

AN ABSTRACT OF THE THESIS OF

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Victor J. Tremblay

This paper presents a model of the determination of excise tax rates by studying the substantial variation in the state excise taxes in the U. S. brewing industry. Two approaches are used. First, assuming that the government is only interested in the public interest, a socially optimal tax rate is derived. The magnitude of the tax rate is determined by the negative externalities of drinking behavior imposed on nondrinkers. Second, a special interest group that engages in lobbying activity and makes campaign contributions is introduced into the model. The government not only cares about the welfare of the society, but is also concerned about the abundance of its campaign contributions. The lobbying activity by the interest group causes the tax rate to deviate from the social optimum. Data from the beer industry in 1992 and 1995 are employed in the estimation. Instrumental variable techniques are used to deal with endogenous consumption and heteroscedasticity. The estimation indicates that states with a production capacity one barrel per person higher than the average state will have a beer tax 20 cents per barrel lower than average. The paper provides evidence that the power of interest group hampers the economic efficiency of the local tax system.

**State Excise Taxes and Public Choice:
Evidence from the U. S. Brewing Industry**

by

Hongrong Feng

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Approved:

Redacted for Privacy _____
Major Professor, representing Economics

Redacted for Privacy _____
Chair of Department of Economics

Redacted for Privacy _____
Dean of Graduate School

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Hongrong Feng, Author

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State Excise Taxes and Public Choice: Evidence from the U. S. Brewing Industry

I. Introduction

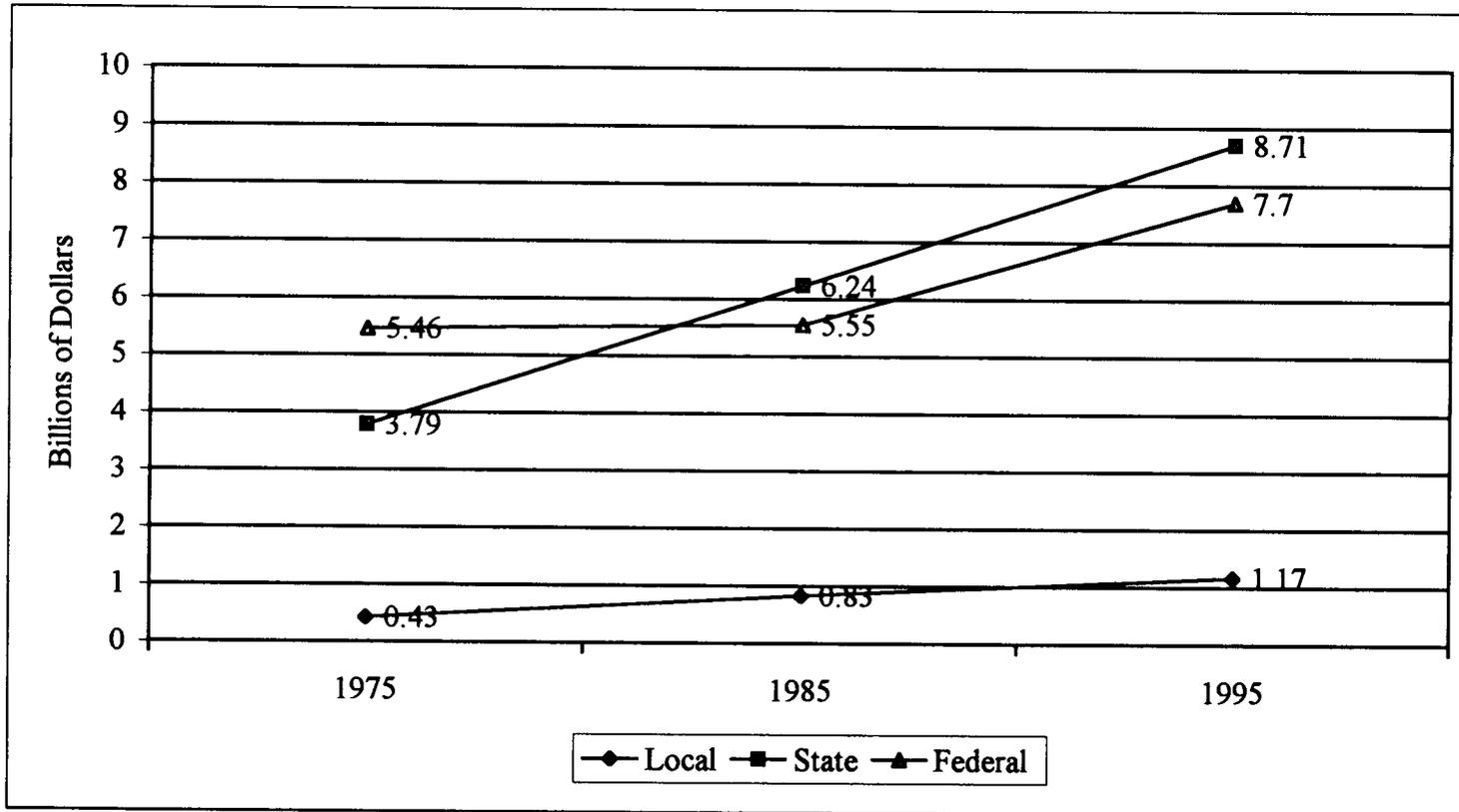
Excise taxes on sin goods such as cigarettes, liquor and beer have become more and more popular as a means both to reduce consumption of commodities that impose externalities on society and to generate government revenues. Alcohol consumption is a social concern because some individuals drink and drive automobiles. In 1996, for example, 17,126 people perished in crashes involving alcohol in the United States, equivalent to an average of one every 32 minutes. These deaths constituted approximately 41% of all 41,901 traffic fatalities in 1996 (National Highway Traffic Safety Administration (1997)). About 1,058,990 people were injured in alcohol-related crashes - an average of one person injured approximately every 30 seconds. About 30,000 people a year will suffer permanent work-related disabilities due to alcohol (Miller et al. (1996)). However, the social cost of drinking and driving is not limited to the parties involved. In addition to loss of lives, injuries, and property damage incurred by individuals involved in alcohol related accidents, more resources have to be allocated for law enforcement, adjudication and insurance costs. In 1993, alcohol-related crashes were estimated to have cost society \$45 billion (Miller et al. (1996)). Alcohol abuse, particularly by youth, is also closely linked to violent crimes. Cook and Moore (1994) find a significant relationship between per capita alcohol consumption and the rate of

every violent crime except homicide, with elasticities of 0.6 for assault, 0.7 for rape, and 0.9 for robbery. The ill effects of alcohol consumption also include an increased number of unwanted pregnancies and a higher incidence of cirrhosis of the liver.

