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Estimating Effects of Alcohol Tax Increases on Highway Fatalities

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Estimating Effects of Alcohol Tax Increases and Equalizations on Highway Fatalities

Overview

There can be no doubt that tax increases which raise the price of all alcoholic beverages will reduce the overall consumption of alcohol which in turn will reduce highway accidents and fatalities. Both theoretical reasoning about the effects of tax increases and empirical investigations give evidence of a causal relationship between higher alcoholic beverage prices and accidents. The issue then becomes one of magnitude: How much of a reduction in accidents can be presently expected for any given amount of tax? The question can be approached in two basic ways: reasoning theoretically and more directly through empirical studies.

The theoretical method attempts to reason about the path any tax increase must take in ultimately reducing accidents and fatalities. Three links are crucial in this path if a strong response is to be expected: (1) the alcohol tax at the supply level must be effective in raising the retail price; (2) the tax-induced higher retail price must reduce consumption; (3) the consumption that is reduced must be that which is involved in alcohol-related crashes. Some of the information about these links can be reasoned from economic theory and from studies not directed specifically toward highway safety. The empirical approach is more direct in trying to establish statistical relationships among historical state tax changes and reductions in highway fatalities.

Using either of the two methods presents challenges. The theoretical approach is made difficult because previous tax increases have provided opportunities to measure only the price sensitivity of *specific* alcoholic beverages. What is needed is the price sensitivity of *all* alcoholic beverages undergoing a simultaneous change in price as current recommendations on alcohol taxation propose. Inferring general effects of alcohol consumption from tax increases on one alcoholic beverage will not properly account for the substitution effects to other beverages not experiencing such a change. Thus, the effect of inferring from this partial experience will be to overestimate the effect of tax changes.

Using the empirical method of determination is made difficult because reliable statistical correlation cannot be established among historical occurrences of state tax changes, and changes in consumption and fatalities. This lack of correlation makes it difficult to find a statistic to properly summarize historical experience, and make forecasts.

Findings

- Four studies – Cook [1], Walsh [2], Saffer and Grossman [3], and Phelps [4] – have addressed the question of the fatality reduction elasticity for a given increase in alcohol taxes. The Cook study is the most often cited. To summarize the historical effect and provide expectations of future tax changes, some have used Cook's median elasticity estimate of a 1 percent increase in the tax on distilled liquor producing a 0.7 percent reduction in *all* highway fatalities. Cook only offers this estimate, and the distribution of outcomes on which it is based, as evidence that price of alcohol matters. Two of the three studies give estimates which are slightly lower in effectiveness than Cook's median elasticity.

- It is the main conclusion of this paper that using the median elasticity estimate from the Cook study, or similar estimates from other studies, will currently overestimate the likely future effects of an alcohol tax proposal like the former Surgeon General's.

- Several aspects about the Cook study should be considered in determining its relevancy for current forecasts:

    - The historical data used in the Cook study exhibits a wide range of outcomes in the 38 occurrences of increases in the state distilled liquor taxes. In 25 instances, highway fatalities went down when compared to the experience in other states. However, two of the declines were not associated with corresponding declines in distilled alcohol consumption. Thus, only 61 percent of these historical occurrences had the desired effect. Among the declines there exists variation in amount. With such variation it is always difficult to find a summary measure, or measures, which fully describes the experience and can be used for forecasting. Deriving a median value fatality elasticity from such a distribution of state changes does not represent the likely outcome of any national tax change. Cook makes no such claim, but offers correctly that there is quantitative evidence that the amount of alcohol tax matters.

    - The historical experience (1961-75) of state changes in taxes on distilled liquor upon which the Cook study is based occurred prior to the recent, intense emphasis on alcohol-impaired driving. Marginal episodes of alcohol-impaired driving may have already been removed by other policy measures.

- As with any time-series study in highway safety, there is always the question that a method of control like quasi-experimental design is adequate for the myriad forces which affect highway fatalities. It would be nice to have more information about the fatality experience in states not having changes in the price of distilled liquor during the same time period.

- In spite of the above qualifications about the Cook study, it is felt that the study does give evidence that price matters, but will not give a national estimate for new alcohol tax proposals.

