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ALCOHOL CONSUMPTION AND TAX DIFFERENTIALS BETWEEN BEER, WINE AND SPIRITS

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ABSTRACT

Several public health interest groups in the United States have recently called for equalization of the federal tax on a unit of alcohol in beer, in wine and in spirits. This paper provides some new empirical evidence of what effect alcohol tax differentials have on total alcohol consumption. The data indicate that the greatest decrease in alcohol consumption results from an increase in spirits taxes, followed by beer taxes and then wine taxes. This suggests that the existing generally accepted taxation policy of placing the highest tax on spirits, a lower tax on beer, and the lowest tax on wine, results in the greatest reduction in total alcohol consumption.

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I. Introduction

Many countries, including the United States, have adopted taxation and other regulatory policies which favor beer and wine over spirits. The justification for these policies has been the belief that there are differential physiological effects and public health effects associated with each beverage.[1] Some support for this belief is provided by the biomedical literature. The Brewers Association of Canada (1986) and the Wine Institute of California (1986) review a number of medical studies of the physiological effects of beer, wine, and spirits. These medical studies indicate that the consumption of alcohol in the form of beer or wine results in a slower increase in blood alcohol concentration, a lower maximum blood alcohol concentration, and a faster decrease in blood alcohol concentration, than when the same amount of alcohol is consumed in the form of spirits.[2]

In the United States, alcohol tax differentials were increased in 1985. The change was the result of an increase in the federal excise tax on spirits. The tax increase precipitated a public

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[1] A second justification for these policies is based on the relative production costs of each beverage. A unit of alcohol is relatively cheaper to produce in the form of spirits than it is in the form of beer or wine. Excise tax differentials thus tend to equate the purchase price of a unit of alcohol in each of the three beverages.

[2] The Wine Institute review explains that beer and wine produce lower blood alcohol levels because of the nutrients found in these beverages. These nutrients stimulate a digestive process which breaks down alcohol and thus limits the amount of alcohol which can be absorbed into the blood stream. There is much less evidence of differential physiological effects of beer and wine.

service campaign by the distilling industry to promote the concept of equivalence. The equivalence concept states that a 1.25 ounce shot of whiskey, a 12 ounce can of beer, and a five ounce glass of wine all have the same alcohol content. The implication of this campaign was that because each serving has the same alcohol content, each alcoholic beverage has the same potential for adverse public health consequences. This suggests that the alcohol, in each alcoholic beverage, should receive the same tax treatment.

This equivalence campaign was also supported by several alcohol oriented public interest groups. One of these interest groups circulated a petition to academic economists in support of an increase in all alcohol taxes and an equalization of the tax on alcohol in each of the three alcoholic beverages. This petition was signed by 80 economists including three Nobel laureates.

The central issue in the debate over equalizing alcohol tax differentials is the degree of beverage substitutability. While beer, wine and spirits all contain alcohol these three beverages are not perfect substitutes. If the three beverages are strongly substitutable, a increase in one tax, or disproportionate increases in all taxes, will induce some consumers to shift to the relatively less expensive beverage. Substitution of beverages will limit the reduction in alcohol consumption which results from the increase in taxes. Alternatively, if the three alcoholic beverages are only weakly substitutable then a change in the tax on one beverage would have only a minor effect on the consumption mix.

While there are a priori reasons to assume substitutability between the three beverages, a review of the empirical literature by Ornstein and Levy (1983) finds little evidence of substitutability. Uri (1986), however, reports evidence that the three alcoholic beverages are substitutable.

The purpose of this paper is to provide a new empirical test of the effect that alcohol tax differentials have on total alcohol consumption. The focus on total alcohol consumption rather than beer, wine and spirits is important for two reasons. First, alcohol related public health problems are a function of total alcohol consumption rather than specific beverage consumption. Second, estimation of a total alcohol demand function reduces the number of estimated parameters that must conform to a priori constraints imposed by demand theory.

II. Empirical Framework

Consumer demand theory provides the conceptual framework for the empirical models. The demand for alcohol is derived by assuming that an individual's utility depends on the consumption of alcohol, the consumption of other goods, and taste. Maximizing this utility function subject to a budget constraint yields the following demand curve for alcohol:

(1) $$A = \beta_1 P + \beta_2 I + Z_1 \alpha_1 + \mu_i$$

The demand for alcohol (A) is defined as a function of the price of alcohol (P), income (I), and a vector of other factors (Z_1).

The price of alcohol can be defined as a function of beer, wine and spirits taxes (t_b, t_w, t_s), other factors (Z_2) as follows.

(2) $$P = \theta_b t_b + \theta_w t_w + \theta_s t_s + Z_2\alpha_2 + \mu_2$$

This price function can be substituted for price in the demand curve. The result in a reduced form demand curve which shows that alcohol consumption is a function of taxes, income and other factors:

(3) $$A = \pi_b t_b + \pi_w t_w + \pi_s t_s + \pi_1 I + Z_3\alpha_3 + \mu_3$$

In these three equations β, θ, and π are coefficients, α are coefficient vectors and the μ values are error terms. The reduced form alcohol demand equation can be aggregated across individuals to yield an empirically estimatable equation.

