws, only the graduated driver's license program explains a significant share of the variation in growth rates of fatalities. Of interest is the reduction in the effect of initial income; higher incomes are associated with reductions in the growth of total alcohol consumption.

In column 4, beer consumption per capita is substituted for total alcohol consumption. Beer alone has no apparent effect on the growth in fatalities. When spirits alone is used, however, in column 5, the coefficient is significant, suggesting that the variation in total consumption driven by spirits underlies the relationship between alcohol and the growth in fatalities. The significance of the relationship notwithstanding, the evidence that the switch to spirits over time is associated with increased fatality rates is slim.

In column 6, the analysis is repeated for the 15-year interval from 1994-2009 as a robustness check (a similar analysis was conducted for the 15-year interval 1989-2004 with similar results). The results are quite similar to the twenty-year analysis. As expected, the coefficients of the initial conditions are smaller (as the magnitude of the dependent variable is less, covering fewer years) and the fit is not as good, but all of the major conclusions remain.

B. Suicides

Figure 5 displays suicide rates per 100,000 populations for the four census regions of the U.S.



As shown in the figure, rates peaked in the early 1990s, coinciding with the peak in the crack cocaine epidemic and the associated peak in the homicide rate for this age group (until the late 1980s, the homicide and suicide rates for this group were roughly similar. From the late 1980s until the mid-1990s, homicide rates nearly doubled before settling back down to historical rates. Suicide rates also increased, but at a much slower pace). Suicide rates are lower in the Northeast, and had been somewhat lower in the South due to lower rates among black youth, but black rates (especially among males) are much closer to white rates in recent years.

Our approach to the estimates of alcohol choice on suicide rates parallels that on traffic fatality rates.

1. Monitoring the Future and Regional Data

Table 4 provides the results of regressing suicide rates on self-reported alcohol consumption and economic and demographic variables.

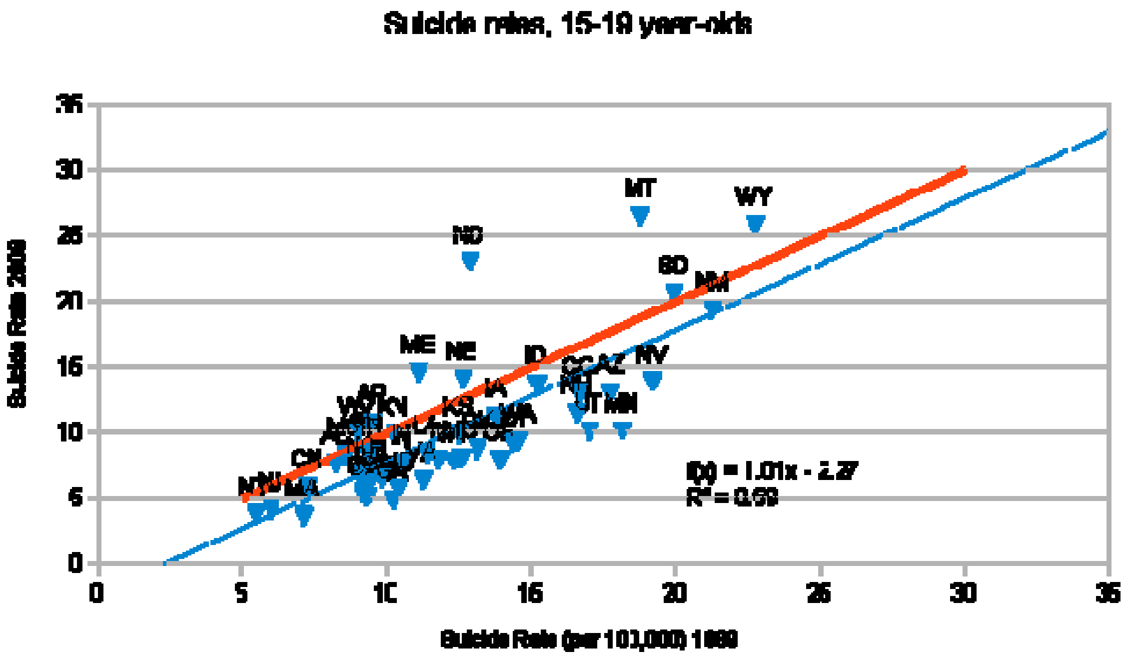
[Table 4 about here]

Columns (1) through (3) vary only in the type of alcohol reported consumed in the last 30 days: in order, total alcohol, spirits, or beer. In all three models (and indeed in all estimations) the size of the 15-19 year cohort in the population is a positive predictor of the suicide rate. This result is predicted by the "Easterlin-Hollinger" cohort effect (Easterlin, 1980 and Hollinger, 1987), whereby the added competition for resources (everything from spots in school to social services) from expanded cohorts leads to higher suicide rates. The employment/population ratio on the other hand provides inconsistent results. Ruhm (2000) and others have shown that recessions tend to be associated with lower mortality rates as the population is subject to lower stress and lower opportunity costs for health-promoting leisure activities. The positive and significant coefficients for this variable are probably an artifact of the data however, as will be shown in columns (5) and (6).