The argument that the user should pay for the negative externalities can be justified in terms of fairness and efficiency. The fairness argument has been suggested by Surgeon General C. Everett Koop (Center for Science in the Public Interest (1990)), who referred to the alcoholic excise tax as a "user fee". The fairness can be justified considering that the drinkers cause costs stemming from alcohol-related traffic accidents or crimes that are borne by innocent victims, boost costs of auto insurance and medical insurance, and claim a disproportionate share of government expenditures on medical care, long-term care, and criminal justice services. The efficiency argument is the notion of a Pigovian tax. Given negative externalities in consumption, some people will drink more than is efficient, since they ignore the external cost of alcohol consumption. The Pigovian tax has the effect of raising the price of alcohol to the level that reflects the social cost of an additional drink.

On the other hand, persistent state and federal budget deficits have triggered a search for new ways of generating government revenue without increasing sales and income tax rates. As stated by Buchanan and Pauly (1970), excise taxes, by virtue of their narrow bases, provide perhaps the best opportunity for shifting the cost of the public sector on to a select group of individuals. From 1975 to 1995, tax revenues from alcoholic beverages have grown dramatically (shown in Figure 1). Excise taxes on alcoholic beverages generated \$5.46 billion in tax revenue for federal government in

Figure 1: Revenue from Taxes on Alcohol Beverages by Level of Government



1975, remained the same until 1985 and increased by 41% to reach \$7.70 billion by 1995. State and local government collected revenue of \$8.71 billion and \$1.17 million in 1995, climbing up 130% and 172% respectively from the 1975 levels.¹

The effectiveness of excise taxes on reducing consumption and raising tax revenues for government depends upon the tax rates and the demand elasticities. Currently, the excise tax on alcohol has two parts. The federal government charges taxes on various kinds of alcoholic beverages, which affect the alcohol consumption in all states. On the top of the federal excise tax, each state adds its own tax on alcoholic beverages. However, tax rates vary dramatically among states. Interestingly, there has been very little research on the determinants of these tax rate differences. To quote Hasen (1983):

“Political scientists, despite their increasing interest in policy over the past twenty years, have focused on government spending and have ignored tax policy almost entirely. Economists have developed powerful analytical tools to examine the effects of taxes on the economy, but few have paid much attention to the origins of taxes or the political changes they impose.”

In this paper, we intend to fill this void, in part, through studying the significant variation in state excise tax rates in the U. S. beer industry. Our concerns are: What are the factors that are playing roles in the government’s policy making process? Are the tax rates set at levels that are effective in adjusting the consumption to its socially optimal level? Does the variation in the state tax rates reflect the different abuse behavior across states? In view of the similarity among consumption and production of most of the sin commodities, our research can be easily extended with small modifications to other

¹ Adapted from "Public Revenues from Alcohol Beverages, 1995," Distilled Spirits Council of the United States. URL: <http://www.discus.health.org/govlev.htm>. April 5, 1998.

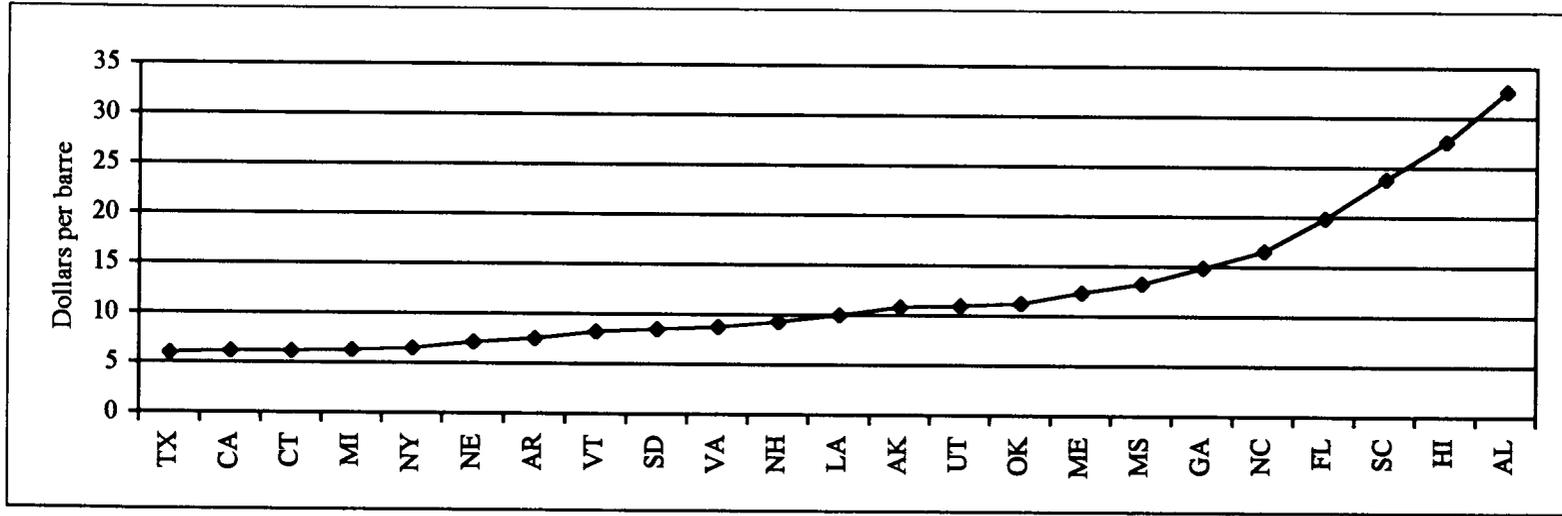
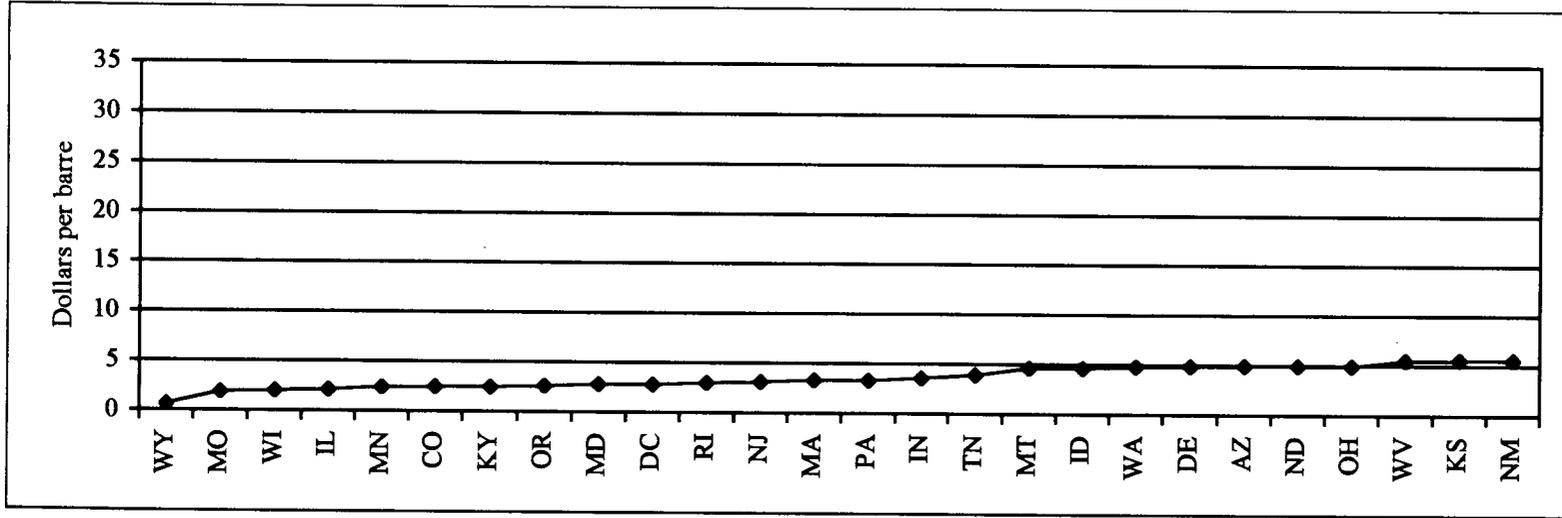
industries such as liquor, wine and cigarettes. It can also be applied to industries that are unfavorable to society in the sense that they impose unwelcome effects such as pollution.