An increase in any one of the beverage taxes results in two effects. The first effect, called the own-price effect, is a reduction in consumption of that beverage. Demand theory requires a negative own-price effect. The second effect, called a cross-price effect, is a change consumption of another beverage. Demand theory does not provide any a priori conclusions about the direction or magnitude of cross-price effects. If an increase in any one of the taxes results in an increase in consumption of another beverage then the two beverages are substitutes. The own-price effect causes a reduction in total alcohol consumption. However, cross-price effects can increase alcohol consumption. The net effect on total alcohol consumption of an increase in any one alcohol tax, or of a change in alcohol tax differentials, is thus ambiguous.

III. Data

The data set used in this study is a time series of cross sections consisting of 14 countries for the years 1970 through 1983. Data from 14 countries are used since the variation in taxation policies is greater across countries than within any single country. For example, in the United States, federal tax differentials between beer, wine and spirits were constant from 1951 to 1985. There is, however, considerable variation in alcohol tax differentials across countries. The increased variation in tax differentials available from an international data set improves the precision of the empirical tests. The 14 countries used in this study are members of the Organization for Economic Cooperation and Development (OECD). The OECD countries were chosen because they have attempted to maintain a data base of comparable economic and social data since 1960. The member countries of the OECD are also the most developed free market countries in the world. The data set was limited to 14 countries because of the availability of data. The data set begins with 1970 and ends in 1983. Table 1 contains summary definitions and mean values for all the variables.

The dependent variable used in the regressions is per capita annual consumption of pure alcohol in liters. These data come from the International Survey of Alcohol Beverage Control Polices published by the Brewers Association of Canada (BAC). The variable is computed by adding together the per capita consumption of pure alcohol in beer, wine and spirits. The data are based on different assumptions, by year and country, about the percent of alcohol in each beverage.

There are three methods of taxing alcohol. These are: (1) national alcohol taxes, (2) local alcohol taxes, and (3) value added or sales taxes which are not specific to alcohol. Each country included in this study uses national alcohol taxes and several countries also use local and value added or sales taxes. Only the national tax data is available on a consistent and historical basis across countries. However, national alcohol taxes, which are usually excise taxes, are the largest of the three taxes. National alcohol taxes are also more important than value added and sales taxes because they are alcohol specific.[3]

The tax data used in the regressions are national taxes per liter of pure alcohol. The national alcohol tax data were divided by the gross domestic product deflator and the purchasing power

[3] Local alcohol taxes are generally lower than national taxes and tend to reflect the pattern of national taxes. The tax differentials are thus not seriously affected by local taxes. Value added and sales taxes are a percentage of price and thus tend to tax the alcohol in beer and wine at a higher rate than spirits. This tends to reduce the size of the actual total tax differential on spirits.

parity.[4] The data come from the BAC International Survey of Alcohol Beverage Control Polices.

Real income was computed by first dividing gross domestic product by population. This was then divided by the gross domestic product deflator and the purchasing power parity. The data are in thousands of U.S. dollars and come from the OECD National Accounts.

The regressions also include a measure of health awareness. This variable is the general mortality rate. Higher mortality rates are associated with lower levels of demand or supply of health services. This variable should have a positive relationship with alcohol demand. The variable is measured as total mortality from all causes divided by population in thousands. The data come from the UN Demographic Yearbook.

A dichotomous spirits advertising ban variable is included in the alcohol demand equation. This variable is equal to one if a country has a voluntary or mandatory ban on broadcast advertising of spirits and is otherwise equal to zero. These data come primarily from the International Survey of Alcohol Beverage Control Polices.

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[4] Taxes and income are reported in units of national currency and must be standardized using purchasing power parities. The OECD reports purchasing power parities for the member countries based on 1980 survey data. Although reliability diminishes with distance from the sample year, purchasing power parities can be estimated for earlier years using inflation rates. The purchasing power parity converts taxes and income to U. S. dollars. Taxes and income are also adjusted for inflation using the gross domestic product deflator with the base year of 1975.

The disadvantage of an international data set is the difficulty in measuring the other factors effecting alcohol consumption. For example, cultural differences may effect alcohol consumption across countries even after observable phenomena are controlled. Quantitative information measuring all the factors influencing alcohol consumption across countries does not exist. The omission of these factors could result in biased estimates of the effects of alcohol taxes.

A fixed effects model is one method of approximating the influence of these omitted factors. Fixed effects models use a series of country dummy variables which, according to Johnston (1984), can account for differences in country specific unobserved factors. These fixed effects models also include time dummy variables which account for time trends in the dependent variables. Cook and Tauchen (1982) also use fixed effects models to estimate the effects of taxes and income on liquor consumption and liver cirrhosis mortality rates.