Regarding alcohol use, columns (1)-(4) appear to imply that spirits use is protective and beer use is harmful with regard to suicide risk among the young. Especially in column (4) and (5), where the coefficient of the ratio of spirit to beer use is strongly negative and significant in the presence of total alcohol use, the message seems to be that use of spirits is associated with fewer suicides. In column (6), however, when year fixed effects are added, a more plausible story emerges: the use of alcohol in any form has a small but significant effect on suicides, but the proportion of spirits to beer has no effect. The confirmation of the Easterlin-Hollinger cohort effect is about the only consistent result that we can obtain from the analysis using the MTF data.

2. Looking at the long run using state-level data

As we did with the fatality data, in this section we examine the relationship between the change in the suicide rate over time, initial conditions, and changes in alcohol consumption. Figure 5 displays the persistence of 5-year averages in state suicide rates over the period 1989-2009.



As can be seen from the figure, suicide rates for young people are even more persistent over the sample period than traffic fatalities. Suicide rates have fallen, on average, but less than was the case for traffic fatalities. The slope of the regression line suggests very little convergence among state rates over time, but his result is heavily influenced by three states, ND, MT, and WY. Without these influential outliers, the slope of the regression line would be 0.710, very similar to that for traffic fatalities.[14]

Given the paucity of the available data, the analysis will be limited to the effects of income and alcohol consumption. Many other factors obviously contribute to youth suicide,

[14] Three states, Delaware, Rhode Island, and Vermont are added to Alaska, Hawaii, and DC in being omitted from the analysis. The death counts were too low to be reported by the CDC.

including issues of family, mental illness, and societal pressures, but a fuller examination of the problem is beyond the scope of the present effort.

Table 5 provides the results of regressions of the growth in the state suicide rate for ages 15-19 on initial conditions and changes in alcohol consumption. Unlike the case of traffic fatalities, there is never any indication of convergence in suicide rates across states, even when controlling for income.[15] Initial income is a strong deciding factor in the reduction in the growth of suicide rates over the succeeding period, however, as before.

Also as before, an increase in the growth rate of alcohol consumption is positively related to the growth rate in the dependent variable, but in the present case with a more pronounced decline in the coefficient of initial income. Part of the decrease in the effect of initial income is due to its strong negative association with subsequent growth in alcohol consumption (r = 0.712), but the growth in alcohol is also more strongly related to the growth in suicide than the growth in traffic fatalities. Unusually, either spirits or beer alone is less strongly associated with suicide than total alcohol, as measured by the R^2 or by the t-statistics of the coefficients.

A robustness check in column (6) uses the 15-year change to ascertain whether the effects of income and alcohol are similar to those of the longer period. The coefficients of the variables retain their signs, but the income variable is no longer significant. When the income variable is used without the alcohol variable in column (6), however, its magnitude is much larger (-0.601), and statistically significant (t = 2.70). One interpretation is that alcohol use and suicide are driven by the same process, so that alcohol growth is correlated with the error term in the regression model. One way around this is to instrument for alcohol use, and some preliminary work using alcohol control laws and beer taxes is promising. Again, however, we are taken beyond the scope of this paper, and we are left with the conclusion (again) that higher incomes are protective against early death.

V. Conclusion

Based on the analysis of this paper, there are several “can’t rule it out” types of findings and a couple of firm conclusions.

Among the “can’t rule it out” findings are the following:

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[15] This remains true if the outlier states (DE, MT, WY) are omitted.