- In this report, attempts were made to explain differences among fatality rates in 31 license states in 1984 using differences in alcohol tax rates on distilled liquor, wine, and beer. Studies to date, like the Cook study, have used time-series methods. However, higher tax rates could not be associated with lower fatality rates after many other factors causing differences were controlled. It is recognized that complete control was not provided. However, even with more control, the lack of significance of the tax variables is not likely to change. This lack of association is not taken to mean that higher rates of taxation would not have an effect on highway fatalities through reducing alcohol-impaired driving. Rather, it is interpreted as showing that taxing alcohol to the degree necessary to reduce highway fatalities has probably never been systematically tried. Alcohol taxation historically has been used to raise revenue. It is rational to expect that taxation policies used to raise revenue would not tax to the extent necessary to make significant reductions in consumption of alcohol that would reduce highway fatalities to the levels which statistical methods could detect.

- An additional attempt was made to estimate the effects of alcohol taxation on highway fatalities using cross-sectional data. Twenty-one of the 31 alcohol license states in 1984 tested BAC levels of 65 percent or more of dead drivers. These states were designated as 'good' states for the purpose of this estimation. The percentages of dead drivers with a positive BAC level for these states were regressed on the same set of alcohol tax rates and control variables as in the above estimation with the 31 state fatality rates. There was no indication that higher state alcohol tax rates were associated with lower percentages of dead drivers with positive BAC levels. However, variation in the 21 cross-sectional observations was not well explained by the control variables. The number of observations may be too small to gain any meaningful results. Estimating this same model with 1988 FARS data would have added only two states with BAC testing of dead drivers of 65 percent or more.

Introduction

Recommendations, such as those made by former Surgeon General C. Everett Koop, to increase and equalize Federal excise taxes on alcoholic beverages have caused much interest in the highway safety community. Higher taxes, it is felt by many, will cause reductions in alcohol related accidents. Although progress has been made in reducing the role of alcohol in accidents, such events continue to represent a significant portion of total fatalities. Alcohol accidents create enormous social costs. In proposing increases in alcohol taxes, emphasis is being placed on background conditions which affect alcohol-impaired driving in addition to traditional countermeasures which place primary emphasis on individual actions and responsibilities.

The purposes of this paper are to:

(1) summarize and interpret new proposals to increase Federal excise taxes;

(2) discuss the theoretical links through which an alcohol tax increase may influence highway accidents;

(3) state and comment on the findings by Cook which have been interpreted by some to mean that a 1.0 percent increase in the price of distilled liquor will inexorably lead to a 0.7 percent reduction in *all* highway fatalities in the present period; and

(4) empirically assess the relationship between existing fatality rates and tax rates on distilled liquor, wine, beer in the 31 alcohol license states.

This study draws the firm conclusion, as does the Cook study, that increases in the price of alcohol will bring about reductions in highway fatalities through the mechanism of reducing overall consumption. However, it is also concluded that the exact quantitative amount of that change is difficult to predict and is regrettably probably not as high as some have calculated using the Cook median price elasticity. It was hoped that a cross-sectional analysis of recent tax levels among states would provide a better guide

to what might be expected from alcohol tax increases. However, no rule could be derived that would indicate that a one percent increase in the tax on alcoholic beverages will lead to a certain percentage change in highway fatalities.

Three characteristics make it difficult to reason theoretically about a specific estimate. First, alcohol is not a homogeneous commodity. It is an ingredient like sugar. Because there are several different types of alcoholic beverages and many brands within each type, a wide array of beverage prices exists. Thus, persons motivated to maintain present levels of alcohol consumption at the same price after a tax increase can do so by shifting downward in the price array, especially in the long-run, by changing tastes and customs. As an example, suppose a consumer who normally drinks a six-pack of beer costing $4.00 now encounters a 25 percent increase in price because of taxation which creates a new $5.00 purchase price. That consumer could now purchase a six-pack that originally cost $3.20 before the tax for $4.00 and consume the same quantity of alcohol. Granted the taste may be different, but the same alcoholic consumption could be maintained.

Second, the entire amount of the alcohol tax need not be reflected in the selling price. Producers, distributors, and retailers need not pass on the full amount of the tax in the form of price increases. The further the alcoholic beverage industry (or parts of it) is from perfect competition the more the potential to absorb the tax. The tax does not represent a true cost of production. Producers particularly may emphasize lower costs of production to keep the price down after a tax increase. No small part of the price of most alcoholic beverages represents the cost of aging, transportation, and advertising. These inputs can be reduced to offset the effect of taxes on price. The understanding of how much an alcohol tax will increase the selling price to the consumer is important. Much disagreement exists. Alcohol beverage industry spokesmen have argued that in some instances not only will the full amount of any increase in tax be reflected in the selling price, but a markup of as much as 60 percent will also be added. Such a high markup would argue for lower alcohol taxes. Many studies have assumed that the traditional 20 to 25 markup in distribution channels will be applied. As mentioned above, one can also make an argument that not even the full amount of the tax, let alone a markup, will be applied. The estimation of alcohol tax effects depends critically on the tax impact on the ultimate selling price.

