ADVERTISING BANS, MONOPOLY, AND ALCOHOL DEMAND:
TESTING FOR SUBSTITUTION EFFECTS
USING PANEL DATA*

by

Jon P. Nelson
Department of Economics
Pennsylvania State University
University Park, PA 16802
jpn@psu.edu

Abstract. Using a panel of 45 states for the period 1982-97, this study analyzes the importance of several restrictive alcohol regulations, including advertising bans for billboards, bans of price advertising, state monopoly control of retail stores, and changes in the minimum legal drinking age. In contrast to previous research, the study allows for substitution among beverages as a response to a regulation that targets a specific beverage. A restrictive law that applies only to one beverage (or one form of advertising) can result in substitution toward other beverages (and other media). Allowing for substitution means that the net effect on total alcohol consumption is uncertain, and must be determined empirically. The empirical results demonstrate that monopoly control of spirits reduces consumption of that beverage, and increases consumption of wine. The effect on beer is positive, but is not statistically significant. The net effect on total alcohol is significantly negative. Higher minimum legal drinking age laws have negative effects on beverage and total alcohol consumption. Partial bans of advertising do not reduce total alcohol consumption, which in part reflects substitution effects. Results in the paper are applied to the Supreme Court's *Central Hudson* test for First Amendment constitutionality of restrictions on commercial speech. ***JEL Codes: K32, L81, M3.***

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INTRODUCTION

In the United States, the distribution and sale of alcoholic beverages is regulated by the individual states. The Twenty-First Amendment, passed in 1933, granted the states broad legal powers over the importation and sale of alcohol. As a result, the extent and nature of alcohol laws vary by state, and these differences represent a long-term "natural experiment" with regard to the effects of regulation. Differences in state laws potentially affect both the organization of the alcoholic beverage industry and alcohol demand, reflecting legal incentives that alter individual behaviors.[1] State laws also differ by beverage, suggesting that substitution among alcoholic beverages is one possible consequence of regulation. For example, state laws for distilled spirits typically are more stringent than similar laws applied to beer and wine. Given these long-standing differences, the objectives of this study are to examine patterns of substitution due to state/beverage laws for: (1) monopoly control of retail sale of alcohol (distribution laws); (2) advertising bans for billboards and beverage prices (information laws); and (3) minimum legal drinking ages by beverage (conduct laws). In contrast to previous studies, the present study examines the effects of these laws for total alcohol consumption as well as consumption of each of the three beverages.

While each state has adopted its own unique regulatory system, several broad categories can be identified. Eighteen states have statutes granting public monopoly control of the distribution of most distilled spirits. Thirteen of these states operate off-premise retail stores for sale of spirits, and two states also control retail sales of most wines. In five states, only the wholesale distribution of distilled spirits is controlled.[2] Some control states also allow for distribution by state-approved contract vendors. No state has monopolized beer sales, but three

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[1] Studies of the effects of alcohol laws on the organization of the industry include Peltzman (1971), Smith (1982), Zardkoohi and Sheer (1984), Toma (1988), McGahan (1995), and Sass and Saurman (1995).

[2] Currently, the five wholesale states for spirits are Iowa, Michigan, Mississippi, West Virginia, and Wyoming. Two states – Iowa and West Virginia – terminated their retail spirits monopolies in 1987 and 1990, respectively. Between 1971 and 1985, nine control states privatized most or all retail wine sales (Her et al. 1999). Currently, most table wines (less than 14% alcohol by volume) come under state retail control in only two states, Pennsylvania and Utah. Two other states – New Hampshire and Washington – allow concurrent off-premise wine sales through special retail agents. Only Utah controls retail sales of beer with greater than 3.2% alcohol, although Minnesota and South Dakota have a system of municipal retail monopolies that may restrict beer sales by alcohol content (Distilled Spirits Council 1996, 2000; Holder and Janes 1987). Because of the small number of monopoly states for table wine and strong beer, this study analyzes only monopoly sales of distilled spirits.

states have some restrictions on private beer sales by alcohol content. In the private license states, an Alcoholic Beverage Control (ABC) agency determines the number and type of retail licenses, subject to possible local options.[3] Because monopoly states have broad authority to restrict the marketing of alcohol, the presumption is that total alcohol consumption will be lower in the control states compared to the license states. However, the available empirical evidence is not entirely conclusive (Beard et al. 1997; Goel and Morey 1995; Nelson 1990). Moreover, previous empirical studies examined alcohol demand by beverage, whereas the present study examines both total and beverage alcohol consumption. Monopoly control tends to raise the full price of spirits by increasing money prices, restricting outlet numbers and hours, and reducing variety. Because beer and wine may be substitutes or complements for spirits, monopoly control can increase or decrease total alcohol consumption.

A second broad category includes state regulations that ban advertising of alcoholic beverages or which restrict the advertising of prices.[4] Fourteen states (at various times) explicitly banned billboard advertising of distilled spirits or beer, including seven license states. While there is no consensus among researchers that advertising increases drinking (Cook and Moore 1999, p. 29; NIAAA 2000, p. 412), most previous research has analyzed the effects of national advertising expenditures (Goel and Morey 1995; Nelson 1999). The present study employs advertising bans as binary explanatory variables, which avoids several potential pitfalls associated with the expenditure approach, including cumulative effects of advertising and the absence of state-level advertising data. Because the state bans have existed for many years, the study also provides evidence regarding the long-term effectiveness of advertising bans on total alcohol and beverage consumption. It is often argued that billboards affect youth drinking behaviors, and this belief has been a basis for a number of municipal ordinances that ban

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[3] In some states, cities and counties have the option of placing a wide range of controls on the retail sale of alcohol, including "dry area" status. In general, populations in dry areas have been significant in only five of the local option states – Alabama, Arkansas, Kentucky, Mississippi, and North Carolina. In other states, cities and counties cannot place controls on licenses that are more strict than the ABC statutes (Toma 1988).

[4] The Twenty-First Amendment only prohibits the transportation or importation of intoxicants in violation of state statutes, and is designed to protect state regulations from invalidation on commerce clause grounds (Sackett 1983). Hence, state laws on alcohol advertising fall under First Amendment guarantees for commercial speech; see *Central Hudson Gas & Electric Corp. v. Public Service Commission of New York,* 447 U.S. 557 (1980) for the Supreme Court's "balancing" test for constitutionality of advertising bans and restrictions. A recent application of the *Central Hudson* four-part test is *44 Liquormart, Inc. v. Rhode Island*, 517 U.S. 484 (1996).

billboard advertising of alcoholic beverages. Although youth drinking is included in the consumption totals, separate analyses by age group are not possible using available state-level data. However, given long-standing bans, it should be expected that past youth behaviors will show up as cross-state differences in adult per capita consumption. These variables are highly correlated (Cook and Moore 2001; Smart and Ogborne 2000). Further, fifteen states (at various times) banned price advertising by alcohol producers or retailers using billboards, newspapers, and visible store displays. In 1996, these laws were ruled unconstitutional by the U.S. Supreme Court in *44 Liquormart, Inc. v. Rhode Island*, 517 U.S. 484 (1996).[5] In general, a ban of price advertising reduces competition among both retailers and manufacturers, and increases search costs of consumers. While these regulations were probably not intended to advance temperance (McGahan 1995), a price advertising ban could reduce alcohol consumption by elevating the general level of full prices. Because most states banned only price advertising of distilled spirits, substitution among beverages is a possible outcome. Previous empirical studies found little or no effect of price bans on consumption of spirits (Hoadley et al. 1984; Ornstein and Hanssens 1985; Nelson 1990). The present study extends prior research to cover all beverages and uses a more recent time period during which alcohol consumption has been declining.

Lastly, one of the more stringent forms of alcohol regulation is the establishment of a minimum legal drinking age (MLDA). As of 1989, all 50 states had a uniform minimum purchase age of 21 years for all forms of alcohol. The enabling legislation was the Federal Uniform Drinking Age Act of 1984 (P.L. 98-363), which increased the legal age in many states. In 1969, only five states permitted the sale of distilled spirits to persons less than 21 years. Between 1970 and 1975, an additional 22 states reduced the minimum purchase age to below 21 for all beverages (usually to 18 years) and two other states reduced the legal age for beer and wine (GAO 1987; Wegenaar 1981/82). This trend was quickly reversed. Between 1976 and 1981, 16 states increased the legal age for one or more beverages (usually from 18 years to 19 or 20). As a consequence of these changes, the period 1982-88 includes numerous differences in state MLDA laws. These differences are used to evaluate effects of MLDA laws on total and beverage alcohol consumption. Separate empirical results are reported for 1982-88.

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[5] Economic effects of *44 Liquormart* are analyzed in Milyo and Waldfogel (1999); see also Troy (1999). A number of local ordinances that ban alcohol billboards recently have been enacted in Baltimore, Chicago, Cleveland, Detroit, Los Angeles, Oakland, San Francisco, and other cites; see *Anheuser-Busch, Inc. v. Schmoke, Mayor of Baltimore City*, 191 F.3d 325 (4th Cir., 1996) for a test of these bans.