1. At the regional levels, higher levels of self-reported alcohol consumption are associated with higher traffic fatality rates for 15-19 year olds. Whether this reflects causality or simple correlation is still an open question. There may be other time-varying factors driving young people to all sorts of risky behavior, including alcohol abuse and risky driving. The association between total consumption and youth traffic fatalities is weaker at the state level, but the relationship is never negative. With respect to youth suicide, the region-state results are flipped: the association between alcohol consumption and suicide is stronger at the state than at the regional level.
2. In no case is there convincing evidence that the *type* of alcohol consumed makes a difference to the outcomes. If anything, contrary to the apparent beliefs of those who favor more restrictions on advertising and sales of spirits, beer consumption, whether in absolute numbers or in relation to spirits sales, is more often associated with negative outcomes than spirits consumption. The differences are quite small, however, and not consistently significant.
3. Traffic laws aimed at alcohol control and driver education appear to be important factors in reducing fatality rates. Even after controlling for fatality rates in the general population, the coefficients of graduated driver's license and zero tolerance laws are negative and significant in region and state-level regressions. When included in regressions of the growth rate of fatalities, however, the coefficients of the zero tolerance law is never significant. Grant (___) also finds that zero tolerance laws have had little to no effect on fatalities.
4. Cohort effects are relatively pronounced with respect to both fatality rates and suicides. Higher percentages of young people leads to more fatalities, perhaps as a result of collectively risky behavior, perhaps as a result of the stress of greater competition for jobs, placement in school, sports and extracurricular activities, and social services.
5. Business cycles have no consistent effect on either outcome. When significant, the unemployment rate and the employment-population ratio confirm that "recessions are good for your health" (Ruhm, 20__). Because we are not measuring teenage employment directly, however, it may be that the use of variables at the total population level is insufficiently precise to capture the effect on young people.

The firm conclusions that can be drawn from the analysis are:

1. Relative rates of youth traffic fatalities and suicides are highly persistent phenomena across states. Over fifty percent of current cross-state variation in either variable can be explained by the cross-state variation 20 years ago. Though there has been a general downward shift in the levels of both, especially with respect to traffic fatalities, there is no evidence of unconditional convergence across states in either measure. Conditional on initial state median income, however, there is evidence of convergence in traffic fatalities, but not of suicides.
2. Higher income is a protective factor against early death. A one percent difference in median state income results in a one percent decline in the growth rate of traffic fatalities and a one-half to three-quarters percent decline in the growth rate of suicides, depending on the specification. That higher incomes are associated with greater longevity has been known at least since Preston (1975), and has been confirmed in many different settings. What is striking here, however, is that Preston-type analyses are usually describing much wider discrepancies in income across countries that are much more heterogeneous than the collection of U.S. states. By contrast, U.S. states are relatively uniform in traffic legislation, alcohol control laws, public campaigns against drunk driving, and so forth, yet income differences still explain a large percentage in the variation of youth fatalities. In the present case, one can speculate that higher incomes result in newer, safer vehicles, in more attention and effort into enforcement, in better roads, in more generous provision of social services (in the case of suicide), among other factors. These are all potential avenues for further research.

Table 1. Regression of 15-19 year-old traffic fatality rates on alcohol consumption, driving laws, and economic variables. Census regions, annual data 1979-2009.

Variable	(1)	(2)	(3)	(4)	(5)	(6)[a]
Fatality rate/15-19	1.915* (16.5)	1.976* (17.9)	1.972* (17.7)	1.931* (16.3)	1.616* (8.03)	2.261*[a] (15.4)
Unemployment rate	-0.197* (1.620)	-0.152 (1.295)	-0.176 (1.452)	-0.191 (1.560)	-0.149 (1.327)	-0.078 (0.542)
Binge last 2 weeks, any alcohol	0.102* (2.416)			0.104* (2.459)		
Binge last 2 weeks, spirits		0.117* (2.383)			0.090* (1.903)	0.073 (1.387)
Binge last 2 weeks, beer			0.082* (2.160)			
Spirits/Beer proportion				0.014 (0.731)		
Zero Tolerance Law	-1.760* (1.892)	-2.281* (2.423)	-1.669* (1.777)	-1.866* (1.979)	-2.088* (2.284)	-3.555* (3.161)
Graduated Driver's License	-1.724 (1.470)	-2.691* (2.151)	-1.493 (1.268)	-2.251* (1.632)	-2.713* (2.276)	5.046* (3.741)
15-19 Percent of Population	0.237* (2.333)	0.229* (2.228)	0.246* (2.411)	0.222* (2.141)	0.236* (2.142)	0.613[a] (1.465)
Lagged Fatality Rate					0.125 (1.618)	
R^2	0.972	0.972	0.972	0.972	0.973	0.968
N	124	124	124	124	120	124

Notes to Table 1: All regressions include regional fixed effects. Asterisk signifies statistical significance at the 0.10 level or lower.

[a]Model (6) uses 20-24 year old fatality rates and associated controls.

Table 2. Regression of 15-19 year-old traffic fatality rates on alcohol consumption, driving laws, and economic variables. State-level, annual data 1980-2009.

