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Taxing to Control Social Costs: The Case of Alcohol

By Thomas F. Pogue and Larry G. Sgontz*

Whether taxation of alcoholic beverages is an appropriate means of reducing social costs of alcohol consumption is a continuing public policy issue. Some argue that “the public health costs and other external costs associated with the consumption of alcoholic beverages are so significant as to justify substantial excise taxes on those beverages.”¹ Others counter that “a tax on alcohol would reduce consumption indiscriminately...and therefore reduce the satisfaction experienced by millions of sensible drinkers without necessarily reducing the harm caused by a few excessive drinkers.”² This paper presents and applies a framework for evaluating these two views of the efficiency (welfare) effects of alcohol taxes.

Determining the efficiency implications of alcohol taxes is complicated by the question of whether and how much abusers, especially alcoholics, benefit from alcohol consumption. Standard welfare theory assumes that all consumers of alcohol enjoy positive net benefits (consumer surplus). However, it is possible that alcoholics over-consume in the sense that consumer surplus from their marginal consumption is zero or negative. Indeed, if alcoholism is a disease, alcoholics' total consumer surplus is arguably negative.

Section I first develops an optimal tax formula under the assumptions of standard welfare theory, and then considers how the formula should be modified if alcoholics over-consume. Section II uses available data to judge whether current taxes on alcoholic beverages are optimal. The final section summarizes our conclusions.

I. Optimal Alcohol Taxation

Alcohol abuse generates costs in addition to the value of resources used to produce and distribute alcohol. Some of these abuse costs are borne by the abuser (internal) and some are inflicted on others (external). Internal abuse costs take various forms, such as increased medical expenses, lost income, increased health and automobile insurance premiums, and the pain, discomfort, and emotional and physical stress associated with excessive use of alcohol. External abuse costs likewise take a number of forms, mainly injury to others and damage to their property.³ Whether external or internal, some of the abuse costs generated by current alcohol consumption may be realized in future periods.

The main issues that arise in taxing alcohol optimally can be explained by supposing that there are two types of alcohol consumers, abusers and nonabusers, who differ only in their demand for alcohol. Figure 1 shows the income-compensated alcohol demand schedule of each abuser (Dₐ) and each nonabuser (Dₙ).⁴ An individual's demand for alcohol will reflect the extent to which he perceives and takes account of internal abuse costs. Dₐ is defined as the demand schedule for individuals who correctly account for the effects of alcohol abuse on their well-being. The demand expressed by individuals who

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¹From a petition signed by 79 economists, most of whom are professors at major universities, presented at the U.S. Congress Ways and Means Committee Hearings on Revenue Increase Options, July 9, 1987, as part of the testimony given by Michael F. Jacobson of the National Alcohol Tax Coalition.

²Stephen Littlefield, p. 274.

³Also, the financing of health care and the pricing of insurance do not at present confront consumers with the full costs of their actions and may therefore cause them to underestimate the costs of alcohol abuse.

⁴To abstract from the revenue effects of an alcohol tax and to focus on its role in controlling social costs, we assume that alcohol tax revenues are returned lump-sum to consumers of alcohol, so that the tax has no income effects and changes only relative prices.
underestimate internal abuse costs would be greater than $D_A$.

To further simplify the analysis, we assume that there is only one alcoholic beverage. It is produced in a competitive industry under constant cost, with price equal to long-run marginal and average total cost, $P$. Marginal external costs, which are negligible at low levels of consumption, are represented in Figure 1 by the distance $E$ between the $P$ and $P + E$ schedules.

When the price of alcohol is $P$ and alcohol consumers take full account of internal abuse costs, each abuser in Figure 1 consumes $x_A$ and each nonabuser consumes $x_B$. Since marginal external abuse costs are positive, consumption of $x_A$ is excessive from the perspective of society as a whole. But it is not excessive from the individual's perspective because in choosing $x_A$ he has taken full account of the abuse costs that he bears. However, if he were to consume more than $x_A$, say $x_A^*$, because he either ignores or is unaware of these abuse costs, then tax or other measures that reduce his consumption could increase his welfare.