Third, not all alcohol consumption brings social costs like alcohol-impaired driving. Even if aggregate consumption changes could accurately be predicted, it is the specific consumption that leads to fatal accidents that must be understood. Unfortunately not enough is understood about this consumption. The effect on the more destructive types of consumption is just what empirical studies try to estimate.

Most empirical estimates of alcohol price elasticities have looked at the price elasticity of one type of beverage. A study that estimates the price elasticity of, say, distilled liquor would freely allow substitution to other alcoholic beverages like beer and wine. The purpose of most price elasticity studies is simply to get an idea of the optimal pricing of a particular beverage or product brand. Estimates of the price elasticity of distilled liquor have ranged between -1.0 and -1.5, meaning a 1 percent increase in price will bring a decline in consumption of between 1.0 and 1.5 percent. The price elasticities of wine have been estimated between -0.5 and -1.0. Beer has been estimated to be the most inelastic with estimates ranging from -0.3 to -0.6. Evidence suggests that because fatal highway accidents and beer consumption are both weighted towards younger persons, the tax must affect the consumption of beverages with relatively inelastic demand.

Using the above price elasticity estimates for any one beverage will overestimate the decline in consumption of all alcoholic beverages given a price increase.

New Alcohol Tax Proposal

The new proposed tax increase would represent a different method of alcohol taxation. Presently Federal taxes, and most state taxes, are based on the economic value (*ad valorem*) of the alcoholic beverage. The proposed changes would tax on the basis of alcoholic content regardless of whether the beverage is distilled liquor, wine, or beer. This switch in the basis of taxation brings recognition that the potential for alcoholic beverages to harm is related to alcoholic content, not to the selling price. Expensive scotch can have the same potential danger if not consumed properly as a relatively cheap beer or wine. Increasing the price of alcoholic beverages through taxation has the potential to reduce a problem like alcohol-impaired driving in at least four ways:

- First, it may reduce overall consumption of alcohol because as the price increases demand will decline. This relationship is a basic tenet of economic

theory. There is no reason to believe that alcoholic beverages should be different in general from other commodities. Therefore, increased alcohol taxes will reduce consumption which presumably will lead to reductions in highway accidents. Obviously, the crux of the matter is determining by how much both consumption and accidents will fall.

- Secondly, a more indirect path, the money raised through taxes may be used to fund additional education and enforcement programs. Such programs would lower the social costs of destructive alcohol consumption.

- Thirdly, as Becker and Murphy [5] have pointed out, the current consumption of a potentially addictive substance is a function not only of its present price but of past prices as well. Thus, future debilitating dependence of alcohol may be prevented if the current price is kept high. A high price may simply discourage new drinkers.

- Finally, placing an increased tax on alcohol may help to convey society's concern about the potential dangers of alcohol abuse.

There are wide differences in the amount of current Federal taxation. Phelps [4] has stated that distilled spirits are currently taxed at the rate of about 20 cents an ethanol ounce. Beer is taxed at about 5 cents, and wine about 1 cent an ethanol ounce.

These taxes have not kept pace with inflation. At the Federal level, there has been only one increase in the tax on alcohol since 1951 and that was only on distilled liquor. Alcohol has become less expensive relative to other goods and services. For beer and wine, the purchase price is low enough even when state taxes are added on to allow these alcoholic beverages to compete with soft drinks. It is not surprising that beer and wine are price inelastic because these beverages represent, for many, such a small percentage of income.

The proposed Federal tax would change the current basis of taxation in three ways: (1) adjust upward the tax on beer and wine to equalize on an alcoholic content basis that of distilled liquor; (2) adjust the resulting equalized excise tax rate to the Consumer Price Index (CPI) for some base year such as 1972; (3) annually index the resulting tax rates to increases in the CPI.

Table 1 gives the effects of these adjustments.

Table 1: Tax Adjustments

Beverage	Current	Equalize	Index
Glass of wine	0.6 cents	11 cents	28 cents
Bottle of beer	2.7 cents	11 cents	28 cents
Shot of whiskey	11 cents	11 cents	28 cents

Source: CSPI, 1501 Sixteenth Street, N.W., Washington, D.C., 20036

(There are also proposals that encourage the equalizing of taxes at the state level on alcoholic beverages and to index the resulting taxes to inflation. This equalization would eliminate differential prices among border states. Having different prices and conditions for consumption has been a problem long addressed by highway accident research.)