Variable	(1)	(2)	(3)	(4)
Fatality rate/15-19	1.485* (25.8)	1.546* (25.6)	1.812* (12.3)	1.477* (9.34)
Unemployment rate	-0.284* (1.790)			
Employment/population		0.216* (3.433)	-0.167 (1.28)	0.149 (0.64)
Total Ethanol *per capita*	0.002 (0.18)	-0.029) (0.61)	-0.002 (0.16)	0.050 (0.38)
Beer share of total ethanol consumption	0.885* (1.89)	0.825* (1.79)	1.335 (1.35)	0.967 (0.86)
Zero Tolerance Law	-4.395* (5.941)	-4.588* (6.544)	-3.555* (4.533)	-0.893 (0.83)
Graduated Driver's License	-4.188* (3.134)	-3.521* (2.630)	-1.552 (1.104)	4.207* (2.113)
15-19 Percent of Population	0.237 (0.215)	0.229 (0.228)	0.246 (.411)	0.222 (.141)
Fixed Effects	None	None	State	State and Year
R^2	0.861	0.865	0.902	0.911
N	288	288	288	288

Notes to Table 2 Asterisk signifies statistical significance at the 0.10 level or lower.

Table 3. Regression of the growth in 15-19 year-old traffic fatality rates on alcohol consumption, driving laws, and economic variables. State-level, 1989-2009.

Variable	(1)	(2)	(3)	(4)	(5)	(6) (2009-1994)
Fatality rate/15-19, 1989	0.257 (1.61)	-0.318* (1.98)	-0.319* (2.21)	-0.286* (1.88)	-0.278* (1.90)	-0.162* (1.65)
Median Income, 1989		-1.250* (5.68)	-0.754* (3.19)	-0.922* (4.29)	-0.936* (4.63)	-0.686* (-3.65)
Total alcohol *per capita*			0.560* (1.90)			0.625* (2.18)
Beer *per capita*				0.734 (1.07)		
Spirits *per capita*					0.797* (1.75)	
Beer share of total ethanol consumption			0.631 (0.84)			
Zero Tolerance Law			-0.007 (0.79)	-0.009 (0.94)	-0.006 (0.73)	-0.005 (0.86)
Graduated Driver's License			-0.037* (2.52)	-0.039* (2.62)	-0.032* (2.09)	-0.187* (1.66)
Seat Belts			-0.031 (1.55)	-0.036* (1.88)	-0.044* (2.30)	-0.030* (2.05)
R^2	0.053	0.420	0.604	0.589	0.608	0.453
N	48	48	48	48	48	48

Notes to Table 3: Dependent variable and alcohol types in log-difference, 1989 Fatality Rate and Median Income in log-levels.

Traffic control laws in cumulative state-years. Asterisk signifies statistical significance at the 0.10 level or lower.

Table 4. Regression of 15-19 year-old suicide rates on alcohol consumption and economic variables. Census regions, annual data 1979-2007.

Variable	(1)	(2)	(3)	(4)	(5)	(6)[a]
Employment/population	0.303* (2.43)	-0.092 (1.02)	0.333* (2.71)	0.299* (3.45)	0.050 (0.72)	-0.037 (0.03)
Alcohol, last 30 days	0.037 (1.30)			-0.315 (1.49)	-0.031* (1.79)	0.059* (1.90)
Spirits, last 30		-0.182* (5.49)				
Beer, last 30			0.050* (1.69)			
Spirits/Beer proportion				-0.852* (11.48)	-0.495* (6.63)	0.067 (0.61)
15-19 Percent of Population	0.980* (10.2)	1.281* (18.7)	0.951* (9.86)	0.887* (13.3)	0.638* (10.1)	0.780* (10.4)
Lagged Suicide Rate					0.465* (7.52)	0.198* (2.87)
R^2	0.711	0.788	0.720	0.861	0.917	0.944
Durbin-Watson	0.52	0.31	0.35	1.16	1.75	1.31
N	128	128	128	124	124	124

[a]Model (6) has year fixed effects.

Notes to Table 1: All regressions include regional fixed effects. Asterisk signifies statistical significance at the 0.10 level or lower.

Table 5. Regression of the growth in 15-19 year-old suicide rates on alcohol consumption and economic variables. State-level, 1989-2009.