In general, restrictive alcohol laws increase full prices – search plus money costs – of alcoholic beverages, other things held constant. Hence, the focus of the paper is not exclusively monetary prices. The possible effects of a price increase for one beverage are: (1) substitute beverages become relatively less costly and complements more costly; (2) the income effect of the higher price reduces the demand for all beverages; and (3) total consumption of alcohol can increase or decrease, depending on the balance of income and substitution effects across all beverages. This study evaluates these impacts for a panel of 45 states covering the time period 1982-97, resulting in a sample of 720 observations. Alcohol consumption per capita is measured in equivalent units of pure alcohol or ethanol (NIAAA 1999). Monetary prices are obtained from quarterly surveys conducted by the American Chamber of Commerce Researchers Association (ACCRA 1997; Young and Bielinska-Kwapisz 2001). In addition to binary variables for monopoly and advertising bans, explanatory variables are included for state-level differences in beverage prices; real income per capita; tourism; two demographic groups (ages 18-24 and ages 65+); and the unemployment rate. Regional dummy variables are included that capture broad differences in urbanization, weather, religious preferences, racial and ethnic differences, social customs, and other common influences. In order to avoid spurious relationships, state-specific exponential time trends are included in the regressions. I also examine several subsamples, including a separate sample for private license states. The regression results for total alcohol consumption are used to decompose the consumption trends in five of the larger states.

Section 1 discusses broad trends in alcohol consumption and prices, as well as differences by control type and geographic region. I also review three previous studies of alcohol regulations that employed state panel data. Section 2 describes the econometric model and variables. Section 3 presents the empirical results for the full sample and subsamples. Using the empirical results for five selected states, Section 4 examines each variable for the magnitude of its effect on changes in total alcohol consumption. Section 5 contains the conclusions from the study.

1. CONSUMPTION TRENDS AND PREVIOUS STUDIES

Long-term trends in alcohol consumption per capita provide a historical perspective on patterns of alcohol use. These trends are documented in a series of reports prepared by the National Institute on Alcohol Abuse and Alcoholism (NIAAA 1999, 2000). Apparent alcohol

consumption for each state is measured by converting gallons sold of each beverage to pure alcohol (ethanol). Based on these data, alcohol consumption rose steadily during the 1960s and 1970s. For the nation, per capita ethanol consumption attained a record high in 1981 at 2.76 gallons for the population 14 years and older. Following that year, "adult" consumption declined steadily to 2.18 gallons in 1997. This represents a decline of -21% for 1981-97, or a compound growth rate of -1.5% per year. Much of the decline is due to falling consumption of distilled spirits (-38%), but beer and wine consumption also declined by about -11% each. The reasons for these decreases are not obvious, and may be due to changes in regulations, demographics, beverage substitution, prices, real incomes, advertising, and health trends. Figure 1 illustrates the trends for five larger states – California, Florida, Illinois, New York, and Pennsylvania. Pennsylvania is a retail monopoly state for both wine and spirits.

For purposes of this study, five states and the District of Columbia were deleted from the sample. There are several reasons for these exclusions, including the importance of tourism (Hawaii, Nevada, District of Columbia, New Hampshire); unique geographic and population features (Alaska, Hawaii, District of Columbia); aggressive state store marketing (New Hampshire); and unique religious make-up (Utah). For the sample of 45 states, Table 1 shows per capita consumption and price data for the period 1982-97. Overall, mean total alcohol consumption was 2.36 gallons per capita. The mean in 1982 was 2.63 gallons compared to 2.17 gallons in 1997, or a decline of -17%. Mean consumption in the license states is about 7% above the control states. By region, total alcohol consumption is highest in the West and lowest in the South. By beverage, beer consumption is highest in the Midwest and West; wine consumption is highest in the East and West; and spirits consumption is highest in the East and West. Real prices fell in most states, and the decline was largest for wine and smallest for beer. Spirits prices are slightly higher in the control states, but there is little difference for wine and beer. Beer prices tend to be lowest in the Midwest region; wine prices are lowest in the West; and spirits prices are lowest in the East. The mean price differences across regions are not large.

State-to-state differences in alcohol consumption reflect several positive and negative influences, including different state laws and regulations. A number of previous studies examined one or more regulations, using either state panel data or cross-sectional state data.

Three panel studies are reviewed here, and a number of other studies are discussed in the notes.[6]
Hoadley et al. (1984) examined the demand for distilled spirits in 48 states for the period 1955-
80, using data at five-year intervals. They estimate six cross-sectional regressions and a pooled
regression for all six years, including explanatory variables for laws and regulations, prices,
income, religion, and tourism. State control is defined to include both retail and wholesale
monopolies. Some of their pooled regressions also include time and regional dummies. The
results for the pooled model indicate that spirits demand is lower in those states that operate a
monopoly, but *higher* in those states that ban billboard advertising (Hoadley et al. 1984, p. 397).
The sign for billboard bans is contrary to their prior expectations. The MLDA and price
advertising ban variables are not statistically significant. Overall, the authors conclude that
demographics, tourism, prices, and income are the most important explanatory variables. There
are several potential problems with this study, including the exclusive focus on spirits and the use
of nominal income.

A second panel study was conducted by Ornstein and Hanssens (1985), who analyzed
spirits and beer demand. For spirits, they use a sample of 50 states and the District of Columbia
for the period 1974-78. For beer, they use a sample of 48 states and the District of Columbia for
the period 1974-78. A large number of economic, demographic, and regulatory variables are
considered in this study. For distilled spirits, they find a statistically negative effect of state
monopolies and an insignificant effect of MLDA laws. Dummy variables for states that permit
price advertising yield significantly positive coefficients, which suggests that search costs are
higher in the presence of a price ban. However, a contrary sign is obtained for billboard bans,
indicating that spirits consumption is *higher* in states that ban these displays (Ornstein and

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[6] In addition to the three panel studies, three cross-sectional studies have used state-level data on alcohol
consumption, monopoly, advertising regulations, MLDA, and other economic and social variables. Schweitzer et al.
(1983) estimated the demand for beer and spirits using data for 35 states in 1975. They control for the beer MLDA
and for bans of alcohol advertising in eight states. In their structural model, the beer MLDA is significantly
negative and the advertising ban variable is insignificant. Zardkoohi and Sheer (1984) estimated the demand for
spirits for 47 states in 1980. They find a positive effect for control states, but the coefficient is weakly significant.
Lastly, Nelson (1990) estimated separate demand functions for beer, wine, and spirits for 48 states in 1982. When
the data are screened for outliers, retail monopoly control is negatively related to spirits consumption and positively
related to beer consumption. This result suggests that monopoly control results in substitution among beverages.
Beer and spirits consumption also are negatively related to the MLDA. Bans of price advertising are insignificant
for all beverages. The main influences on beverage demands are prices, income, tourism, MLDA laws, and
monopoly control.

Hanssens 1985, p. 208). In separate regressions for beer, Ornstein and Hanssens find a significantly negative effect of the beer MLDA; no effect of state monopolies; and no effect of billboard bans. The beer price advertising coefficients are difficult to interpret, due to different results for print ads and billboard ads. Overall, the authors conclude that most regulatory variables have very small effects on consumption (Ornstein and Hanssens 1985, p. 211). One potential problem with this study is the small cell sizes that can result from narrowly-defined regulatory actions (e.g., print ad bans).

Wilkinson (1985) studied the relationships between total alcohol consumption, advertising, and highway fatalities using a sample of 48 states for 1976-79. He includes two measures of advertising restrictions: first, whether states prohibited advertising all together in periodicals or on billboards; and, second, whether states prohibited price advertising in periodicals and on billboards. He argues that advertising bans can increase or decrease consumption depending on the net effects of advertising on entry barriers and information flows. Using a recursive specification, the panel model is estimated using two-stage least squares with a random effects error term. The regression results for alcohol consumption indicate that a price bans has significantly negative effect on per capita ethanol consumption, while total bans are insignificant (Wilkinson 1985, p. 113). In Wilkinson (1987), these results are extended to account for possible simultaneity among alcohol consumption, prices, and alcohol outlets. The sample is 45 states for the years 1976-80. The significant determinates of total alcohol consumption are price, outlets, income, religion, state monopoly control, and the minimum legal age. For advertising regulations, the price advertising coefficient again is negative and significant. The additional restraint of forbidding all billboard advertising has an insignificant effect on demand.

A review of three previous panel studies reveals several areas for additional research. First, most studies used data for years prior to the mid-1980s. As reported above, there has been a steady decline in alcohol consumption since that time. It is unclear if empirical results for the 1970s or early 1980s can be transferred to the more recent period. Second, many studies consider only consumption of one or two beverages. This eliminates the analysis of substitution among beverages. Third, only one study to date has examined the effects of all three regulation

types on total alcohol consumption, which may be the policy variable of greatest interest.[7] The present study examines total ethanol consumption as well as beverage consumption, which permits evaluations of the net effects of restrictive alcohol laws. Fourth, there is limited evidence that consumption is reduced by monopoly control or higher MLDAs, but there is uncertainly due to the variety of empirical results, different measurement methods, and different time periods. Fifth, while several studies failed to find a negative effect of billboard bans, there is uncertainty for these same reasons. Even where significant effects of regulation have been found, there is inadequate information regarding the magnitude of effects.