II. Overview of Beer Industry

Although the production of beer had reminded people of small-scale home brewing in its early ages, today, microbrewers aside, beer production in the United States is highly concentrated both geographically and industrially. During the last half of this century, the decline in the number of individual plants and independent companies in the brewing industry has been dramatic. In 1935, 750 brewing plants were operating in the United States. The number has fallen to a total of 58 in 1992. Along with the decline in the number of companies, an increasing share of the market is held by the largest brewers. In 1947, the top five companies accounted for only 19 percent of the industry's barrelage; in 1992 their share was 88 percent (Elzinga (1995)). Beer production is also centralized geographically. The states of Missouri, Wisconsin and Colorado, where the largest three breweries are located, account for 55% of the total beer production capacity in this country. Beer is an expensive product to ship. Breweries serve their distant customers at a significant transportation cost disadvantage. Although the large breweries are beginning to operate new plants closer to the new markets in order to extend their reach to serve wider geographic regions, currently the centralization is still notable. Prohibited by law from owning retail outlets, most brewers rely on independent distributors to channel their product to the consumers. Both a federal and a state-specific excise tax are charged on the consumption of beer. Federal tax, having remained at \$9 per barrel from 1951 to 1990, leaped to \$18 per barrel in 1991. Each state is taxing beer consumption

very differently. Figure 2 shows the variation of state excise taxes on beer in 1992. Tax rates ranged from \$0.62 per barrel in Wyoming to \$32.65 per barrel in Alabama, with a mean of \$7.67 and standard deviation of \$6.63.

Figure 2: State Excise Taxes on Beer in 1992



III. Literature Review

There is considerable research on the effect of excise taxes on consumption. Lewit and Coate (1982) examine the potential for reducing cigarette smoking through increases in cigarette excise taxes by estimating the price elasticity of demand for cigarettes. They find that the adult price elasticity of demand for cigarettes is -0.42 and that the price operates primarily on the decision to smoke rather than via adjustments in the quantity of cigarettes smoked. Wasserman et al. (1991) estimate a generalized linear model to examine adult and teenage cigarette demand with a focus on the extent to which excise taxes and regulations restricting smoking in public places affect cigarette consumption. Their results indicate that the price elasticity of demand is unstable over time, ranging from 0.06 in 1970 to -0.23 in 1985. The teenage price elasticity does not differ statistically from the estimates for adults. Baltagi and Griffin (1995) estimate a dynamic demand model for liquor in the United States using panel data from 43 states over the period 1959-1982. The finding suggests that sin taxes raise revenues for government and reduce consumption. Heien and Pompelli (1989) present estimates of a demand system for beer, wine and spirits based on household-level survey data. Both the price elasticity of each beverage and the demographic effects on consumption have been examined. The results show that demand is inelastic for all classes of alcoholic beverage. Demographic effects play a significant role.

Although there has been extensive research on the impact of excise taxes on consumption, there has been little work done on the determination of excise tax rates. On the theoretical side, research on the role of special interest groups from public choice may

be useful in explaining excise tax rates. For example, Denzau and Munger (1986) suggest that the interest group can pay a bribe in order to seek a favorable policy move. Nevertheless, government officials are elected as a representative of their constituencies, therefore the unorganized and noncontributing voters can shape and constrain political decisions to a great extent. Fredriksson (1997) develops a positive theory to explain pollution tax policy outcomes in a small open economy. He finds that the political equilibrium tax rate on pollution is lower than the Pigovian rate. The result can be explained by the lobbying activity of the interest group and the relative weight given to social welfare by the politicians involved.

Empirical work on the topic is even more rare. Benjamin and Dougan (1997) evaluate the cause of tax rate variation in the U. S. cigarette industry. They develop a model in which the producer location affects the level of excise taxes. The model predicts that taxes rise at decreasing rate as one moves outward from the point of production. The prediction is consistent with the observed pattern of cigarette taxes imposed by state governments in the United States. An important consequence of cigarette excise taxes is bootlegging, the smuggling of the cigarettes from a nearby state with a lower tax rate. Although the model provides some valuable insights into the tax determination issue, it can not be applied to the beer industry or other alcoholic beverage industries because bootlegging is not an important problem in the beer market in view of the difficulties with bulk transportation. Therefore, another approach is needed to explain the substantial variation of excise taxes on beer in the United States.

IV. Theoretical Model

We look into the issue through two approaches. First, we assume that no influence of a politically active group exists in the tax determination process. The approach provides us information on the socially optimal tax rate. Second, the activity of a special interest group is added to the basic model. The approach identifies the effect of the interest group on the political equilibrium tax.

We begin with a model of social welfare maximization. An ideal tax rate for a society is one that maximizes the aggregate utility of the society rather than a particular group. We assume that there are two types of commodities - beer (B) and a numeraire good (Z) that the consumers can choose from. All the individuals in the society can be categorized into beer drinkers (D), who extract positive utility from drinking beer, and non-drinkers (N), whose utilities are reduced by beer consumption. These utility reductions can be reflected in many ways in reality, such as death, injury or property damage from drunk driving, increased medical or auto insurance, and social problems such as homeless. The aggregate utility function for the society is written as consisting of the different utilities of the two categories of consumers. For simplicity, we focus solely on the utilities of consumers and leave out the producer side. This is justifiable for the current purpose of determining the optimal tax level, since this does not require identification of the tax incidence. The production side will be considered below. The social welfare function is represented as

$$U_A = U_D (B_D, Z_D) + U_N (B_D, Z_N)$$

where U_A represents the aggregate utility function for the society; U_i is the utility

function of a representative consumer in group i ($i = D, N$); Z_i is the consumption of the numeraire good by individual i ($i = D, N$); and B_D is the consumption of beer by the drinker.

Furthermore, in the above social welfare function, $\frac{\partial U_i}{\partial Z_i} > 0$ ($i = D, N$), which

means both groups draw positive utilities from consumption of the numeraire good.