These changes in taxes are quite dramatic as can be seen from Table 1 which shows the current, equalized, and inflation adjusted tax for each of the three types of alcoholic beverages. The higher taxes will increase the price of beer and wine relative to the price of distilled liquor. It is likely that such increases will meet with political resistance. Regardless of the chances of adoption, however, it would be nice to know what effect these changes might have on highway accidents.

Incidence of Alcohol Taxation

Increasing the price of alcohol by taxing may reduce alcohol-impaired driving and associated accidents as well as other problems associated with the misuse of alcohol. However, it should be pointed out that higher taxes will also reduce uses of alcohol from which consumers derive satisfaction. As stated above, the alcohol tax is a blunt policy instrument. Clearly, not all consumers misuse alcohol or drive after consuming more than the legal limit for intoxication. The alcohol tax has been described as being a regressive tax because low income persons pay a higher proportion of their income for alcoholic beverages. The alcohol tax has also been categorized as a user fee with

those persons consuming the most alcohol paying the most tax. It is likely that the bigger consumers will also incur the most social costs so that there is some equity in taxing alcohol. The degree to which alcohol taxation should be categorized as a regressive tax or a user fee depends on the amount of overlap between high consumption with low income. Regardless of the nature of alcohol taxation, some uses which clearly do not incur social costs are going to be taxed. Judgments, normative values, will need to be made about the costs and benefits of various increases in alcohol taxes.

Other Alcohol Tax Benefits

As mentioned above, highway accidents involving alcohol would likely be reduced by increases and equalization of the Federal alcohol excise tax because overall consumption would be reduced. The exact magnitude of that change and its stability over time are, however, difficult to predict. Other benefits to society from increased alcohol taxation also exist.

Most economists would advocate that a tax on any good or service be equal to the value society places on any damage done by that good or service. Since it is unlikely that the current tax at both the Federal and state levels equals the damage done by the misuse of alcohol, there is justification for increasing the tax. The increased revenue could be used to sponsor education and treatment programs on alcohol abuse. As mentioned above, however, increased taxation on alcohol is not without its inequities to those who use alcohol without harm. Unfortunately alcohol taxation is a 'blunt' instrument. Bad use cannot be singled out. The very essence of why it is difficult to reason theoretically about the effectiveness of increased taxation is because of this bluntness of taxation. The tax cannot selectively be used to reduce alcoholic drinking episodes that lead to highway accidents.

Another reason why increased taxation is desirable is that any reduction in alcohol consumption that would produce changes in alcohol-impaired driving in society will likely be accompanied by reductions in costs in other areas. Harmful alcohol consumption patterns have been identified as factors in other trauma, chronic illness, crime, family disruption, and child abuse.

Theoretical Determination of Alcohol Tax Effects

It is natural to try and reason logically about the effects that higher and different types of alcohol taxes will have on highway accidents. This approach can be successful in identifying the issues and placing certain limiting values on outcomes; but not successful when specific quantitative values are needed. The path that increased alcohol taxes must take in affecting highway accidents is a winding one. Along each step of the path there are potential pitfalls that can limit the ability of the tax to reduce accidents.

There are basically two main factors that must be determined. First, the effect the alcohol tax has on reducing overall consumption. This effect is a function of the ability of the tax to raise the selling price, and the sensitivity of the selling price to consumption. Economists generally believe that alcohol itself is a price inelastic good within a low range of price increases. Particular types of alcoholic beverages, however, can be quite price sensitive. In general though, a one percent increase in the overall price of alcohol should bring a less than a one percent decrease in consumption. A one percent decrease in the price will correspondingly bring a less than one percent increase in consumption. Probably, the main reason that alcohol is an inelastic good is that it has no close substitutes.

Alcohol is not just a single good, however. There are three basic types of alcoholic beverages (distilled liquor, wine, and beer) and within these types there are many different brands. The price sensitivity of any one brand is likely elastic. That is, because there are close substitutes for any one brand, a one percent change in price will bring a more than one percent change in consumption. The situation under which alcohol is consumed may also affect its elasticity. One further complexity is that different individuals have different elasticities. More empirical work needs to be directed toward measuring specific price elasticities like the price elasticity of beer consumed by youth prior to driving.

Existing Estimates

There are four empirical studies – Cook [1], Walsh [2], Saffer and Grossman [3], and Phelps [4] – that have been undertaken to determine the effects that increased taxation on alcoholic beverages will have on reducing highway accidents. In most instances, the studies concentrate on the effect alcohol-impaired driving has had on accidents, particularly those involving fatalities. This focus on fatalities is probably taken because the data on fatalities are more consistently recorded across time. Using alcohol-impaired driving itself might be desirable. However, the level of intoxication of the general population is not known.