2. MODEL AND VARIABLES

The regression analysis uses data for 45 states over the period from 1982 to 1997. The full sample is 720 observations. In the monopoly control states and the post-1988 period, the distribution of alcohol is governed in ways that may be fundamentally different. Hence, I also consider subsamples for license states only and for two subperiods, 1982-88 and 1989-97. As a matter of future public policy, it is unlikely that any of the current license states will adopt retail monopoly controls. This means that a separate analysis of the license states is desirable. Further, during the time period 1989-97, MLDA laws were uniform across states. Analysis of the effects of MLDA laws is best examined using data for 1982-88. Measurement of MLDAs in the present study allows for "grandfather" clauses and for different legal ages by beverage. Finally, the analysis of regulations for monopoly control and advertising restrictions focus on regulation of distilled spirits. For reliable statistical results, there are too few states in the sample that operate wine monopolies. Separate analysis of billboard bans for beer and beer prices is treated as a model extension.

Several recent studies of alcohol demand employ fixed-effects (FE) econometric models (see n. 7). These models rely on within-state variation in economic conditions and have the

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[7] Other state-level panel studies estimate fixed-effect (FE) models, which generally precludes the inclusion of more than one binary regulatory variable. These studies include Baltagi and Griffin (1995) for spirits (no regulation variables included for 1959-82); Beard et al. (1997) for beer and spirits (no effect of monopoly in 1989-93); Goel and Morey (1995) for spirits (positive effect of monopoly in 1959-82); McCornac and Filante (1984) for spirits (no effect of monopoly or spirits MLDA in 1970-75); and Ruhm (1995) for total alcohol consumption (beer MLDA is negative in 1975-88). This is a mixed set of results for monopoly control, which reflects the difficulty of including binary variables in state FE models. The present study seeks to avoid this problem.

potential for improving on aggregate time-series analysis if there are substantial economic fluctuations across states. State FE models allow for a host of other economic, legal, social, and cultural variables, which are captured in state-specific dummy variables. This specification reduces problems of spurious correlation and multicollinearity. However, estimation of FE models is difficult for binary regulatory variables, which have limited cross-sectional and temporal variation. Further, the dependent variable in the present study have pronounced time trends (see Figure 1). In this study, these data complications lead to three important changes in the model specification compared to FE models. First, in order to avoid the inclusion of a large number of additional explanatory variables, with attendant collinearity problems, three regional dummy variables are included for the Midwest, South, and West (the East is the excluded region). Regional fixed-effects capture broad geographic differences, such as urbanization, religious preferences, weather, and social customs. Second, in order to detrend the data and focus on cross-sectional differences, a state-specific time trend is included for each of the 45 states.[8] This reduces the temporal variation in the data, and thus reduces the potential for serial correlation, unit roots, and spurious results. Third, the real price of total alcohol is a beverage-share weighted mean of the real beverage prices, rather than a single beverage price or tax rate.

All variables are specified in log levels, except the dummy variables, time trends, and MLDA variables. The dependent variables are the logs of pure alcohol per capita (ages 14+) for four outcomes: total alcohol, beer, wine, and distilled spirits. Given these restrictions and definitions, the econometric estimates for total alcohol and each beverage are variants of the following model (beverage subscripts are omitted):

$$A_{it} = \alpha + R_j + \beta_i T_{it} + \gamma P_{it} + \delta C_{it} + X_{it}\eta + Z_{it}\psi + \varepsilon_{it} \tag{1}$$

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[8] See Chesson et al. (2000) and Dee (1999) for similar specifications. I also considered several other specifications, including time dummies for each year, which removes only the common national trend in consumption, and state fixed-effect dummies. The specification chosen is a compromise between these two cases. Estimation of a GLS model that corrects explicitly for both serial correlation and heteroscedasticity was not possible because the number of cross-sectional observations is greater than the number of time periods. Using time dummies resulted in negative coefficients for the spirits price variable.

where A is log of per capita alcohol consumption for state i at time t; α is an intercept term; **R** is a time-invariant regional constant term (a vector of regional dummies with each state assigned to one region); T is an exponential time trend for each state (1982 = 0 to 1997 = 15); β is a state-specific exogenous growth rate per capita; P is the logged own-beverage price; C is a logged cross-price; **X** is a vector of logged economic and social conditions; **Z** is a vector of variables for state laws; and ε is the error term. Included in the **X** vector are variables for real per capita disposable income, state tourism, percent of the state population aged 18 to 24 years, percent of the population 65 years or older, and the unemployment rate. Included in the **Z** vector are the MLDAs (beer, wine, spirits in years); retail monopoly control of distilled spirits (binary); bans of billboard advertising of distilled spirits or beer (binary); and bans of price advertising of distilled spirts or beer (binary). In separate regressions for the license states, a dummy variable is included for wholesale control of distilled spirits. A more complete description of the variables and data sources is found in Appendix A.

With regard to the coefficient signs, price is expected to have a negative effect on beverage demand and income is expected to have a positive effect, although a zero income elasticity for beer has been found in previous studies (e.g., Ornstein and Hanssens 1985, p. 209). The cross-price effects are uncertain.[9] The variable for tourism accounts for sales to non-residents of the state (per capita data are based on resident populations) and for larger numbers of alcohol outlets where tourism is important. The expected coefficient sign is positive for both of these reasons. For the demographic variables, higher alcohol consumption is observed for youth (ages 18-24) and lower consumption for the elderly (ages 65+). The expected coefficient signs are positive and negative, respectively. Based on Ruhm's (1995) results, expected signs for the unemployment rate are negative.

With regard to the regulatory variables, higher MLDAs are expected to have a negative effect on beverage demands. In contrast to past studies, these variables are measured separately for each beverage. Due to high correlations, only the spirits MLDA is included in the demand function for total alcohol. Monopoly control of spirits is expected to have a negative effect on

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[9] One cross-price is included in each demand: for total alcohol, the cross-price is the state's cigarette price index; for beer, the cross-price is wine; for wine, the cross-price is beer; and for spirits, the cross-price is wine. As there are no explicit cross-equation restrictions, the focus in Section 4 is on total alcohol consumption.

spirits demand. The cross-beverage effects of monopoly control on beer and wine are uncertain, since the results depend on the relative strengths of income and substitution effects of the regulation-induced changes in full prices. A ban of billboard advertising of spirits (beer) is expected to reduce consumption of distilled spirits (beer). Holding prices constant, eliminating a positive inducement should reduce consumption, unless increased advertising by non-banned media more than counterbalance the effects of a billboard ban. A ban of price advertising for spirits (beer) should increase search costs and reduce competition, thus resulting in higher full prices and lower beverage demand. The cross-beverage effects of billboard and price ad bans are uncertain. Lastly, the regulatory effects for total alcohol consumption reflect the net impact on all three beverages, and the coefficient signs are therefore uncertain.

3. EMPIRICAL RESULTS

The empirical results are reported in four parts: all 45 states for the period 1982-97; only license states for the period 1982-97; all states for two subperiods, 1982-88 and 1989-97; and a model extension that includes beer advertising bans. The econometric method is generalized least-squares, with corrections for cross-sectional heteroscedasticity. Joint estimates of the state-specific time trends are not reported, except for regression (2) in Table 2 (see Appendix B).

All States and Years. Table 2 shows the results for total consumption of alcohol and the three beverages. For sensitivity comparisons, results are shown with and without the advertising variables. The adjusted R^2s are in the range 0.798 to 0.899. In part, the R^2 values reflect the assignment of states to geographic regions. For example, placing the "border" state of Texas in the West region would raise the R^2 for beer. However, the results for the continuous variables are largely unaffected by different regional groupings. Compared to the East region, the regional dummies indicate lower total alcohol use in the Midwest and South, and equal or higher consumption in the West. The income and price elasticities are small, except for the income elasticity of wine. These values reflect the removal of state time trends in consumption. For example, replacing the state-specific time trends with year dummies in regression (2) reduced the R^2 value from 0.896 to 0.723, and increased the price elasticity from -0.066 to -0.293.[10]

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[10] Dee (1999, p. 301) finds a reduction in the beer tax elasticity for teen drinking when he includes state-fixed effects; the elasticity falls from -0.158 to -0.026. He attributes this to the high collinearity between the state fixed-effects and beer taxes, and to unobserved state-specific attributes that influence both taxes and teen drinking.

Total alcohol demand is moderately income elastic (elasticity = 0.33 to 0.38). The demand for beer is unaffected by income, which replicates earlier findings by Ornstein and Hanssens (1985, p. 209) and others. Wine demand is income elastic (1.7 to 1.9) and spirits has an income elasticity of about 0.33 to 0.39. Total alcohol demand is price inelastic (-0.07); beer's price elasticity ranges from -0.16 to -0.18; and wine's price elasticity is -0.20 to -0.29. In Table 2, the demand for spirits is completely price inelastic, and this result is examined below. Only wine has a significantly negative cross-price effect with beer (t-statistic > 2).