$\frac{\partial U_i}{\partial B_D}$ represents the marginal utility of individual i from beer drinking ($i = D, N$). $\frac{\partial U_D}{\partial B_D}$

> 0 , which represents the enjoyment that the drinker gains from beer drinking. $\frac{\partial U_N}{\partial B_D} < 0$,

which indicates utility cutback of the nondrinker due to the ill effects from drunk driving and alcohol-related health problems.

The individual is seeking to maximize "private utility" subject to the budget constraint. When no excise tax is levied on beer consumption, the budget constraint for the beer drinker is:

$$L_D = P_B B_D + P_Z Z_D$$

where P_B and P_Z are the prices of beer and the numeraire good respectively.

Optimization by the beer drinker yields the following first order condition:

$$\frac{\partial U_D}{\partial B_D} = \alpha P_B \quad (1)$$

where α is the individual's marginal utility of income.

The utility function of nondrinker is negatively affected by the consumption of beer by the drinker, over whom he has no control. The optimization by the beer drinker does not result in the optimization of aggregate social welfare because he has no motive to

take into account of the utility loss of nondrinker. Social welfare maximization requires the aggregate utility optimization subject to the budget constraint of the entire society:

$$L = P_B B_D + P_Z (Z_D + Z_N)$$

yields:

$$\frac{\partial U_D}{\partial B_D} = \alpha P_B - \frac{\partial U_N}{\partial B_D} \quad (2)$$

Comparing equation (1) with (2) reveals that the beer drinker will drink more beer than is

socially optimal due to the negative effect on the nondrinker. Because $\frac{\partial U_N}{\partial B_D} < 0$, $\frac{\partial U_D}{\partial B_D}$ in

(1) is less than $\frac{\partial U_D}{\partial B_D}$ in (2), meaning that B_D in (1) is greater than B_D in (2) (Assuming

diminishing marginal utility). The drinker will not curb his consumption level when the consumption level reaches the condition in (2), but continue drinking until the condition in (1) is achieved. The social optimum can be reached with an excise tax on beer. The tax modifies the budget constraint of the drinker as:

$$L_D = (P_B + T) B_D + P_Z Z_D$$

where T is the excise beer tax, represented as a fixed amount added to the retail unit price of beer. The optimization now yields:

$$\frac{\partial U_D}{\partial B_D} = \alpha P_B + \alpha T$$

The optimization conditions for the social and private utility functions are the same when

$$T^* = - \frac{1}{\alpha} \frac{\partial U_N}{\partial B_D}$$

Therefore, in the presence of the excise tax, the optimization behavior of the beer drinker yields the socially optimal result. The optimal tax rate is determined by the negative effect of drinking behavior incurred by the nondrinker.

In this framework, the government is only interested in the public interest. The government imposes additional cost to the user, which would cause the consumption of the commodity to be cut back. The excise tax was first put forward lucidly in the 1920s by A. C. Pigou and is termed as Pigovian Tax. Pigou (1950) states that whenever marginal private and marginal social net products diverge, self-interest tends to bring about equality in the values of marginal private net products and equality in the values of marginal social net products is obstructed. The divergence can be mitigated by a judicious employment of taxes and sometimes by direct coercion. Therefore, the central issue for the regulators is to obtain sufficient empirical information so that the correct tax can be determined. The most dramatic improvement we make over previous research is that we study the influence of a special interest group on tax legislation. This area in taxation has not been sufficiently explored by either economists or political scientists.

To model the special interest group demand for tax legislation, we assume that the group will participate in lobbying when the expected benefits exceed the costs of lobbying to change the beer tax. In the model, we add beer producers and assume that they are the only group who engages in lobbying activity. The organized interest group makes campaign contributions to the legislator in exchange for a favorable policy move. The amount of the contribution is dependent on the level of satisfaction the group obtains from the legislative decision.

Although excise tax on beer is charged on retail consumption, not levied on the producers directly, a higher tax amount will boost the ultimate unit price that the consumers are facing and in turn reduce the quantity demanded. Because the demand for beer is not perfectly inelastic, the beer producers have to bear some portion of this tax burden. Thus, the producers benefit from lower excise taxes on beer.

We do not explicitly include the lobbying activities of the consumers and retailers for several reasons. First, large numbers of consumers and retailers make the costs of lobbying exceed the small benefits gained from any individual lobbying activity. Second, theoretically, an association can be built up to act on behalf of any particular group of economic actors. However, the overhead will be high. Moreover, an important tool that is used by the lobbying group to connect with the legislator is the pecuniary contribution made to the legislator's election campaign. The fund raising among a large number of dispersing members can be an inefficient and complex task, especially when we consider the lobbying group organized among the consumers. The funds are mainly accumulated through relatively small amount of charitable donations. The inadequate resources may obstruct the ability of the group to affect the legislator. On the contrary, the beer industry is highly concentrated. Therefore, it is more likely that the beer producers will try to influence the political process that determines the excise tax on beer. The profits that the companies can earn as a result of a favorable tax move provide incentives as well as resources for such activities. We consider the lobbying power of producers as a relative power with regard to the groups of consumers and retailers.

Because lobbying has been introduced to the model, the government is now considered to be an agent that not only cares about the welfare of the society, but is also

concerned about the abundance of its campaign resources, which determines to a large extent its success in the reelection campaign. The government is willing to trade some extent of social welfare for the campaign resources that it can receive from the interest group. The weights that are put on these campaign resources relative to the social welfare vary across the legislation.

In the discussion of lobbying activity, the inclusion of the producers as well as legislator into the social welfare function becomes crucial, because a payment transfer from the producers to the legislator is involved. Assuming for the moment that the legislator views social welfare as equally important as its campaign resources received, we write down the indirect social welfare function as

$$W = U_A + (\Pi_P - \Omega_p) + \Omega_p$$

where W is the indirect aggregate utility function of the entire society; U_A is the aggregate utility of the consumers, as before; Π_P is the profit maximization function of the producers in the beer industry; Ω_p is the campaign resources that are contributed to the legislator by the producers. Under this assumption, the lobbying activity only causes a transfer of resources from the producers to the legislator. The optimization of the aggregate social welfare function yields the same result as that of no lobbies:

$$\frac{\partial U_A}{\partial T^*} + \frac{\partial \Pi_P}{\partial T^*} = 0 \quad (3)$$

where T^* is the tax rate that maximizes the aggregate utility of the entire society,

$$-\frac{1}{\alpha} \frac{\partial U_N}{\partial B_D}$$

However, if the legislator puts more weight on campaign contributions than on firm profit, which is probable given that the success in election/reelection is the prerequisite

for any political actions, the legislator maximizes a different welfare function:

$$W_L = U_A + (\Pi_P - \Omega_P) + \delta \Omega_P = U_A + \Pi_P + (\delta - 1)\Omega_P$$

where W_L is the utility function of the legislator; $\delta > 1$ is the parameter reflecting the attitude of legislator towards campaign contributions. The optimization of the legislator's utility function yields

$$\frac{\partial U_A}{\partial T'} + \frac{\partial \Pi_P}{\partial T'} + (\delta - 1) \frac{\partial \Omega_P}{\partial T'} = 0$$

where T' is the tax rate level decided by the legislator based on the maximization of his

own utility function. In the optimization condition, $\frac{\partial \Omega_P}{\partial T'} < 0$, because the beer

producers intend to reduce the excise tax on beer, the resources that are contributed to the government's election campaign will be enhanced as the policy outcome goes along with their expectation. Therefore, assuming $(U_A + \Pi_P)$ is strictly concave in T , the government, for its own benefit, deviates from T^* and sets tax rate at a lower level T' , where

$\frac{\partial U_A}{\partial T'} + \frac{\partial \Pi_P}{\partial T'} > 0$. Social welfare has not been maximized due to the demand of the

interest group and the government's public choice decision. And in this context, a higher tax rate would benefit the society as a whole.