The most well known, and most widely cited, study is by Cook [1], "The Effect of Liquor Taxes on Drinking, Cirrhosis, and Auto Accidents." By some this study has been interpreted to mean that a 1 percent change in the price of distilled liquor will lead presently to a 0.7 percent reduction in all highway fatalities (not just alcohol related fatalities). Obviously, if this type of return could be obtained from the proposal to increase, equalize, and index the Federal excise tax on distilled liquor, wine, and beer, the fatality reductions would be quite dramatic. Cook uses changes in distilled liquor prices induced by states increasing taxes for the basis of estimation because there have been far fewer changes by states in the taxation of wine and beer during the last 40 years.

Walsh [2] used time series data (1953-1981) for Ireland to explore the sensitivity of alcohol tax increases upon highway fatalities. His main conclusion (which in his own words "...is estimated very tentatively") is that a "simultaneous increase of 12.5% in the real spirits excise tax and 20% in the real beer excise tax would be required to reduce...the road fatality rate by 4%."

Saffer and Grossman [3] also provide empirical evidence of the effect of increased taxation on highway fatalities. Their work is more restrictive relative to the question being considered here. They looked at the effect of changes in the price of beer on fatalities involving 18-20 year-olds. They found that a 100 percent increase in the real tax on beer will reduce fatalities by 27 percent among 18-20 year-olds.

The Phelps [4] study has as its primary concern the determination of an optimal tax on alcoholic beverages in relationship to accidents by youths. The optimal tax would be at a point where the loss of value to consumers from consumption equals the damage done to society by alcohol consumption. Phelps believes that alcohol taxes could increase by 25 to 40 percent to approximate this optimal point. In making that estimate, Phelps used an estimate based on the work of Saffer and Grossman.

It should be noted that all of these four studies point out that in addition to reducing highway accidents and fatalities other alcohol-related problems will also decline. The other problem most referred to by these studies is cirrhosis of the liver. This disease may be more amenable to price changes because reducing total consumption more directly impacts the disease creation mechanism than it does alcohol-impaired driving. Alcohol-impaired driving may result from more select types of consumption which are not fully understood. As mentioned above, these existing estimates deal with historical experience and not with an event like the new proposal for increasing, equalizing, and indexing alcohol taxation.

The four studies, however, clearly give empirical evidence that the price of alcoholic beverages does matter in determining the level of highway accidents. In quantitative terms, the results are similar. From here on, the Cook study will be discussed since it is the most widely known. As mentioned above, it is the view of this report that Cook's study has been over interpreted.

Analysis of Methodology

The Cook [1] study is by far the most often cited. These citations have at times given a simplistic and misleading representation of what Cook found. Cook used the occurrence of 39 instances of changes in distilled liquor taxes in 23 different states from the period 1961 to 1975. In 16 of those 39 instances there was also a change in the state beer tax in the same year.

Cook uses the tax change instances that history provides. But these instances do not represent the type of change that is being proposed by the former Surgeon General. A big difference exists between the two types. The historical changes allow for consumers to substitute other alcoholic beverages for distilled liquor upon facing a change in the

price because of a tax increase. The alcoholic-content tax change will limit this type of substitution. Thus the changes in consumption of distilled liquor will overstate the likely changes in consumption of all alcoholic beverages because substitution to other beverages is possible. One of the main factors in the determination of a price elasticity is the degree to which substitution is possible. The greater the existence of close substitutes, the greater the price elasticity will be, all other things being equal.

The 39 instances of distilled liquor change in the Cook study are given in Table 2 along with the changes in highway fatalities as measured by deviations from fatalities in other states. (Cook also examined in his study the effects of distilled liquor tax changes on rates of cirrhosis of the liver.)

Using the base price of distilled liquor and assuming that tax changes will be marked up by 20 percent in the distribution channel, Cook derives from the tax changes a percentage change in price of distilled liquor for 38 of the 39 instances. This percentage change in price is divided into the percentage change in fatalities to derive an elasticity. Cook states "The median of these price elasticities is -0.7 for auto fatalities..." That means that this median change of 1 percent in distilled liquor prices induced by tax increases will result if applied literally in 0.7 percent reduction in *all* highway fatalities. Finding a summary measure to describe the likely effect from an increase in alcohol taxation is difficult. As can be seen from Table 2, there is a large variation in outcomes from the 38 instances used by Cook. Of the 38 instances, there were 25 occurrences where highway fatalities were evaluated to have gone down. Of the 25 occurrences of decreased fatalities, 2 of those occurrences were not associated with declines in alcohol consumption. Viewed from the perspective of changes in consumption, there were 30 out of 38 changes in tax on distilled liquor which led to declines in consumption. Of those 30 declines, 23 declines were accompanied by declines in highway fatalities.