IV. Results

The results from four fixed effects models are summarized in table 2.[5] Each model includes 13 country dummies and 13 time dummy variables for the years 1970 to 1982. These dummy variables account for excluded country and time specific factors which effect

[5] The dependent variable was transformed into the natural logarithm of alcohol consumption. This functional form is often used in demand studies. Because of aggregation, these regressions are weighted by $n^{1/2}$, where n is the population of the country.

the dependent variable. Each model uses an alternative combination of the independent variables which provides a test for specification bias. The three taxes are included in all four models.

The results presented in table 2 show that beer taxes and spirits taxes have a significant negative effect on total alcohol consumption. Wine taxes, however, have no significant effect on total alcohol consumption. The beer tax coefficient indicates that if beer taxes were increased, the increase in alcohol consumption in the form of wine and spirits is insufficient to offset the decrease in alcohol consumption in the form of beer. The spirits tax coefficient indicates that if spirits taxes were increased, the increase in alcohol consumption in the form of beer and wine is also insufficient to offset the decrease in alcohol consumption in the form of spirits. The wine tax coefficient indicates that if wine taxes were increased, the increase in alcohol consumption in the form of beer and spirits is sufficient to offset the decrease in alcohol consumption in the form of wine.

These results suggest that wine is substitutable with beer and spirits, but beer and spirits are only weakly substitutable with each other. A change in wine taxes would cause substitution to beer and spirits. Symmetry requires that an increase in beer or spirits taxes cause substitution to wine. These substitution effects are not sufficient to offset the own-price effects. An increase in beer or spirits taxes would not, however result in much substitution between these beverages.

Real income is also included in three specifications. Real income has no a priori expectation since an increase in income can be expected to increase the demand for both alcohol and health. The increased demand for health could reduce the demand for alcohol. Real income is positive and significant in the alcohol demand equations. These results show that an increase in income increases per capita alcohol consumption.

The remaining independent variables are significant and conform to a priori expectations. The general mortality rate is inversely related to health awareness. The positive coefficient of general mortality suggests that alcohol demand is lower where health awareness is higher. The advertising ban variable is negative and significant suggesting that banning spirits advertisements reduces alcohol demand.

V. Conclusions

This paper provides an empirical test of the effects of alcohol tax differentials on alcohol consumption. Since there is little variation in tax differentials over time in individual countries, data from 14 countries over a period of 14 years were employed in the empirical models. All of the regression models estimated are fixed effects models which account for unobservable influences which vary by country and time.

The elasticity of total alcohol consumption with respect to beer taxes is estimated to be .071 and for spirits taxes is estimated to be .104. Wine taxes have no significant effect on total alcohol consumption. These elasticities were estimated using the empirical model which includes all the independent variables. The elasticities indicate that the greatest decrease in alcohol consumption results from an increase in spirits taxes. A given percentage increase in beer taxes will reduce alcohol consumption by about 70 percent as much as the same percentage increase in spirits taxes. Wine tax increases have no effect on total alcohol consumption. This suggests that the existing generally accepted taxation policy of placing the highest tax on spirits, a lower tax on beer, and the lowest tax on wine, results in the greatest reduction in total alcohol consumption.

Table 1

Definitions and Means of Variables*

Variable	Definition and Mean
Per Capita Consumption of Pure Alcohol	Consumption in liters per capita of pure alcohol from beer, wine and spirits. μ=8.95.
Beer Tax	National tax on a liter of pure alcohol in the form of beer divided by GDP deflator and converted to U.S. dollars by dividing by the purchasing power parity. μ=5.10.
Wine Tax	National tax on a liter of pure alcohol in the form of wine divided by GDP deflator and converted to U.S. dollars by dividing by the purchasing power parity. μ=4.29.
Spirits Tax	National tax on a liter of pure alcohol in the form of spirits divided by GDP deflator and converted to U.S. dollars by dividing by the purchasing power parity. μ=12.96.
Real Income	National income divided by GDP deflator and converted to thousands of U.S. dollars by dividing by the Purchasing Power Parity. μ=5.84.
General Mortality Rate	Mortality from all causes, per thousand population. μ=10.06.
Advertising Ban	A dichotomous variable is equal to one if a country has a ban on broadcast advertising of spirits, and is equal to zero otherwise. μ=0.68.

*All data are for the 14 countries for the years 1970 through 1983. The 14 countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Ireland, Luxembourg, Netherlands, Norway, Sweden, the United Kingdom, and the United States.

Table 2*

Fixed Effects Models

Dependent Variable: Alcohol Demand				
Beer Tax	-.009 (1.66)	-.009 (1.68)	-.012 (2.26)	-.014 (2.68)
Wine Tax	.005 (1.05)	.007 (1.42)	.007 (1.36)	.003 (.67)
Spirits Tax	-.006 (4.22)	-.009 (5.01)	-.007 (4.47)	-.008 (4.64)
Real Income		.022 (2.64)	.029 (3.51)	.033 (3.97)
General Mortality			.065 (3.61)	.067 (3.80)
Advertising Ban				-.182 (2.57)
R-Squared	.98	.98	.98	.98

* The t-ratios are in parentheses. All equations include dummy variables for 13 countries and the years 1970 through 1982, and an intercept.

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