V. Empirical Model

The theoretical analysis presented above suggests several testable hypotheses. The model indicates that two forces influence the government's policy making process - social welfare maximization and campaign resources maximization with different weights put on each objective. The more weight is on the campaign resources objective, the greater the deviation of the final tax rate from its socially optimal rate. The ill effect of beer drinking behavior is the primary factor that the government takes into consideration in order to maximize the utility of the entire society. The more severe the damage to the society is, the larger the tax magnitude is required to reduce the consumption. Therefore, we define

$$T^* = f(\theta C)$$

where θ is the damage coefficient relating to beer consumption and C is the aggregate beer consumption. The more beer is consumed, the more serious the problem with drunk driving behavior, crimes associated with drinking, health injuries, and property damage. We assume θ is constant across the states and use consumption quantity as a proxy for the externality, because people are affected by the ethanol content of beer in a similar manner. However, we have several concerns in this context. First, the distribution of this consumption will make a difference in the negative effect of consumption. Assuming that two states have equal per capita beer consumption, the bad consequences from it would be much less in a state with equally distributed beer consumption among all residents than a state with a portion of heavy drinkers and the rest being abstinent. The ethanol will not influence human behavior until the intake of it reaches a certain point.

An equal distribution may result in a moderate amount of consumption for each individual and won't cause behavioral problems at all. But the heavy drinkers will be a source of danger and damage to the rest of the individuals. However, a measure of per capita consumption among drinkers rather than among the whole population in each state is unavailable. Therefore a proxy based on general alcohol consumption is used as the leading component in the government's decision. Second, the marginal damage may differ with the population density in the state. In a traffic crash associated with drunk driving, more people would be involved, die or be injured, if more cars and drivers are running on the road. But the population density can not be measured easily, because the population densities vary greatly in the metropolitan and rural areas within a state.

The ability of the interest group to shift the tax magnitude in favor of itself is the main focus of this research. The interest group in our research, as explained above, is the beer producers. The beer producers make campaign contributions to the legislator with the amount varying with the satisfaction they receive from the legislator's policy. With this contribution of campaign resources, the interest group could form a coalition with the legislator to effectively enact a tax burden that is lighter than it ought to be for the sake of social welfare optimization. The benefits that two interest groups receive from an equal tax policy differ according to their bases that are subject to this policy. Beer excise tax is a unit price paid on top of the producer's price. The more beer the producers produce and supply the market, the more benefits will be received as a result of a successful move in the legislature. Consequently, there are more possibilities that the interest group would

make efforts in the activities, such as lobbying, because benefits of doing so will be greater than costs incurred. We will use production volume to represent the influence that the interest group exerts on the legislature.

Another factor that is essential in the whole policy making process is the weights deserved by the two objectives in each state. The nature of the state government plays a critical role in this mechanism. There may be some conflicting forces that are working against each other underlying the process. The overall outcome depends on the comparative strength of each different force. The two factors determining the comparative strengths are the preferences of the voters in each state and the fiscal needs of the governments. The legislator, elected by the voters in the state, should be a good representative of the preferences of the voters. A legislator who is not working in accordance with the needs of voters could not have been elected in the first place. Moreover, for a legislator in power, this representation derives from the institutional requirement of periodic reelection. Denzau and Munger (1986) provide more detailed theoretical justification for this argument.

We adopt religion as a proxy of the preferences of voters following Fuchs (1974). Fuchs argues in his book that the predominance of self-abstinent religion determines to a significant extent the residents' attitude towards sin commodities such as alcohol and tobacco.

To evaluate the importance of interest group demand in the legislative process, we also use the financial needs of the government. A larger public sector requires more financial resources to maintain its functional operation. The interest group contributes campaign resources in exchange for a favorable policy. But a lower tax rate will result in

the reduction of tax revenue assuming the marginal revenue with respect to tax rate is positive. The assumption is supported by Cook and Moore (1994), who argue that alcohol taxes are not high enough and additional public revenue can be obtained through increasing tax rates. Tax revenue is one of the major components of fiscal revenue. Therefore, the importance of tax revenue would rise when the government is experiencing an enormous amount of spending. The expenditure of the government will be used to capture this effect. As we expect a time lag in the government's adjustment, the expenditure in the previous year instead of the current one is employed.

In summary of the above analysis, the empirical model that will be used in our estimation can be written as follows:

$$T^i = f(\text{CONSUMP}, \text{PROD}, \text{FUND}, \text{EXPEND}_{-1})$$

where T^i is the actual tax rate determined by both social welfare maximization and the campaign contribution process in each state; *CONSUMP* is the per capita consumption of beer in each state; *PROD* is the production volume by all the beer producers in each state; *FUND* is the percentage of fundamentalists in the population in each state; *EXPEND*₋₁ is the state government's expenditure in the previous year.

In studying the tax rate determination, we recognize the endogeneity of beer consumption in the determination of the tax and fix the problem by utilizing instrumental variables. Per capita consumption, as a proxy of the negative externality, plays a key role in determining tax rate. On the other hand, economists have been debating over the price elasticity of sin goods consumption to a great extent. Although there is not yet a consensus on the magnitude of this elasticity, most of the research has found a significant relationship between the price and consumption. As the tax serves as a major indicator of

interstate differences in alcoholic beverage prices, the interaction between tax and consumption is not negligible. We construct an equation for the level of consumption, making it explicitly endogenous. We model the beer consumption as

$$CONSUMP = f(PRICE, INCOME, \underline{Z})$$

where \underline{Z} is a vector of variables that reflect demographic attributes of each state: religion, race, education, youth and state tourism index. This explicit inclusion of cross sectionally varying taste variables concurs with Baltagi and Griffin (1995), who estimate a dynamic demand model for liquor in the United States using panel data from 43 states over the period 1959-1982. We do not introduce a time-varying taste variable into our model, as they do, because we are studying a very short time frame, during which the taste can be viewed as constant. We do not treat the price of beer in a state as endogenous, because the producers charge similar prices nationwide. The variation of beer prices among states mostly reflects the differences in transportation costs and excise taxes. Each single state plays a relatively small role in the price setting behavior of producers based upon aggregate demand across country. Therefore, we view price as exogenous in the study of the demand function. The methodology is consistent with previous work on the consumption of sin goods.