Among the other variables, tourism has large positive elasticities (0.32 to 0.64). Even in a restricted sample of 45 states, this result indicates the importance of tourism for alcohol outlets and consumption. All of the youth elasticities are positive, but the coefficients are less than unity and the wine coefficients are not significant. The effect on total alcohol is in the range 0.43 to 0.45, suggesting that decline of the youth population alone is not sufficient to explain the fall in per capita alcohol consumption. Results for the elderly population indicate a statistically positive effect on wine consumption, but negative effects for beer, spirits, and total alcohol. Most of the unemployment coefficients are negative as expected, but very small for total alcohol (-0.03). By beverage, the unemployment elasticity is small and negative for beer (-0.02), insignificant for wine, and negative for distilled spirits (-0.04). The unemployment results are similar to Ruhm's (1995) findings for both the coefficient signs and magnitudes.

The results for laws and regulations indicate a negative effect of the MLDA variables, except that the beer MLDA is insignificantly positive. The MLDA values for wine and spirits are about -0.07 and -0.02, respectively. Note that these results combine two subperiods, and the MLDA results are examined further below. For total alcohol consumption, the MLDA coefficient is -0.02. The results for retail monopoly control indicate a negative effect for spirits (-0.15) and a small positive effect for wine (0.04). This result suggests substitution among beverages due to distribution laws. The effects of monopoly control on beer demand are positive, but not statistically significant. Monopoly control has a net negative effect on total alcohol demand (-0.06). The results for the advertising variables are mixed, and do not support the notion that advertising bans reduce consumption. Total alcohol demand is *positively* related to billboard bans, and is not affected significantly by bans of price advertising. At the beverage level, the demands for spirits and wine are *positively* related to billboard bans and negatively

affected by bans of price advertising. The billboard results replicate the findings of Hoadley et al. (1984) and Ornstein and Hanssens (1985). The signs on the advertising coefficients for wine are the same as that for spirits, which suggests complementarity with regard to information laws. The advertising coefficients for beer demand have signs that are the opposite of spirits and wine.

In summary, the empirical findings for restrictive alcohol laws indicate that, first, bans of price advertising reduce the consumption of spirits and wine, and increase beer consumption. The net effect of price bans on total alcohol is not significantly different from zero. Second, the results for billboard bans indicate an increase in the demand for spirits and wine, and reduction of beer consumption. The net effect on total alcohol is significantly positive. Despite the existence of long-standing billboard bans, the results for total alcohol indicate that these bans have not reduced consumption. The counterfactual is that consumption would have been higher absent the bans, but past studies of the removal of bans argue against this outcome (e.g., Makowsky and Whitehead 1991). Third, both higher MLDAs and state monopoly controls reduce spirits and total alcohol consumption. Overall, the results in Table 2 indicate substitution effects due to distribution laws, since monopoly control of spirits increases the demand for wine. There also is a substitution effect due to price advertising bans, which reduces the demand for spirits and wine and increases the demand for beer. On the other hand, billboard bans increase spirits and wine consumption, and reduce beer consumption. The net effect is that total alcohol demand is positively affected by billboard bans and unaffected by price bans.

License States. The sample of 45 states contains eleven states that operate retail stores for the sale of spirits (New Hampshire and Utah are not in the sample). Current policy options in the license states probably do not include adoption of retail monopoly controls. In order to hold constant the structure of retail distribution, separate regressions were estimated for the license states. The sample size is 528 observations. The license state results are reported in Table 3. The income elasticities are similar to the full sample results. The negative price elasticities for the license states are: total alcohol, -0.11; beer, -0.13; and wine, -0.42. The cross-price effects are significantly negative for beer and wine. For the license states, the cigarette price is significantly positive for total alcohol. The tourism elasticities are slightly higher, especially for spirits and total alcohol. The youth elasticities also are higher, especially for beer and total alcohol. The results for the elderly population show a positive effect for wine and a negative

effect for spirits demand. The overall effect of the elderly on total consumption is negative, but it is not statistically significant. The unemployment coefficients are significantly negative for total alcohol and spirits, but positive for wine.

In the present context, policymakers in license states could attempt to reduce alcohol consumption by imposing additional regulations on alcohol use or by passing laws that limit information in the form of advertising messages. Table 3 shows that higher MLDAs have reduced total alcohol, wine, and spirits consumption. The beer MLDA is not significant in regression (4). For the advertising variables, a ban of billboard advertising of spirits increases the demand for spirits and wine. Billboard bans have no effect on beer and a weak positive effect on total alcohol demand. A ban of price advertising of spirits has negative effects on spirits and beer. The results for total alcohol and wine are insignificant. Hence, the effects of billboard bans and price ad bans on total alcohol are insignificant for the license states. These results indicate that substitution among beverages is important with respect to the overall effect of a regulation. Lastly, a dummy variable is included in Table 3 for those states that exercise wholesale control of distilled spirits. The regressions indicate that wholesale control is associated with higher consumption of beer and lower consumption of wine. For spirits and total alcohol, wholesale monopoly has a weak positive effect. These results are inconsistent with states adopting wholesale controls for temperance reasons.

All States by Time Period. In Tables 2 and 3, the results for MLDA laws are affected by a uniform legal drinking age after 1988. In order to clarify the MLDA results, the sample was split into two subperiods, 1982-88 and 1989-97. The results are displayed in Table 4, and the R^2 values are not notably different between the two time periods. All of the MLDA coefficients are significantly negative. The income elasticities are about the same for both time periods. The price elasticity of spirits is significantly negative during 1989-97. The cross-price effect for cigarettes is negative for 1982-88 and positive for 1989-97. The tourism elasticities are positive in both periods, and suggest a stronger effect of tourism on total alcohol for 1989-97. Some of the youth elasticities are smaller during 1989-97, especially spirits. The youth elasticity for total alcohol falls from 0.84 to 0.48; the beer elasticity declines from 0.64 to 0.56; and the spirits elasticity declines from 1.05 to -0.23. The elderly coefficient is positive for wine during both time periods, but insignificant for total alcohol during 1989-97.

For the regulatory variables, the MLDA results for 1982-88 indicate that higher legal drinking ages are an effective way to reduce alcohol consumption by youth. The MLDA variables are always significantly negative during 1982-88. The absolute values of coefficients are smallest for beer (-0.007) and largest for wine (-0.034). For advertising, there is no indication that billboard bans consistently reduce alcohol consumption. During both time periods, billboard bans increase consumption of wine and spirits, and reduce consumption of beer. The net effect on total alcohol demand is significantly positive during 1982-88, but insignificant thereafter. Most of this difference is due to a change in the magnitude of the wine coefficient, which declines from 0.240 to 0.102. Hence, it seems likely that these results reflect changes occurring in the wine market, such as declining sales of wine coolers. During both time periods, price ad bans are associated with lower consumption of spirits, higher consumption of beer, and no effect on total alcohol. The wine coefficient is insignificant after 1988. For 1989-97, neither billboard nor price bans have a significant effect on total alcohol demand.

Beer Advertising Restrictions. As an extension of the above results, two dummy variables were added for restrictions on beer advertising. Only four states in the sample banned beer price advertising, but did not ban all beer advertising on billboards and exterior signs (Georgia, Minnesota, Pennsylvania, Rhode Island). Also, among the private license states there is a good deal of overlap between bans of spirits advertising and beer advertising. Table 5 shows the results with beer advertising bans added to the model. The non-advertising coefficients do not change very much. For total alcohol, the price ad ban has a significant negative coefficient for 1982-88, but the coefficient for beer price ad bans is significantly positive. For total alcohol during 1982-97, both of the beer advertising coefficients are insignificantly different from zero. In the beer demand functions, all of the advertising coefficients for beer are insignificant. In general, there is not much to be gained statistically from consideration of additional laws and regulations on advertising by beverage.

4. CHANGES IN ALCOHOL CONSUMPTION BY STATE

Figure 1 illustrates the trend in ethanol consumption for five states: California, Florida, Illinois, New York, and Pennsylvania. In order to analyze these trends, this section uses the results in regression (2) in Table 2 to quantify the change in total alcohol consumption from 1982

to 1997. For each state, I calculated the fitted values of total alcohol consumption per capita for 1982 and 1997, expressed in both level values and logs. The fitted values are displayed in Table 6, together with the residuals (level values only) for each state and year. For each of the explanatory variables, I calculated its contribution to the logged change in the fitted value by multiplying the variable's coefficient by the logged change in the explanatory variable. For example, the change in the log fitted value for California is -0.362 (= 0.782 - 1.144), which is then decomposed in the lower part of Table 5. In addition, arc elasticity estimates are used to estimate the magnitude of the contribution to the change in the fitted level-values. The estimates in Table 6 provide indicators of the magnitude or importance of each variable for the changes that occurred between 1982 and 1997. The log changes add-up exactly (with minor rounding errors), while the arc elasticity calculations are approximate, and do not add up exactly to the fitted level changes.