Statistical tests performed by Cook indicate that the relationship between tax changes and consumption, and tax changes and highway fatalities, have non-parametric statistical significance. Work done for this study could not find correlation between changes in consumption and changes in highway fatalities. Without such correlation, it would not be possible to make much improvement on Cook's selection of the median price elasticity as a summary statistic.

Table 2: Liquor Tax Changes per Gallon and Fatality Changes

Year	State	Tax Change ($)	Consumption Change (%)	Fatality Rate Change (%)
1961	CO	1.00	-8.7	13.2
	MO	0.40	-2.5	-7.2
	NV	0.60	-6.0	-39.2
1963	FL	0.33	-0.1	-2.7
	NE	0.40	-7.8	2.8
	NJ	0.30	-1.9	4.7
	NY	0.75	-7.4	-0.0
	SD	0.50	-6.8	-17.2
	TN	0.50	0.3	2.0
	WI	0.25	1.6	-4.3
1964	GA	0.50	9.8	-2.0
	KS	0.30	-7.0	-6.1
1966	MA	0.70	-6.9	-4.2
1967	CA	0.50	-4.6	-6.4
	TN	1.50	-11.3	-3.0
1968	AR	0.56	0.8	10.3
	FL	1.23	-9.9	8.0
1969	CT	0.50	-9.2	-6.3
	DE	0.50	0.3	4.5
	IL	0.48	-4.8	-5.7
	MA	0.41	14.8	5.3
	MI	0.755	-4.4	-9.0
	NV	0.50	-2.6	-1.7
	NJ	0.50	-8.8	-3.2
	RI	0.50	-4.3	-26.1
1970	KY	0.64	-0.5	0.3
	LA	0.82	-0.6	-1.5
1971	DE	0.60	-10.7	-26.8
	OK	1.60	-7.3	-2.1
	MI	0.90	-3.2	1.1
	MO	0.80	-7.1	0.3
	SD	1.75	1.6	19.6
	TX	0.32	-3.2	-0.5
	WI	0.35	2.9	0.3
1972	NE	0.40	-2.3	-20.2
	NJ	0.50	-7.2	-1.7
	NY	1.00	-10.0	-3.3
1974	AZ	0.50	-4.3	-2.2
1975	MA	0.69	0.2	– –

Source: Cook [1]

Certainly, Cook's work gives evidence that increased taxation on alcohol will reduce highway fatalities. The exact quantitative amount of that reduction across the nation, however, is difficult to predict and goes beyond the intent of the Cook study. The Cook study also cannot deal with distributional effects that must be solved when calculating a likely national fatality reduction. A change in one state is not always equal to a change in another state. Texas and California represent about 20 percent of all alcohol consumption in the United States. These two states also represent about 20 percent of all highway fatalities. A summary measure like the median change does not weigh the sensitivity of an individual state for its effect on the total number of fatalities. This fact is not a criticism of the Cook study because an aggregate estimate of fatalities was not his intent.

Cross-Sectional Estimation of Alcohol Tax Effects

In trying to determine what the quantitative effect is of alcohol taxes on highway fatalities, a cross-sectional model was constructed. The work that has been done on this question to date has used time-series observations of state tax changes and either consumption of a particular type of alcoholic beverage or, as a more direct approach, highway fatalities. The dependent variable of the cross-sectional model was highway fatalities per vehicle mile traveled (VMT). The observations were 31 states which sold alcohol through granting licenses to wholesalers and retailers as opposed to state controlled distribution. With state controlled distribution, the retail price of alcoholic beverages may be above or below what the market would set. Determining what the price elasticity would be from such state administered prices might result in biases. As well, with administered prices a change in the amount of tax may not be independent of demand conditions which would also would bias any estimation of price elasticity.

Clearly there are differences among the fatality rates of these 31 states. Independent variables selected to explain these differences were per capita VMT; proportion of urban miles of total VMT; per capita consumption of distilled liquor, wine, and beer; per capita income; and per capita homicide rate. These variables were combined additively in the model. The amount of tax per gallon on distilled liquor, wine, and beer were also included additively in the model to test whether states with higher taxes on different types of alcoholic beverages had any effect on reducing the overall fatality rate.