With a unit tax in the amount $T$ levied on all consumption, quantity consumed falls to $x_{A1}$ and $x_{B1}$ for abusers and nonabusers, respectively. The welfare gain, $W$, from the tax is equal to area $a$ multiplied by the number of abusers, $N_A$, minus area $b$ multiplied by the number of nonabusers, $N_B$. Or,

$$W = -E(\Delta x_A)N_A + \frac{1}{2} T(\Delta x_A)N_A + \frac{1}{2} T(\Delta x_B)N_B,$$

where $\Delta x_A \equiv x_{A1} - x_A$ and $\Delta x_B \equiv x_{B1} - x_B$, and $E$ now denotes marginal external abuse cost averaged over the change in abusive consumption from $x_A$ to $x_{A1}$. The first term in equation (1) is the tax-induced decrease in external cost; the second and third terms are the decreases in the consumer surplus of abusers and nonabusers.\(^5\)

Assuming that price increases by the amount of the tax, $T$, the tax-induced changes in consumption are

$$\Delta x_A = \frac{T\eta_A x_A}{P}$$

\(^5\)In general, collection costs (the costs of administering, enforcing, and complying with the tax) should be included in equation (1). We have not done so because these are largely fixed costs, which do not vary significantly as the tax rate on alcohol varies. Therefore, collection costs do not affect the optimal rate rate, given that $W$ is in fact positive when they are taken into account.
\begin{equation}
\Delta x_B = \frac{T \eta_B x_B}{P},
\end{equation}
where the demand elasticity is \( \eta_A \) for abusers and \( \eta_B \) for nonabusers. Substituting equations (2) and (3) into (1) gives

\begin{equation}
W = -\frac{ET \eta_A X_A}{P} + \frac{\frac{1}{2} T^2 \eta_A X_A}{P} + \frac{\frac{1}{2} T^2 \eta_B X_B}{P},
\end{equation}
where \( X_A \equiv x_A N_A \) and \( X_B \equiv x_B N_B \) denote total consumption by abusers and nonabusers, respectively. The first-order condition for maximizing \( W \) is

\begin{equation}
\frac{\partial W}{\partial T} = -\frac{E \eta_A X_A}{P} + \frac{T \eta_A X_A}{P} + \frac{T \eta_B X_B}{P} = 0.
\end{equation}
Solving equation (5) for \( T/P \) gives the \textit{ad valorem} tax that maximizes welfare (in a second-best sense):

\begin{equation}
\frac{T}{P} \equiv t = \frac{E}{P} \left[ \frac{1}{\eta_B X_B} \right],
\end{equation}
for \( \eta_A > 0 \).

Of course, the first-best tax would be one that could costlessly tax only abusers. In such case, the last terms in equations (1), (4), and (5) would drop out and the optimal tax rate, applied only to consumption by abusers, would be

\begin{equation}
t = \frac{E}{P}, \text{ for } \eta_A > 0.
\end{equation}

Equation (7), which also applies if all consumers are abusers, is the standard Pigovian tax rate for correcting an externality.

The preceding analysis assumes that \textit{all} consumers of alcohol are informed and make welfare-maximizing decisions. An alternative view is that alcoholism is a disease. Although some persons may knowingly make decisions that risk a disease, disease itself is not welfare enhancing. If alcoholism is a disease, alcoholics benefit not from the consumption of alcohol but from arresting the disease, which requires a sharp reduction in if not complete abstention from alcohol consumption. In this case, consumer surplus from alcohol consumption is \textit{negative}. Persons who have the disease of alcoholism \textit{gain} when alcohol taxes reduce their consumption; their gain is the decrease in their alcohol expenditures plus the decrease in internal abuse costs.

Allowing for alcoholism as a disease, the welfare gains from alcohol taxation can be expressed by modifying equation (4)

\begin{equation}
W = -\frac{ET \eta_A X_A}{P} + \frac{\frac{1}{2} m T^2 \eta_A X_A}{P} + \frac{\frac{1}{2} T^2 \eta_B X_B}{P} - \frac{(P + A)(1 - m) T \eta_A X_A}{P}.
\end{equation}
The first and third terms in equations (4) and (8) are identical. The second term is the tax-induced reduction in consumer surplus of \textit{nonalcoholic} abusers, who are assumed to account for a fraction \( 0 < m < 1 \) of abusive consumption. Alcoholics therefore consume \((1 - m)X_A\). Assuming that they have the same demand elasticity as nonalcoholic abusers,

\textit{The American Medical Association classifies alcoholism as a disease. Recognizing alcoholism as a disease does not render economic factors unimportant in the decisions that lead to the disease.}