Variable	(1)	(2)	(3)	(4)	(5)	(6) (2009-1994)
Suicide rate/15-19, 1989	0.151 (1.17)	0.080 (0.72)	0.057 (0.56)	0.140 (1.27)	0.053 (0.51)	-0.123 (1.29)
Median Income, 1989		-0.932* (4.30)	-0.437* (1.72)	-0.781* (-3.55)	-0.812* (3.82)	-0.258 (-1.00)
Total alcohol *per capita*			1.172* (3.08)			1.146* (2.53)
Beer *per capita*				2.155* (2.109)		
Spirits *per capita*					1.381* (2.31)	
Beer share of total ethanol consumption			0.627 (0.57)			
R^2	0.031	0.295	0.414	0.348	0.361	0.295
N	4	45	45	45	45	45

Notes to Table 5: Dependent variable and alcohol types in log-difference, 1989 Suicide Rate and Median Income in log-levels. Asterisk signifies statistical significance at the 0.10 level or lower.

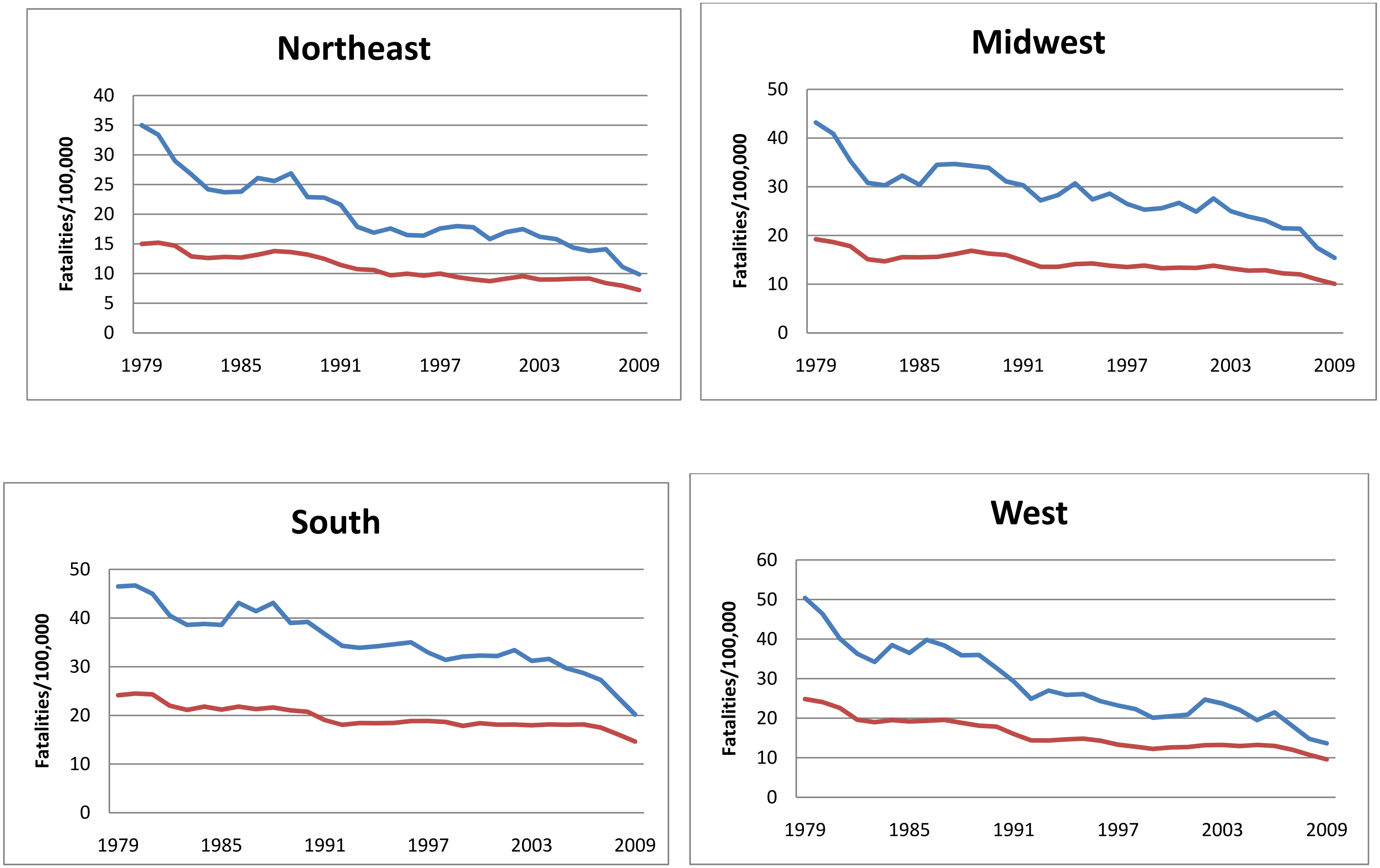

Figure 4: Traffic fatalities per 100,000 population. Top line in each region is the fatality rate for 15-19 year old; bottom line is fatality rate for the rest of the population

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