Examination of results in Table 6 indicates that real income, youth population, and tourism are the three most important factors that explain changes in total alcohol consumption. Using the log contributions, the net effect of these variables is negative for three states. The importance of these factors does not vary greatly among the states, except for the greater importance of income in New York. In all states, the real price of alcohol fell, so that the own-price contribution is always positive. There are some important differences in the estimated time trends as indicated by the large negative trends for California and New York, and the smaller trend values for Florida and Illinois. However, in four of the states, the net contribution of the non-trend variables is negative, so that total alcohol consumption would have fallen even if it were not for the exogenous trend. Illinois is the exception. The importance of demographic factors for changes in alcohol consumption supports earlier findings on this issue (Nelson 1997).

The relative importance of the regulatory variables can be assessed using the estimates in Tables 2 and 6. First, if a state had adopted monopoly control between 1982 and 1997, Table 2 indicates that the log of total alcohol would have fallen by -0.057. This is a modest change compared to the observed contributions of several other variables. For example, in three states, monopoly control would have a smaller absolute effect than the observed change due to tourism. Two states, Florida and New York, raised the MLDA during the sample period. The log contributions are -0.040 and -0.060, respectively. Pennsylvania repealed its ban of price

advertising as a restrictive alcohol law in 1997. The effect of this change on total alcohol consumption is small in comparison to the other explanatory variables, and represents a level change of about 1 percent of 1982 consumption. Although none of these states revised their laws on billboard bans, Table 2 indicates that adopting a ban would have *increased* the log of total alcohol by 0.054.

5. CONCLUSIONS

Using a longitudinal sample of 45 states for the period 1982-97, this study examined the importance of several restrictive alcohol control policies, including state monopoly control of retail stores, advertising bans for billboards and alcohol prices, and changes in the minimum legal drinking age. In contrast to previous research, the study examined substitution among beverages as a response to a law or regulation that targets a specific beverage. A restrictive law that applies to only one beverage (or one advertising medium) can result in substitution toward other beverages (and non-banned advertising media). Allowing for this effect means that the net effect on total alcohol consumption is uncertain, and must be ascertained empirically. The study finds that monopoly control of retail sales of spirits reduces consumption of spirits and increases consumption of wine. The effect on beer is positive, but not statistically significant. The net effect of monopoly on total alcohol demand is significantly negative. Higher minimum legal drinking age laws have negative effects on beverages and total alcohol consumption. It follows that better enforcement of drinking age laws is an effective control measure.

It remains to be shown that state laws that ban advertising can directly advance alcohol control. Indeed, this study finds that billboard bans might have unintended consequences on alcohol consumption. The empirical results indicate that bans of billboard advertising increases consumption of spirits and wine, and reduces the demand for beer. The net effect on total alcohol demand is positive prior to 1989, and zero thereafter. Billboards account for only 8 percent of total alcohol advertising. Hence, the elimination of this medium would not be expected to substantially or materially affect alcohol consumption, which implies that such bans may be symbolic policies. Finally, prior to the *44 Liquormart* decision in 1996, some states instituted bans of price advertising of alcoholic beverages. The empirical results indicate that states with price advertising bans had lower consumption of spirits and wine, but higher

consumption of beer. The net effect on total alcohol consumption is never statistically significant, which reflects substitution effects of restrictive laws and regulations.

The *Central Hudson* "balancing" test (see n. 4) requires that government censorship of commercial speech must pass a four-prong test of reasonableness: (1) the speech must concern lawful activity and must not be misleading; (2) the asserted government interest must substantial; (3) the regulation must directly and materially advance that interest; and (4) the law must not be more extensive than necessary to serve the government's interest. Hence, the results in this study fail to support the third prong.[11]   This study demonstrates that past advertising regulations in the market for alcoholic beverages have had little or no effect on the final outcome, suggesting that bans of commercial speech are either misguided or motivated by other concerns.

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[11] Writing before to the *Central Hudson* decision, Coase (1974, 1977) laid out the economic tradeoffs between government intervention in the market for goods and the market for ideas, including informative and persuasive ideas expressed in the form of advertising.   He argued that commercial speech requires as much (or more) protection than political speech. The billboard results in the present study also are supported by a recent studies of tobacco advertising bans, which demonstrate the limited impact of partial bans of advertising (Czart et al. 2001; Saffer and Chaloupka 2000).

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Table 1 – Mean Total Alcohol (ethanol) Consumption and Prices

Category–years	Mean ethanol gal. per capita (std dev)				Mean real price per oz. ethanol (std dev)			
	Total	**Beer**	**Wine**	**Spirits**	**Total**	**Beer**	**Wine**	**Spirits**
All States - all yrs	2.36 (.4)	1.31 (.2)	0.29 (.1)	0.76 (.2)	1.24 (.1)	1.08 (.1)	0.94 (.1)	1.65 (.1)
- 1982	2.63 (.4)	1.38 (.2)	0.30 (.1)	0.95 (.2)	1.36 (.1)	1.11 (.1)	1.17 (.1)	1.78 (.2)
- 1997	2.17 (.3)	1.26 (.2)	0.27 (.1)	0.64 (.1)	1.17 (.1)	1.04 (.1)	0.85 (.1)	1.56 (.1)
License - all yrs	2.40 (.4)	1.32 (.2)	0.28 (.1)	0.80 (.2)	1.24 (.1)	1.08 (.1)	0.94 (.1)	1.62 (.1)
- 1982	2.67 (.4)	1.39 (.2)	0.30 (.2)	0.98 (.2)	1.35 (.1)	1.09 (.1)	1.17 (.1)	1.77 (.2)
- 1997	2.22 (.3)	1.27 (.2)	0.26 (.1)	0.68 (.1)	1.17 (.1)	1.05 (.1)	0.85 (.1)	1.53 (.1)
Control - all yrs	2.25 (.4)	1.28 (.2)	0.30 (.1)	0.67 (.2)	1.26 (.1)	1.10 (.1)	0.94 (.1)	1.72 (.1)
- 1982	2.52 (.5)	1.35 (.2)	0.31 (.1)	0.86 (.2)	1.39 (.1)	1.17 (.1)	1.18 (.1)	1.80 (.1)
- 1997	2.05 (.2)	1.21 (.1)	0.29 (.1)	0.54 (.1)	1.17 (.1)	1.02 (.1)	0.86 (.1)	1.67 (.1)
Regions--years								
East - all yrs	2.54 (.3)	1.25 (.1)	0.40 (.1)	0.89 (.2)	1.30 (.1)	1.16 (.1)	1.00 (.1)	1.62 (.1)
- 1982	2.87 (.3)	1.32 (.1)	0.42 (.1)	1.12 (.2)	1.42 (.1)	1.15 (.1)	1.19 (.1)	1.82 (.2)
- 1997	2.25 (.3)	1.14 (.1)	0.40 (.1)	0.71 (.1)	1.19 (.1)	1.08 (.1)	0.91 (.1)	1.52 (.1)
Midwest - all yrs	2.30 (.3)	1.35 (.1)	0.22 (.1)	0.73 (.2)	1.19 (.1)	1.02 (.1)	0.90 (.1)	1.62 (.1)
- 1982	2.52 (.4)	1.42 (.2)	0.24 (.1)	0.86 (.2)	1.28 (.1)	1.04 (.1)	1.14 (.1)	1.74 (.1)
- 1997	2.15 (.3)	1.30 (.1)	0.20 (.1)	0.65 (.1)	1.15 (.1)	1.02 (.1)	0.82 (.1)	1.54 (.1)
South - all yrs	2.13 (.4)	1.25 (.2)	0.20 (.1)	0.68 (.2)	1.25 (.1)	1.08 (.1)	0.96 (.1)	1.66 (.1)
- 1982	2.30 (.4)	1.25 (.2)	0.20 (.1)	0.85 (.2)	1.37 (.1)	1.14 (.1)	1.20 (.1)	1.74 (.2)
- 1997	2.02 (.3)	1.26 (.2)	0.19 (.1)	0.57 (.1)	1.17 (.1)	1.03 (.1)	0.88 (.1)	1.59 (.1)
West - all yrs	2.60 (.3)	1.43 (.2)	0.39 (.1)	0.79 (.2)	1.24 (.1)	1.08 (.1)	0.88 (.1)	1.70 (.1)
- 1982	3.03 (.3)	1.58 (.2)	0.43 (.1)	1.02 (.1)	1.36 (.1)	1.12 (.1)	1.16 (.1)	1.83 (.1)
- 1997	2.34 (.2)	1.33 (.2)	0.35 (.1)	0.66 (.1)	1.17 (.1)	1.05 (.1)	0.78 (.1)	1.61 (.1)

Notes: First row for each category shows the mean for all 16 years. Consumption is gallons per capita of ethanol equivalents (NIAAA 1999). Prices are the ACCRA prices of each beverage converted to price per ounce of ethanol, and deflated by the CPI-U index (ACCRA 1997). The ethanol prices are based on a six-pack of 12-oz. containers of Budweiser (5% alcohol); 1.5-liter bottle of Paul Masson (or Gallo) Chablis (11.5% alcohol); and 750-ml. bottle of J&B Scotch (40% alcohol). The price of total ethanol is a share-weighted price per ounce, where the shares are the per capita quantities by beverage, state, and year. The samples exclude Alaska, District of Columbia, Hawaii, Nevada, New Hampshire, and Utah. Regions follow census definitions, except Delaware and Maryland are in the East region.