In summary, we'll estimate a system of equations that consists of a tax equation and a consumption equation. Taking into account of the interaction between tax and consumption in the studies of tax determination makes the paper more robust and justifiable.

VI. Data Selection

Panel data of 50 states and Washington DC for 1992 and 1995 are used in the estimation. The 50 states and Washington DC provides a wide cross-sectional variation of tax rates. Data in 1995 is employed in order to have enough observations and thus ensure adequate degrees of freedom for the estimation of the system of equations. The data are extracted from various sources. Table 1 presents a description of statistical characteristics and definitions of the variables. These are discussed in more detail below.

The real tax rates (TAX) for different years are employed in the model. The nominal tax rates in 1995 are converted into the real tax rates in 1992 dollars by deflating them with the ratio of Consumer Price Indexes for Major Expenditure Classes in 1992 and 1995. The nominal tax rates and the Consumer Price Indexes are obtained from various issues of *Brewery's Almanac* and *Statistical Abstract of the United States*. Cook and Moore (1994) point out that the decline in the value of excise tax rates weakens its capability in deterring alcohol abuse and call for a dramatic increase in the excise tax rates. Using real tax rates, our model aims to explain the reasons underlying this decline in real tax rates overtime.

The production volume in each state is expected to be negatively related to the tax rate due to the resources that the producers in the industry own and the lobbying activities they engage in to oppose the rising beer taxes. In our estimation, we employ the production capacity in a state instead of actual production volume, because the production volumes for some of the states are not available. Per capita beer production capacity (PRODPC) in each state is used to account for the difference in state size.

Table 1
Variable Definitions and Descriptive Statistics

Variables	Means (Standard Deviations)	Definitions
TAX	7.35 (6.31)	Real state excise tax in 1992 dollars per 31-gallon barrel
CONSUMP	23.07 (3.80)	Per-capita gallons of beer consumption in a state
PRODPC	1.24 (3.60)	Per-capita production capacity of beer in 31-gallon barrels in a state
EXPPC	2.45 (0.88)	Per-capita state government expenditure in the preceding year in thousands of 1991 dollars
FUND	20.28 (15.80)	Percentage of fundamentalist adherent in the population in a state in 1990
PRICE	3.9 (0.34)	Real price in 1992 dollars of Miller Lite or Budweiser 6 pack, 12-oz containers.
INCOME	17.32 (24.53)	Per-capita income in thousands of 1992 U. S. dollars
YOUTH	25.61 (1.72)	Percentage of people aged between 18 and 34 in the population in a state
BLACK	10.95 (12.11)	Percentage of black people in the population in a state
TOURPC	0.32 (0.76)	Per capita receipts in thousands of dollars from hotel or other lodging places in a state
EDU	76.22 (5.56)	Percentage of people with a high school diploma in the population in a state
DMW	0.24 (0.43)	Midwest Region Dummy equals 1 for states in the region and 0 otherwise
DS	0.33 (0.47)	South Region Dummy equals 1 for states in the region and 0 otherwise
DNE	0.18 (0.38)	Northeast Region Dummy equals 1 for states in the region and 0 otherwise
CONSUMP ⁻¹	23.38 (3.75)	Per-capita gallons of beer consumption in a state in the preceding year
POPDEN	350.55 (1,303.19)	Population per square mile of land area in a state

Benjamin and Dougan (1997), in their research on excise taxation in cigarettes industry, find a positive effect of production on tax. We prefer per capita production capacity to aggregate production level in the belief that the comparative importance of a particular industry in a state matters in deciding the lobbying power of this interest group. The production capacities of breweries are extracted from *Brewers' Digest*. A brewery needs to have a capacity of more than 60,000 barrels per year in order to be counted. We decide on a capacity of 60,000 barrels per year as the cutting point because the breweries with less capacities will be treated as micro breweries. Micro breweries account for a considerably small percentage of total beer production in the industry and are not subject to the excise tax policy we studied here. Therefore, this taxonomy is legitimate because a firm that enjoys no benefits and assumes no harm from a policy would have no motive to do anything with the policy. A brief look at the fundamental statistics of beer production capacity and excise tax rate in each state (shown in Table 2) supports our conjecture. In 1992, the states with enormous production capacities, average 14.6 barrels per person, assume tax rates as low as \$2.11 per barrel on average, relative to the cross-country average of \$7.66 per barrel.

The percentage of state residents who are Fundamentalist adherents (FUND) is constructed by using Brandley et al. (1992) and Smith (1990). Brandley et al. (1992) lists the percentages of the population adhering to specific churches and Smith (1990) identifies which Protestant denominations are Fundamentalist. Data are available for 1990 only. Thus, the 1990 religion data are used for both the 1992 and 1995 observations, and it is assumed that the religious composition of a state does not vary substantially over time. The percentage of state population who are Fundamentalists is

Table 2: State Beer Production Capacities v.s. Excise Tax Rates in 1992

	States with Big Production Capacity	States with Small Production Capacity	State with No Production Capacity	All States
Excise Tax (\$/barrel)	2.11	7.66	8.22	7.66
Production Capacity (barrel/person)	14.6	1.15	0	1.27
List of States	WI, MO, CO	NH, NC, MI, VA, NJ, TX, MN, GA, NY, OH, TN, WA, FL, CA, PA, IN, LA	AK, AL, AR, AZ, CT, DE, HI, IA, ID, IL, KS, KY, MA, MD, DC, ME, MS, MT, ND, NE, NM, NV, OK, OR, RI, SC, SD, UT, VT, WV, WY	

expected to exert a positive influence on the excise tax rate on beer. The decrees in the religion will give people more abstinence from alcoholism. Thus, the government, as a representative of the state residents, would have more strict control over drinking.

The government's expenditure in the previous year is obtained through various issues of *Statistical Abstract of the United States*. A positive relationship between the government's expenditure and tax rate is expected, as tax revenue is an important source to finance the government's spending and keep fiscal account in balance. Again, we average the total government expenditure by the total population in each state to reflect the variation in state size. Per capita consumption in each state is used instead of the state aggregate consumption based on the same justification.

To endogenize consumption, we collect data on the variables that may have influences on the demand. Beer price information, obtained from *ACCRA Inner-City Cost of Living Index*, is used to derive a measure for state beer prices for the years 1992 and 1995. In each year, we take the average of the published beer prices in different cities and/or counties for all four quarters in order to purge the geographical variation and seasonality out of the price variable. We deflate the prices in year 1995 into 1992 dollars. The real incomes in 1992 dollars in the two years and a vector of demographic attributes are obtained from various issues of *Statistical Abstract of the United States*.