Real differences exist in the amount of consumption per capita among different states and the three different beverage types. As well, there are differences among the rates of taxation. California, for instance, taxes wine at a relatively low rate compared to other states. Kentucky taxes distilled liquor at a relatively low rate. Wisconsin taxes beer at a relatively low rate. Delaware taxes all three at a relatively low rate.

Table 3 lists for each of the 31 license states the fatality rate, the revenue derived per wine/liquid gallon from Federal, state, and local taxes on distilled liquor, wine, and beer.

Table 3: Fatality Rates and Combined Taxes by Beverage Type, 1984

State	Fatal/ VMT	Spirits($)	Wine($)	Beer($)
AZ	4.22	14.10	1.99	0.74
AR	3.08	14.95	1.88	0.69
CA	2.55	13.26	1.33	0.63
CO	2.48	14.84	1.97	0.83
CT	2.23	14.94	1.83	0.77
DE	2.53	11.17	0.93	0.35
DC	1.99	13.86	1.80	0.79
FL	3.34	18.64	3.77	1.25
GA	2.79	14.70	3.37	1.47
IL	2.25	14.31	1.78	0.74
IN	2.25	14.02	1.75	0.72
KS	2.72	15.28	2.02	0.77
KY	2.70	14.57	1.98	0.74
LA	2.83	14.59	1.72	1.05
MD	2.03	12.89	1.72	0.70
MA	1.73	14.06	1.49	0.54
MN	1.83	18.72	2.60	1.01
MO	2.51	13.37	1.52	0.62
NE	2.38	13.86	1.96	0.71
NV	3.40	18.10	3.09	1.25
NJ	1.77	13.67	1.46	0.57
NM	4.00	15.82	2.31	0.81
NY	2.35	16.78	1.48	0.70
ND	1.84	14.84	2.19	0.87
OK	2.61	13.91	1.57	0.66
RI	1.49	14.25	1.86	0.72
SC	3.52	17.40	2.03	1.24
SD	2.23	15.86	2.56	0.87
TN	3.00	18.99	3.47	1.29
TX	2.84	18.13	2.95	0.74
WI	2.36	13.56	1.32	0.55

Source: Jobson's Liquor Handbook, 1985.

The corrected R-square for the model was .323. This corrected R-square is not high although a low value is not uncommon in cross-sectional estimation. None of the three tax variables indicated that higher rates of any of the alcoholic beverage types contributed to lower highway fatality rates. Specifications of the model were tried with each tax rate included separately and in combinations to allow for multicollinearity. It is recognized that this model has omitted variables which could contribute to the unexplained variation. However, it is doubtful that inclusion of more variables will make the tax variables significant. However, this lack of association is not taken to mean that higher rates of taxation would not have an effect on highway fatalities through reducing alcohol-impaired driving. Rather, it is interpreted as showing that the purpose of taxing alcohol has been historically to raise revenue. To reduce consumption by a significant amount, as would be required for impacting highway fatalities, would be counterproductive to raising taxes.

(Note: The cross-sectional model confirmed once again what is generally believed among highway safety experts. It is the consumption of beer that has the most relative impact on highway fatalities compared to the consumption of the other two types of alcoholic beverages. This relationship, probably because of the common links to younger drivers, must be borne in mind when implementing efficient and equitable tax policies. Also, because of this relationship the more important price elasticity for consumption may be that for beer which has been estimated, as mentioned above, to be between -0.3 to -0.6.)

Another attempt was made to establish a relationship between state tax rates on the three alcohol beverage types and highway fatalities. The above model was made more specific to the problem of alcohol-impaired driving. The dependent variable of the preceding model represented the fatality rate for all fatalities, alcohol related or not. In the new model, the dependent variable measured the percentage of dead drivers who tested positive for blood alcohol content (BAC) in states where 65 percent or more of dead drivers had been tested in 1984. There were 21 of these 'good' states, along with the District of Columbia, which had such a level of testing in 1984. The District of Columbia, however, had only 23 dead drivers and was dropped from the estimation for lack of size. The percentage of positive BAC levels for all the 31 alcohol licensed states is shown in Table 4 along with the percentage of all dead drivers who were actually tested.