Table 2 – Alcohol Demand: All States and Years (per capita gallons of ethanol)

Variable	(1) Total	(2) Total	(3) Beer	(4) Beer	(5) Wine	(6) Wine	(7) Spirits	(8) Spirits
Constant	-3.618 (9.48)	-4.044 (10.7)	-1.504 (3.85)	-0.871 (2.20)	-17.55 (15.6)	-19.70 (17.4)	-5.309 (9.42)	-5.647 (10.3)
Income (real per capita)	0.331 (11.3)	0.381 (13.0)	-0.005 (0.18)	-0.058 (1.89)	1.732 (22.4)	1.929 (23.8)	0.333 (7.75)	0.390 (9.49)
Own-price (real)	-0.064 (2.10)	-0.066 (2.16)	-0.185 (6.39)	-0.163 (5.72)	-0.288 (5.38)	-0.202 (3.66)	0.072 (1.56)	0.056 (1.26)
Cross-price: cigs, wine, beer, wine	0.001 (0.06)	-0.001 (0.07)	-0.008 (0.40)	-0.010 (0.48)	-0.319 (4.27)	-0.355 (4.65)	0.046 (1.46)	0.059 (1.92)
Tourism	0.463 (18.8)	0.409 (16.1)	0.613 (24.0)	0.640 (24.7)	0.604 (9.96)	0.548 (9.17)	0.433 (10.8)	0.315 (7.84)
Pct. ages 18-24	0.449 (11.4)	0.431 (11.0)	0.374 (8.91)	0.339 (8.14)	0.227 (1.85)	0.226 (1.80)	0.729 (12.6)	0.687 (12.0)
Pct. ages 65+	-0.090 (2.85)	-0.049 (1.55)	-0.049 (1.78)	-0.089 (3.03)	0.091 (1.02)	0.208 (2.30)	-0.208 (4.64)	-0.137 (3.04)
Unemployment rate	-0.035 (5.18)	-0.026 (3.73)	-0.007 (0.99)	-0.016 (2.08)	0.009 (0.41)	0.025 (1.14)	-0.047 (4.00)	-0.043 (3.90)
MLDA: spirits; beer; wine; spirits	-0.018 (7.71)	-0.020 (8.63)	0.002 (0.68)	0.003 (1.17)	-0.060 (8.90)	-0.067 (9.47)	-0.016 (4.12)	-0.019 (5.00)
Retail monopoly: spirits dummy	-0.047 (7.99)	-0.057 (9.69)	0.009 (1.38)	0.001 (0.12)	0.053 (2.69)	0.043 (2.09)	-0.118 (11.4)	-0.149 (13.9)
Billboard ban: spirits dummy	---	0.054 (6.56)	---	-0.037 (5.28)	---	0.170 (6.01)	---	0.128 (9.62)
Price ad ban: spirits dummy	---	-0.009 (1.83)	---	0.028 (4.75)	---	-0.083 (4.29)	---	-0.052 (5.73)
Midwest state dummy	-0.145 (16.9)	-0.128 (14.6)	-0.011 (1.17)	-0.019 (2.07)	-0.450 (15.7)	-0.384 (12.4)	-0.252 (16.4)	-0.232 (15.4)
Southern state dummy	-0.125 (11.3)	-0.132 (11.9)	-0.061 (5.66)	-0.070 (6.70)	-0.330 (11.2)	-0.324 (11.4)	-0.210 (13.2)	-0.229 (14.5)
Western state dummy	0.001 (0.08)	0.030 (2.99)	0.028 (2.29)	0.005 (0.43)	0.077 (2.11)	0.173 (4.66)	-0.156 (10.5)	-0.091 (5.84)
Adj R-sq (unwt)	0.897	0.896	0.798	0.799	0.895	0.899	0.889	0.894

Notes: Dependent variable is log of per capita ethanol demand in gallons (ages 14+). Sample size is 720 (45 states for the period 1982-97). All estimates obtained using GLS with weights based on the cross-section residual variance for each state; t-statistics reported in parentheses. All continuous variables in log-level, except MLDAs. All regressions include 45 state-specific exponential time trends (1982 = 0); see Appendix B for trend estimates for regression (2). The cross-price for total alcohol is the state cigarette price; for beer, the cross-price is wine; for wine, the cross-price is beer; and for spirits, the cross-price is wine.

Table 3 – Alcohol Demand: License States (per capita gallons of ethanol)

Variable	(1) Total	(2) Total	(3) Beer	(4) Beer	(5) Wine	(6) Wine	(7) Spirits	(8) Spirits
Constant	-4.679 (9.60)	-4.806 (9.60)	-1.640 (3.62)	-1.661 (3.63)	-18.01 (12.9)	-17.56 (12.8)	-6.413 (7.97)	-5.632 (6.96)
Income (real per capita)	0.361 (9.09)	0.363 (9.05)	-0.059 (1.53)	-0.046 (1.19)	1.705 (16.5)	1.668 (16.3)	0.428 (6.80)	0.371 (5.91)
Own-price (real)	-0.096 (2.51)	-0.108 (2.66)	-0.138 (4.17)	-0.132 (3.93)	-0.378 (5.93)	-0.415 (6.60)	0.115 (1.93)	0.094 (1.62)
Cross-price: cigs, wine, beer, wine	0.052 (2.13)	0.062 (2.46)	-0.059 (2.48)	-0.061 (2.60)	-0.422 (4.81)	-0.453 (5.34)	0.013 (0.31)	0.007 (0.16)
Tourism	0.498 (12.8)	0.521 (13.1)	0.647 (21.4)	0.601 (18.5)	0.626 (7.00)	0.670 (7.54)	0.515 (8.65)	0.549 (9.35)
Pct. ages 18-24	0.584 (11.9)	0.597 (11.6)	0.471 (9.86)	0.499 (9.97)	0.397 (2.81)	0.337 (2.43)	0.759 (10.5)	0.718 (9.50)
Pct. ages 65+	-0.061 (1.73)	-0.058 (1.63)	0.045 (1.57)	0.028 (0.89)	0.212 (2.12)	0.264 (2.72)	-0.202 (3.84)	-0.190 (3.65)
Unemployment rate	-0.021 (2.33)	-0.020 (2.21)	-0.011 (1.11)	-0.013 (1.33)	0.056 (2.10)	0.056 (2.13)	-0.050 (3.38)	-0.062 (4.24)
MLDA: spirits; beer; wine; spirits	-0.019 (6.17)	-0.020 (6.22)	0.006 (2.32)	0.004 (1.38)	-0.055 (6.59)	-0.057 (6.78)	-0.022 (4.63)	-0.027 (5.62)
Whlsale monopoly: spirits dummy	0.036 (2.53)	0.029 (1.86)	0.061 (5.34)	0.069 (5.77)	-0.105 (2.16)	-0.193 (3.81)	0.068 (3.36)	0.035 (1.57)
Billboard ban: spirits dummy	---	0.023 (1.68)	---	-0.011 (1.10)	---	0.130 (3.12)	---	0.115 (5.04)
Price ad ban: spirits dummy	---	-0.008 (0.94)	---	-0.019 (2.30)	---	0.030 (1.44)	---	-0.047 (2.72)
Midwest state dummy	-0.146 (11.3)	-0.148 (10.9)	-0.057 (4.86)	-0.030 (2.32)	-0.507 (13.9)	-0.547 (14.3)	-0.234 (11.0)	-0.256 (11.8)
Southern state dummy	-0.118 (8.07)	-0.124 (7.65)	-0.082 (6.10)	-0.057 (3.83)	-0.369 (9.09)	-0.430 (10.4)	-0.198 (8.30)	-0.232 (9.47)
Western state dummy	-0.032 (1.86)	-0.038 (2.18)	0.027 (1.73)	0.034 (2.17)	0.006 (0.10)	-0.007 (0.13)	-0.222 (9.19)	-0.233 (9.60)
Adj R-sq (unwt)	0.883	0.883	0.806	0.820	0.906	0.906	0.873	0.876

Notes: Dependent variable is log of per capita ethanol demand in gallons (ages 14+). Sample size is 528 (33 states for the period 1982-97). All estimates obtained using GLS with weights based on the cross-section residual variance for each state; t-statistics reported in parentheses. All continuous variables in log-level, except MLDAs. All regressions include 45 state-specific exponential time trends (1982 = 0). The cross-price for total alcohol is the state cigarette price; for beer, the cross-price is wine; for wine, the cross-price is beer; and for spirits, the cross-price is wine.