Demographic regressors used in the demand model include the percentage of the state population who are black (BLACK), the percentage of the population aged between 18 and 34 (YOUTH), the percentage of the population who have graduated from high school (EDU), and the percentage of the population who are Fundamentalist adherents (FUND). As elucidated above in the tax equation, we expect the percentage of Fundamentalists in

the population to be negatively correlated with the beer consumption. Beard et al. (1997) show a result conforming to our conjecture in their studies in beer consumption. In their studies of border-crossing sales of alcohol, the percentage of Fundamentalist Christian is employed. A negative influence of this variable on per capita beer sales, significant at 1%, is found. The effect from BLACK is controversial in the previous studies. Heine and Pompelli (1989) suggest being black has a significant positive effect on beer consumption, whereas Beard et al. fail to find any significant effect from the percentage of African-Americans in the population. The percentage of youth in the population is defined differently from the previous beer consumption studies. Beard et al. (1997) use the percentage of people aged under 21 years old, whereas our YOUTH variable is defined as the percentage of population that are aged between 18 and 34. *Advertising Age* (1984) indicates that 61% of the 18-to-24-year-old and 58% 25-to-34-year-old population drink beer. The percentages of beer drinkers in other age ranges are substantially lower. The effect of education attainment in each state on per capita consumption is not clear to us. Per capita receipts from hotel rooms and other lodging places (TOURPC) is used as a tourism index. Tourists are more likely to drink beer for fun or relaxation. The prosperity of the tourism industry in a state should boost the beer consumption volume.

VII. Empirical Results

Because the cross-state data are used in the research, we suspect that heteroskedasticity may be a problem inherent in the model. White's (1980) test is used to test for heteroskedasticity within the system of equations. The results indicate that the consumption equation has the problem of heteroskedasticity based on 5% significance level. Therefore, Instrumental Variables techniques (General Method of Moments and two Stage Least Squares) are employed in the estimation in order to deal with the endogenous beer consumption and correct the heteroskedasticity. The results in Column 1 of Table 3 present the estimates for this model. We do not report information on R^2 or Adjusted R^2 in the table, because both statistics are poor measures of goodness-of-fit in instrumental variable models. (Greene (1997), pp. 508-509).

Consumption indicates a positive but insignificant influence on the tax determination. The result does not seem to support our social welfare maximization argument, however it poses more concern about our assumption that damage coefficient of θ is constant among states. We already stated our concerns in an earlier section of this paper - the quantity of consumption in a state, the distribution of the consumption and the population density in a state may matter in determining the externality of drinking. A preliminary investigation reinforces our suspicion. In 1996, Wyoming and New Mexico, where per capita beer consumption is among the top range, are associated with an about average or below-average mortality rate involved in drunk driving auto crashes, 42.4% and 34.7% respectively, relative to a national average of 40.9% ranging from 23.7% to 53.4%. Also both states have very low population. Moreover, another explanation for

Table 3
The Determination of State Excise Taxes on Beer

	(1) <u>GMM</u>	(2) <u>GMM</u>	(3) <u>2SLS</u>	(4) <u>GMM</u>	(5) <u>GMM</u>
<i>Tax Equation</i>					
INTERCEPT	-5.59 (0.78)	-5.43 (0.93)	-7.71 (1.01)	-5.90 (1.77)	-27.79 (2.34) ^b
CONSUMP	0.25 (0.89)	0.21 (0.91)	0.36 (1.21)	0.26 (1.99) ^b	1.08 (2.44) ^b
PRODPC	-0.20 (3.16) ^a	-0.19 (3.47) ^a	-0.31 (1.94) ^c	-0.25 (4.51) ^a	-0.31 (3.58) ^a
EXPPC	1.56 (2.68) ^a	1.85 (3.83) ^a	1.13 (1.69) ^c	1.67 (2.86) ^a	1.63 (2.73) ^a
FUND	0.15 (3.78) ^a	0.15 (4.38) ^a	0.21 (4.79) ^a	0.14 (3.57) ^a	0.27 (3.77) ^a
POPDEN					0.0067 (1.74) ^c
<i>Consumption Equation</i>					
INTERCEPT	28.36 (3.60) ^a	30.14 (3.49) ^a	31.39 (4.25) ^a	-4.30 (1.99) ^b	29.19 (3.76) ^a
PRICE	-0.40 (0.54)	-0.29 (0.27)	-0.78 (0.81)	0.16 (0.82)	-0.03 (0.04)
INCOME	-0.91 (4.56) ^a	-0.97 (5.94) ^a	-0.91 (4.31) ^a	-0.13 (2.20) ^b	-0.96 (5.50) ^a
FUND	-0.15 (5.54) ^a	-0.18 (6.78) ^a	-0.17 (5.71) ^a	-0.01 (1.08)	-0.15 (5.27) ^a
YOUTH	0.08 (0.39)	-0.04 (0.18)	0.04 (0.16)	0.04 (0.82)	-0.11 (0.60)
BLACK	0.14 (2.33) ^b	0.12 (1.89) ^c	0.14 (2.60) ^b	0.06 (1.79) ^c	0.20 (4.14) ^a
TOURPC	2.57 (15.94) ^a	2.49 (14.46) ^a	2.60 (4.68) ^a	0.01 (0.11)	2.75 (20.68) ^a
EDU	0.14 (1.63)	0.17 (1.60)	0.14 (1.68) ^c	0.07 (1.93) ^c	0.18 (2.46) ^b
DMW		-0.88 (1.14)			
DS		1.19 (0.92)			
DNE		-1.14 (0.78)			
CONSUMP ⁻¹				0.96 (26.48) ^a	

Notes: t statistics in absolute values are reported in the parentheses.

^a significant at 1% significance level

^b significant at 5% significance level

^c significant at 10% significance level

the insignificance is that high consumption occurs in the tourism prevalent states such as Nevada and Hawaii. In these cases, even if the consumption is a good indication of externalities, the externalities may be imposed, to a substantial extent, on the non-residents, who do not have voices on the public policy making process. Thus, the government may put more weight on its need for campaign resources. Additionally, issues such as traffic regulations or other public regulations that help prevent drunk driving have to be looked into before any solid conclusion can be drawn. However, some of these effects may be picked up by the fundamentalist variable because of the correlation of different government policies.

Production capacity of each state indicates a negative impact on the tax rate and the result is significant at 1%. If per capita beer production capacity increases by one barrel per person, it will drag down the tax in a state by 20 cents per barrel on average. This conforms to our public choice conjecture. The beer producers that have large capacities will consider it worthwhile to allocate resources for lobbying. Their benefits from a favorable policy change would be notable, whereas their costs to organize and launch the campaign would be relatively small due to their concentrated management and economies of scale. Therefore, the legislatures in the states that have large beer producers are more likely subject to the lobbying activities of the beer producers that attempt to hold back the tax rates. The results provide evidence that the current tax rates might be set at levels that deviate from their social optimum. There has long been a debate between policy researchers and industry economists on the magnitude of the existing tax rates. The policy researchers support that the current tax rates are too low to

deter alcohol abuse, whereas the industry economists argue that the tax rates are set at their optimal levels. Our research joins the team of policy researchers and supports the viewpoint that the tax rates are not efficiently designed.