Table 4: Percent of Dead Drivers with Positive BAC and Percent of Dead Drivers Tested, 1984 and 1988

State	% Tested(1984)	% Drivers(1984)
AZ	54	65
AR	61	31
CA	54	89
CO	63	88
CT	62	86
DE	41	91
DC	45	96
FL	56	60
GA	57	72
IL	58	83
IN	62	59
KS	73	42
KY	56	74
LA	79	26
MD	53	78
MA	57	74
MN	59	87
MO	61	46
NE	42	76
NV	52	93
NJ	50	85
NM	52	88
NY	50	69
ND	100	09
OK	46	72
RI	63	93
SC	61	41
SD	64	71
TN	57	77
TX	85	03
WI	58	83

Source: Fatal Accident Reporting System (FARS)

The level of reporting is extremely important in accurately estimating the amount of alcohol involvement when not all persons are tested and/or when states test at a

differential rate. With increases in the level of testing the likelihood of any one dead driver having a positive BAC decreases. The decline represents the natural inclination of police to test first those dead drivers involved in accidents which manifest signs of alcohol. Two states might have the same rate of positive BAC among persons tested. The rate might indicate that 50 percent of these persons had been drinking. In the first state, however, 40 percent, say, of all dead drivers might have been tested. In the second state, the test rate might be, say, 80 percent. The first state would very likely have a lower rate of positive BAC involvement if testing were performed at the 80 percent level or higher. There are diminishing returns, in terms of finding positive BAC levels, to testing. In any case, the comparison of a low testing state with a high testing state is not likely to yield valid comparisons.

For this estimation, a reporting level of 65 percent or greater was used. This level was selected *ad hoc* so, hopefully, enough observations would be retained to estimate a meaningful model. It is assumed that the additional marginal testing above the 65 percent level would not unduly biased the results. Dead drivers, as opposed to any other group of persons involved in accidents, were selected because dead drivers experience by far the highest level of testing.

Even with the selection of dead drivers, and a fairly low reporting threshold of 65 percent, only 21 of the 31 states, and the District of Columbia, in 1984 qualified to be included in the new estimation. If the observations were updated to 1988 only two more states would have been added using the same reporting criteria.

The percentage of dead drivers who had positive BAC levels in each of the 21 states were regressed on levels of alcohol taxation for distilled liquor, wine, and beer as well as the other independent variables mention above. There was no indication that states with higher rates of taxation on any of the three alcoholic types had lower percentages of dead drivers with positive BAC levels. However, variation in the 21 cross-sectional, state observations was not well explained by the control variables. It may be that the 21 states do not represent enough observations to make meaningful models. As mentioned above, using 1988 data which is the latest FARS data available would only increase the number of observations by two.

Summary

There can be no doubt that tax increases which raise the price of alcoholic beverages will reduce consumption and thus highway accidents and fatalities. The price of alcohol matters. The question then becomes what is the magnitude of the reduction in fatalities for any given change in the tax. Trying to reason about what the effect will be is difficult. The result depends on three crucial links. The first link is the effect that the tax will have on the retail price. Previous studies have assumed that the full amount of the tax will be passed forward with a markup of between 20 and 60 percent. However, because the tax does not represent a cost of production, and because there is potential for reducing the production costs of others factors in alcohol beverage consumption, not all of the tax may be reflected in the selling price. It may be that in absence of a large tax increase, relatively cheap alcoholic beverages will still exist as a legacy of virtually no new taxes at the Federal level for a number of years.

The second consideration in determining the impact on highway accidents and fatalities is that given any increase in the price of alcohol, What will the reduction in consumption be? Most studies have been directed at estimating a price elasticity for a particular type of alcoholic beverage. With the type of changes in alcohol taxation being considered, these estimates overstate the price elasticity of alcohol consumption. With equalization of taxes by alcoholic content and indexing, substitution to other alcoholic beverage types will be reduced. However, substitution will be possible within price categories of the same beverage type. A consumer may be able to maintain the same alcoholic content for the same expenditure.

The third consideration is probably the least understood. It is unlikely that all types of alcoholic consumption by all consumers have the same elasticity. Because it has been difficult to identify that consumption which leads directly to alcohol-impaired driving, it is not clear by how much this type of consumption will be reduced given a particular increase in all alcoholic beverage consumption.

Given that it is difficult to reason about the effects of higher alcohol taxes, it was only natural that empirical studies would be undertaken to try and link episodes of state alcohol tax changes to highway accidents, particularly fatalities. The Cook study does

just that. However, the median price elasticity used to describe the historical results will probably overestimate the reductions in fatalities from a plan like the former Surgeon General.

Attempts to explain different fatality rates among 31 states for 1984 with the levels of taxes on distilled liquor, wine, and beer did not give an indication that higher taxes are associated with lower rates. However, the interpretation is made that taxes have been set at a level to raise revenue and not to reduce consumption by an amount necessary to reduce highway fatalities.

An attempt was also made to relate higher alcohol taxes in alcohol license states to lower percentages of dead drivers who had positive BAC test results. There was no indication that such a relationship existed for 1984. However, the 21 observations on which this result is based may be too small to form a meaningful estimation.

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