Table 4 – Alcohol Demand: All States by Time Periods (per capita gallons of ethanol)

Variable	(1) Total 82-88	(2) Total 89-97	(3) Beer 82-88	(4) Beer 89-97	(5) Wine 82-88	(6) Wine 89-97	(7) Spirits 82-88	(8) Spirits 89-97
Constant	-7.225 (10.3)	-5.734 (12.2)	-1.336 (1.57)	-2.376 (3.93)	-25.14 (10.5)	-30.13 (22.7)	-9.426 (9.96)	-4.185 (5.00)
Income (real per capita)	0.548 (10.5)	0.325 (10.4)	-0.099 (1.80)	-0.028 (0.77)	2.232 (15.2)	2.395 (29.9)	0.575 (9.99)	0.507 (9.03)
Own-price (real)	-0.097 (2.21)	-0.234 (4.73)	-0.237 (5.56)	-0.118 (2.60)	-0.114 (1.21)	-0.283 (3.95)	0.095 (1.89)	-0.495 (6.05)
Cross-price: cigs, wine, beer, wine	-0.099 (2.68)	0.202 (7.82)	0.016 (0.50)	-0.038 (1.36)	-0.308 (2.86)	-0.338 (3.32)	-0.038 (0.97)	0.039 (0.77)
Tourism	0.515 (14.3)	0.591 (18.6)	0.711 (20.4)	0.628 (24.0)	0.634 (7.44)	0.761 (9.60)	0.476 (8.85)	0.414 (6.84)
Pct. ages 18-24	0.836 (9.32)	0.482 (7.92)	0.640 (6.76)	0.564 (7.97)	0.338 (1.18)	1.258 (7.50)	1.054 (8.55)	-0.228 (2.17)
Pct. ages 65+	0.092 (2.36)	0.022 (0.65)	-0.068 (1.50)	0.122 (2.94)	0.441 (3.48)	0.512 (5.09)	0.042 (0.82)	0.031 (0.58)
Unemployment rate	0.056 (4.50)	-0.026 (2.82)	0.011 (0.80)	0.008 (0.72)	0.280 (6.45)	0.050 (1.93)	0.016 (0.84)	0.019 (1.22)
MLDA: spirits, beer, wine, spirits	-0.013 (4.93)	---	-0.007 (2.67)	---	-0.034 (4.08)	---	-0.013 (3.53)	--
Retail monopoly: spirits dummy	-0.066 (8.86)	-0.054 (7.22)	-0.015 (1.43)	-0.006 (0.93)	0.016 (0.54)	0.130 (5.37)	-0.146 (14.4)	-0.176 (10.1)
Billboard ban: spirits dummy	0.052 (5.30)	0.001 (0.07)	-0.053 (5.30)	-0.057 (6.33)	0.240 (5.88)	0.102 (3.26)	0.152 (9.85)	0.129 (6.43)
Price ad ban: spirits dummy	-0.002 (0.30)	0.005 (0.72)	0.034 (3.98)	0.028 (3.19)	-0.123 (4.09)	0.020 (0.67)	-0.055 (4.99)	-0.036 (2.05)
Midwest state dummy	-0.168 (16.6)	-0.069 (6.80)	-0.024 (2.16)	0.032 (3.05)	-0.509 (12.4)	-0.260 (8.68)	-0.284 (16.9)	-0.144 (7.60)
Southern state dummy	-0.123 (7.71)	-0.051 (5.53)	-0.070 (4.29)	-0.016 (1.27)	-0.357 (10.8)	-0.173 (5.43)	-0.208 (10.1)	-0.086 (4.05)
Western state dummy	-0.003 (0.23)	0.001 (0.12)	-0.003 (0.23)	0.007 (0.49)	0.103 (2.09)	0.244 (7.06)	-0.103 (5.91)	-0.028 (1.12)
Adj R-sq (unwt)	0.914	0.803	0.799	0.746	0.893	0.890	0.890	0.767

Notes: Dependent variable is log of per capita ethanol demand in gallons (ages 14+) for 1982-88 and 1989-97, respectively. Sample sizes are 315 and 405 (45 states for seven and nine years). All estimates obtained using GLS with weights based on the cross-section residual variance for each state; t-statistics reported in parentheses. All continuous variables in log-level, except MLDAs. All regressions include 45 state-specific exponential time trends (1982 = 0 and 1989 = 0). The cross-price for total alcohol is the state cigarette price; for beer, the cross-price is wine; for wine, the cross-price is beer; and for spirits, the cross-price is wine.

Table 5 – Alcohol Demand: All States and Beer Ad Bans (per capita consumption of ethanol)

Variable	(1) Total 82-88	(2) Total 82-97	(3) Beer 82-88	(4) Beer 82-97	(5) Wine 82-88	(6) Wine 82-97	(7) Spirits 82-88	(8) Spirits 82-97
Constant	-6.937 (9.71)	-4.137 (10.9)	-1.478 (1.72)	-0.759 (1.90)	-26.00 (11.4)	-20.70 (18.0)	-9.404 (9.81)	-6.225 (10.9)
Income (real per capita)	0.522 (9.83)	0.387 (13.0)	-0.096 (1.73)	-0.072 (2.30)	2.240 (15.8)	1.948 (23.4)	0.596 (10.0)	0.430 (9.77)
Own-price (real)	-0.138 (2.93)	-0.079 (2.49)	-0.221 (5.12)	-0.161 (5.56)	-0.241 (2.36)	-0.218 (3.94)	0.053 (1.10)	0.070 (1.56)
Cross-price: cigs, wine, beer, wine	-0.079 (2.15)	-0.007 (0.38)	0.017 (0.52)	-0.014 (0.67)	-0.415 (3.83)	-0.408 (5.35)	-0.025 (0.60)	0.066 (2.11)
Tourism	0.503 (12.9)	0.413 (15.1)	0.701 (19.6)	0.629 (23.7)	0.554 (5.34)	0.517 (7.97)	0.493 (8.40)	0.351 (8.20)
Pct ages 18-24	0.795 (8.80)	0.438 (11.2)	0.665 (6.96)	0.347 (8.31)	0.406 (1.48)	0.332 (2.75)	0.979 (8.10)	0.712 (12.5)
Pct ages 65+	0.094 (2.48)	-0.039 (1.21)	-0.084 (1.80)	-0.083 (2.75)	0.733 (5.78)	0.400 (4.27)	0.065 (1.26)	-0.132 (2.83)
Unemployment rate	0.057 (4.71)	-0.024 (3.46)	0.013 (0.92)	-0.016 (2.12)	0.317 (7.17)	0.047 (2.10)	0.003 (0.19)	-0.046 (4.10)
MLDA: spirits, beer, wine, spirits	-0.012 (4.51)	-0.019 (8.38)	-0.003 (0.97)	0.003 (1.34)	-0.021 (2.61)	-0.063 (9.15)	-0.013 (3.18)	-0.020 (5.13)
Retail monopoly: spirits dummy	-0.063 (6.73)	-0.053 (7.25)	-0.019 (1.80)	-0.003 (0.42)	0.011 (0.34)	0.051 (2.10)	-0.120 (11.3)	-0.122 (10.3)
Billboard ban: spirits dummy	0.066 (5.83)	0.059 (6.09)	-0.065 (5.11)	-0.038 (4.17)	0.380 (8.88)	0.256 (7.65)	0.195 (12.1)	0.154 (9.79)
Price ad ban: spirits dummy	-0.022 (2.02)	-0.014 (1.68)	0.039 (3.69)	0.026 (3.46)	-0.294 (7.72)	-0.159 (5.66)	-0.073 (5.18)	-0.060 (4.44)
Billboard ban: beer dummy	-0.012 (0.96)	-0.010 (1.15)	0.023 (1.90)	0.008 (0.93)	-0.116 (3.52)	-0.095 (3.81)	-0.087 (5.40)	-0.070 (4.96)
Price ad ban: beer dummy	0.028 (2.29)	0.007 (0.76)	-0.010 (0.66)	0.007 (0.78)	0.354 (7.63)	0.143 (4.46)	0.023 (1.24)	0.017 (1.07)
Midwest state dummy	-0.167 (17.2)	-0.129 (14.4)	-0.030 (2.57)	-0.022 (2.32)	-0.578 (13.7)	-0.409 (12.9)	-0.265 (15.9)	-0.221 (14.7)
Southern state dummy	-0.131 (7.83)	-0.133 (11.4)	-0.080 (4.71)	-0.076 (6.55)	-0.386 (9.73)	-0.303 (9.42)	-0.179 (8.43)	-0.195 (11.0)
Western state dummy	-0.001 (0.04)	0.029 (2.77)	-0.007 (0.43)	0.008 (0.65)	0.145 (2.93)	0.208 (5.55)	-0.099 (5.43)	-0.091 (5.43)
Adj R-sq (unwt)	0.915	0.897	0.796	0.798	0.908	0.904	0.891	0.897

Notes: Dependent variable is log of per capita ethanol demand (ages 14+) for 1982-88 and 1982-97, respectively. Sample sizes are 315 and 720 (45 states for seven and fifteen years). All estimates obtained using GLS with weights based on the cross-section residual variance for each state; t-statistics reported in parentheses. All continuous variables in log-level, except MLDAs. All regressions include 45 state-specific exponential time trends (1982 = 0).