The two variables that are used to explain the weights that the government assigned to each component in its policy making process, the percentage of fundamentalists in the population (FUND) and per capita government expenditure in the previous year (EXPPC), both meet our expectations. The percentage of fundamentalists in the population exerts a positive influence on tax rate. As a result of a 1% increase of fundamentalists in the population, the tax rate will rise by 15 cents per barrel. The result suggests that the local legislator reflects the preference of the constituency. It also provides empirical support to Denzau and Munger (1986), who argue that the voters who have preferences over policy are in effect represented even though they are not organized. The parameter estimate associated with per capita government expenditure shows a positive significant effect on the tax rate. An increase in government spending of \$1000 per capita corresponds to an increase in tax rate of \$1.56 per barrel.

The estimation of the consumption function of beer basically goes along with the previous work in the literature except the insignificance of the parameter associated with the price variable. Although a negative parameter estimate is obtained for beer price, the result is not statistically significant. It is not astonishing considering that only a two-year period is utilized in our estimation. A longer time horizon might be effective in capturing the significant effect of price on consumption. Some previous research has made such caveat as well.

The estimation of the parameter associated with income indicates that beer is an inferior good. A \$1000 increase in per capita disposable income in the state will reduce per capita consumption by 0.91 gallon. This conforms to the findings in Beard et al. (1997) and is not a surprise considering that beer has always been considered as the working class alcoholic beverage. Also as we expected, beer consumption is shunned by those identified as "Fundamentalists" and is popular with tourists. A 1% increase of fundamentalists in the population will result in 0.15 gallon reduction in per capita consumption. And a \$1000 increase in per capita receipts from hotel or other lodging places in a state corresponds to 2.57 gallons increase in consumption. The positive significant effect of tourism on consumption may also offer some underpinnings for our hypothetical explanation for the insignificance of consumption on the tax rate. The results advocate that tourists play a significant role in the consumption in a state. However, tourists are not counted in the constituency, thus they have limited power in advancing their preferences and being represented by the local legislator.

The percentage of black people in the population exerts a positive significant influence on the per capita consumption in the state. A 1% increase of African-American in the population is accompanied by an increase of 0.14 gallon in per capita consumption. This is consistent with Heine and Pompelli (1989), which suggests that black people drink more beer than the population as a whole. The impacts of YOUTH and EDU on beer consumption are both statistically insignificant in our model. There is no consensus on the effects from those variables either. Beard et al. (1997) employ the percentage of population under 21 years of age in their study of beer consumption. The result is positive and very insignificant. A variable to represent education attainment is used by Baltagi

and Griffin (1995) in their estimation of liquor consumption, but a negative and insignificant parameter estimate is obtained. We need to look into the issues further before any solid conclusion can be made.

To make our model more flexible, we try several additional specifications. Although we have included a vector of variables to represent the demographic characteristics in each state, chances are that we have not included a complete list of them. Therefore, we reestimate the model by adding some region dummy variables to capture the leftover effects. The result of this estimation is presented in Column 2 of Table 3. The region dummies are defined following the regions used by U.S. Bureau of the Census. Dummies for Midwest, South and Northeast are used while the one for West is left out. All the region dummies appear to be insignificant. Because no strong evidence of regional effects is found and none of the other estimates change dramatically, the model is not much of an improvement over the original one.

We use the General Method of Moments in order to correct for heteroskedasticity in the cross-state data. We reestimate the model using two stage least squares to justify our selection of estimation technique. The estimation result is included in Column 3 of Table 3. The values of parameter estimates do not vary substantially, but the t-statistics appear to be worsened to a noticeable extent. The EXPPC and PRODPC are no longer significant at even a 5% significance level. The General Method of Moments helps us gain more efficiency by correcting for heteroskedasticity.

Because alcohol consumption is considered to be addictive, we reflect this in demand function by incorporating the consumption volume in the previous year into the model. The result from this model is reported in Column 4 in Table 3. The lagged

consumption variable shows a very strong correlation with the current consumption level. But the inclusion of the lagged consumption weakens the effect of all the other variables. This is probably because the determination of lagged consumption is similar to the current one and the values of demand determining variables do not change much from one year to the next. The multicollinearity between the lagged variable and the demand determining variables might be brought in the model, a problem that might distort the individual parameter estimates and related t-statistics. The conspicuous result from this specification is that the impact of per capita consumption in the tax equation becomes significant. It provides some support to our social welfare maximization argument. Despite the limitations on this variable discussed in an earlier section, the result does offer some helpful insight into how to quantify the magnitude of negative externality of beer drinking.

Lastly, as we discussed earlier in this section, the insignificance of per capita beer consumption as an indicator of externality may result from different damage coefficients (θ) among states. We reestimate the model by including population per square mile (POPDEN) in the tax equation. We collect the data from various issues of *Statistical Abstract of the United States*. The estimation results are reported in Column 5 of Table 3. The parameter associated with per capita consumption goes up greatly to 1.08, and the result is significant at 5%. The population per square mile also shows a positive and significant influence on tax rate. If population per square mile increases by 100 persons, the tax rate will increase by 67 cents per barrel. However, in the consumption equation, the price coefficient slumps to -0.03 and is extremely insignificant. We realize that this population density measurement does not effectively reflect the difference in population

distribution in metropolitan and rural areas, but the estimation results provide us important evidence on different θ among states. More accurate measurement of these factors merits future consideration.

VIII. Conclusion

This paper presents a model of the determination mechanism of excise tax rates. The agents in the model include the legislator, local residents and an interest group - beer producers. The interest group is assumed to contribute resources to the election campaign with the amount determined through their weighing of costs and benefits. The tax rate is determined by the legislator, who is seeking to maximize the combined utilities of aggregate social welfare and increasing campaign resources received. The research sheds some light on the complex institutions that determine our tax systems.

First of all, although the paper does not provide solid empirical support for social welfare maximization because of the unavailability of appropriate data, it does support our conjecture that the comparative strength of beer producers can effectively exert an influence on the legislature and make the policy favorable to themselves. The analysis raises an important policy concern. The power of the interest groups hampers the economic efficiency of the local tax systems. A higher tax rate would be in the interest of the society as a whole.

The second interesting finding from this research is that our empirical work shows that the local legislator reflects the taste of the constituency. This is inferred from the fact that a state with a higher proportion of fundamentalists has a higher tax rate. Therefore, the unorganized and noncontributing constituency may be represented even in a situation in which the interest group is well organized and active. This representation weakens the effectiveness of lobbying activity by the interest group and to some extent salvages the economic efficiency of the tax system.

One important contribution of this research is that it endogenizes the externality in the model. The excise tax is initiated as a policy tool to curtail the consumption of sin goods that create negative externalities. Thus, the magnitude of this externality should be a critical consideration in the determination of the tax rate. However, if the policy actively serves its role as designed, the magnitude of externality should have been adjusted as a result of the implementation of the policy. The interaction between the tax rate and the externality is captured by making the externality (proxied by consumption) endogenous.

In conclusion, the findings help us to understand the tax determination process and provide empirical evidence to the theoretical work laid down by early research on this issue. The paper points out that the influence of beer producers causes the tax rates to deviate from their socially optimal levels. The bias of the tax system depends on the production capacity that exists in the state. The research provides useful insight into the evaluation of the local tax system.

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