Table 6 – Fitted Values and Incremental Contributions, 1982 and 1997

	California		Florida		Illinois		New York		Pennsylvania	
Dep. Variable	**1982**	**1997**	**1982**	**1997**	**1982**	**1997**	**1982**	**1997**	**1982**	**1997**
Total alcohol (level)	3.230	2.250	3.290	2.620	2.830	2.310	2.840	1.930	2.360	1.870
Fitted value (level)	3.139	2.185	2.532	2.799	2.408	2.473	2.775	1.860	2.429	1.803
Residual (level)	0.091	0.065	0.758	-0.179	0.422	-0.163	0.065	0.070	-0.069	0.067
Log fitted value	1.144	0.782	0.959	1.029	0.871	0.906	1.021	0.621	0.887	0.590
Incremental contribution to change in fitted value, 1982-1997:										
Indep. Variable	**Level**	**Log**	**Level**	**Log**	**Level**	**Log**	**Level**	**Log**	**Level**	**Log**
State time trend	-1.096	-0.349	0.372	0.113	-0.055	-0.023	-1.060	-0.382	-0.712	-0.292
Income	0.120	0.045	0.256	0.091	0.244	0.096	0.269	0.119	0.213	0.103
Own-price	0.028	0.010	0.032	0.011	0.022	0.008	0.015	0.006	0.012	0.006
Cross-price	-0.002	-0.001	-0.001	-0.001	-0.002	-0.001	-0.002	-0.001	-0.001	-0.001
Tourism	0.176	0.066	0.109	0.039	0.215	0.086	0.163	0.071	0.088	0.042
Pct. ages 18-24	-0.384	-0.140	-0.453	-0.154	-0.394	-0.150	-0.358	-0.157	-0.372	-0.177
Pct. ages 65+	-0.013	-0.005	-0.009	-0.003	-0.009	-0.004	-0.007	-0.003	-0.014	-0.006
Unemploy. rate	0.035	0.012	0.041	0.014	0.061	0.022	0.021	0.008	0.046	0.019
MLDA (increase)	---	---	-0.101	-0.040	---	---	-0.166	-0.060	---	---
Price ad ban (drop)	---	---	---	---	---	---	---	---	0.022	0.009
Sum of increments	-1.136	-0.362	0.246	0.070	0.082	0.034	-1.125	-0.399	-0.718	-0.297
Fitted change	-0.954	-0.362	0.267	0.070	0.065	0.035	-0.915	-0.040	-0.626	-0.297

Notes: Level values are in per capita gallons of ethanol. Incremental contributions in logs add-up to the change in the log fitted value. The level estimates are based on arc elasticities, using the mean ratio of (A/X) averaged over the period 1982-97. The level estimates of changes are approximate values. *Sum of increments* is the column sum of the incremental contributions, and *Fitted change* is the difference in the row values for Fitted value (level) and Log fitted value.

Appendix A – Variables and Data Sources

Alcohol consumption per capita – state per capita alcohol consumption (ages 14+) in gallons of pure alcohol (ethanol) for each beverage; total alcohol obtained by summing over the three beverages (see Table 1). Population deflator is ages 14 years and older. Source: NIAAA (1999).

Real income per capita – state per capita disposable personal income, deflated by the implicit price deflator (IPD) for gross domestic product (1992 = 100). Sources: U.S. Bureau of Economic Analysis, *Survey of Current Business* (Washington, DC: U.S. Department of Commerce, monthly); and BEA web site at http://www.bea.doc.gov.

Beverage prices – ACCRA state price of each beverage, deflated by the CPI-U (1992 = 100) and expressed in dollars per standard container. The real price of total alcohol is a beverage share-weighted average, using ethanol consumption in each year as the weights. Each beverage price was converted to the price per ounce of ethanol (see Table 1). Source: Young and Bielinska-Kwapisz (2001).

Cigarette price – state average price per pack of cigarettes, deflated by the CPI-U (1992 = 100), and expressed in cents per pack. Source: *The Tax Burden on Tobacco: Historical Compilation* (Washington, DC: Orzechowski and Walker, 1999).

Tourism – percent of total state employment in combined industries of (1) eating and drinking places, (2) hotels and other lodging places, and (3) amusement and recreation services. Source: U.S. Bureau of Labor Statistics web site at http://stats.bls.gov.

Percent ages 18-24 – percent of state population in the age group 18 to 24 years. Sources: U.S. Bureau of the Census, *Statistical Abstract of the United States* (Washington, DC: U.S. Department of Commerce, annual); and U.S. Bureau of the Census web site at http://www.census.gov.

Percent ages 65+ – percent of state population in age group 65 years and older. Sources: U.S. Bureau of the Census, *Statistical Abstract of the United States* (Washington, DC: U.S. Department of Commerce, annual); and U.S. Bureau of the Census web site at http://www.census.gov.

Unemployment rate – state unemployment rate. Sources: U.S. Bureau of the Census, *Statistical Abstract of the United States* (Washington, DC: U.S. Department of Commerce, annual); and U.S. Bureau of Labor Statistics web site at http://stats.bls.gov.

Minimum legal drinking ages (MLDA) – state minimum age in years for each beverage, adjusted for grandfather clauses. Sources: F. Chaloupka, *State Minimum Alcohol Purchase Age Laws*, University of Illinois at Chicago, July 1988; and Wegenaar (1981/82).

State monopoly control – state retail and wholesale control of distilled spirits sales (one equals state control, zero otherwise). Sources: *Summary of State Laws & Regulations Relating to Distilled Spirits*, 24th to 29th editions (Washington, DC: DISCUS, 1983, 1985, 1989, 1991, 1993, 1996); and Holder and Janes (1987).

Advertising bans – state bans of billboard advertising of distilled spirits (one equals ban, zero otherwise) and state bans of price advertising of spirits (one equals ban, zero otherwise). Sources: *Summary of State Laws & Regulations Relating to Distilled Spirits*, 24th to 29th editions (Washington, DC: DISCUS, 1983, 1985, 1989, 1991, 1993, 1996); and Holder and Janes (1987). For beer, Sources are Sass and Saurman (1995); and *Modern Brewery Age Blue Book* (East Norwalk, CT: Modern Brewery Age Publications, annual).

Appendix B – Estimated State-Specific Time Trends (from Table 2, regr. 2)

State	Trend	State	Trend	State	Trend	State	Trend	State	Trend
AL	-0.0088 (.0013)	ID	-0.0226 (.0014)	MA	-0.0131 (.0017)	NY	-0.0255 (.0014)	SD	-0.0116 (.0014)
AZ	-0.0118 (.0014)	IL	-0.0016 (.0025)	MI	-0.0132 (.0016)	NC	-0.0150 (.0016)	TN	-0.0214 (.0026)
AR	-0.0153 (.0022)	IN	-0.0204 (.0016)	MN	-0.0034 (.0015)	ND	-0.0009 (.0017)	TX	-0.0046 (.0020)
CA	-0.0233 (.0014)	IA	-0.0187 (.0017)	MS	-0.0064 (.0027)	OH	-0.0140 (.0013)	VT	-0.0152 (.0016)
CO	-0.0200 (.0019)	KS	-0.0283 (.0029)	MO	-0.0090 (.0014)	OK	-0.0256 (.0028)	VA	-0.0181 (.0022)
CT	-0.0158 (.0016)	KY	-0.0249 (.0024)	MT	-0.0074 (.0020)	OR	-0.0102 (.0018)	WA	-0.0175 (.0014)
DE	-0.0017 (.0019)	LA	0.0010 (.0020)	NE	-0.0091 (.0012)	PA	-0.0195 (.0016)	WV	-0.0241 (.0024)
FL	0.0075 (.0035)	ME	-0.0155 (.0017)	NJ	-0.0162 (.0015)	RI	-0.0110 (.0018)	WI	0.0112 (.0025)
GA	-0.0148 (.0015)	MD	-0.0219 (.0015)	NM	-0.0166 (.0015)	SC	-0.0068 (.0020)	WY	-0.0264 (.0018)

Notes: Standard errors reported in parentheses. State-specific exponential time trends for 1982-97 (1982 = 0) from regression (2) in Table 2, with an adjusted R^2 of 0.896. An auxiliary regression of total alcohol on the time trends and a constant term yielded an adjusted R^2 of 0.612, and adding the regional dummies raised this value to 0.765.
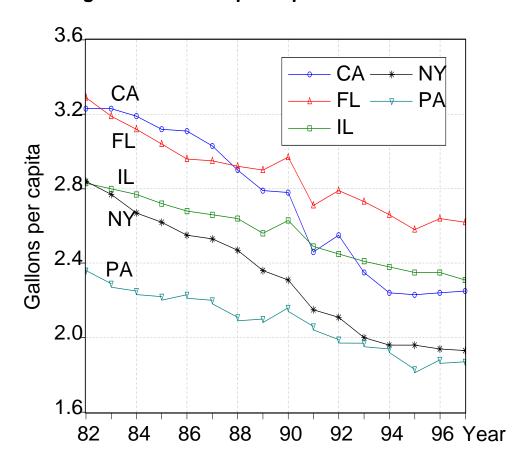
Figure 1. Ethanol per capita--Selected States