\textit{Imperfect information and addiction are also reasons why the standard consumer choice model may not adequately characterize the alcohol consumption decisions of some persons. See Gary Becker and Kevin Murphy, 1987; Thomas Barthold and Harold Hochman, 1988; and Charles Phelps, 1988. Becker et al., 1987, test their theory of rational addiction against data on cigarette use.}

\textit{This statement is strictly correct only if administration, enforcement, and compliance costs do not exhaust the net welfare gains from the tax.}
the tax reduces alcoholics’ consumption by 

\((1 - m)(T\eta_A X_A)/P\). Multiplying this amount by \(P + A\), the marginal cost of a unit of alcohol plus the marginal internal abuse cost, gives the last term of equation (8).

Following the procedure used to derive equation (6), the optimal tax rate is

\[
(9) \quad t = \frac{E}{P} + (1 - m) \frac{(P + A)}{P} \quad \frac{m + \eta_B X_B}{\eta_A X_A}, \quad \eta_A > 0.
\]

Equation (9) assumes that alcoholics differ from other abusers in neither the externalities they generate nor in their demand elasticities. Such differences can easily be allowed for in the optimal tax formula. Specifically, if the marginal external cost associated with consumption by alcoholics is \(\tilde{E}\) and their demand elasticity is \(\tilde{\eta}_A\), then the optimal tax formula given in equation (9) should be modified:

\[
(10) \quad t = \frac{mE}{P} + (1 - m) \frac{\tilde{\eta}_A}{\eta_A} \frac{(\tilde{E} + P + A)}{P} \quad \frac{m + \eta_B X_B}{\eta_A X_A}, \quad \eta_A > 0.
\]

It is easily seen that if \(\tilde{E} = E\) and \(\tilde{\eta}_A = \eta_A\), equation (10) reduces to equation (9). Equations (9) and (10) make clear that the optimal tax rate depends on relative rather than absolute demand elasticities. Note that even if demand by alcoholics is completely unresponsive to price (\(\tilde{\eta}_A = 0\)), the optimal tax is nevertheless positive if other abusers respond to price.

Equations (9) and (10) are simple adjustments of the optimal tax formula that illustrate the consequences of viewing alcoholism as a disease. Having detailed and accurate information about the demands of alcoholics and other abusers would likely lead to more complicated adjustments, but it would not alter the conclusion that allowing for the disease aspect of alcoholism increases the optimal tax rate.

II. Estimates of Optimal Tax Rates

To apply the tax formulas, we estimated \(X_B/X_A\), \(m\), \(E\), \(A\), \(P\), and \(\eta_B/\eta_A\) from sources described briefly below and in detail in an Appendix that is available upon request.

From a 1979 survey of adult alcohol use and problems (Walter Clark and Lorraine Midanik), we classify abusers as persons who report at least one alcohol-related problem. Thus defined, abusers are only 10 percent of the adult population but, based on data reported in Mark Moore and Dean Gerstein (1981), they account for 38 percent or more of total consumption.\(^9\) From a survey of youth drinking (J. Rachal et al., 1982), we estimate that adolescent abusers consume 3 percent of all alcohol. Together, youth and adult abusers account for at least 41 percent of alcohol consumption, which implies a maximum for \(X_B/X_A\) of 1.42.

The National Institute on Alcohol Abuse and Alcoholism (NIAAA, 1986) estimated that adult alcoholics were 6 percent of the adult population in 1985. Combining this fraction with data on consumption of clinical alcoholic patients (Clark and Midanik, 1982) we estimate that adult alcoholics account for at least 30 percent of total consumption and 73.5 percent of abusive consumption,\(^10\) which implies a maximum for \(m\) of .265.

A Research Triangle Institute report (Henrick Harwood et al., 1984) estimates total abuse cost in 1983 at $116.7 billion. It identifies the main types of costs as alcohol-related treatment and support, deaths, re-

\(^9\)This estimate is probably low because problems with alcohol are likely to be underreported. Also, we have assumed that abusers consume in proportion to their numbers in each of the drinking categories (heavy, moderate, and light) used in the survey. However, it is plausible that in each drinking category abusers consume more than nonabusers. The survey does not report separately consumption by those who do and do not report alcohol-related problems.

\(^10\)This estimate understates consumption by alcoholics because it is based on the minimum consumption of clinical alcoholic patients, and it does not allow for consumption by youth alcoholics. We have found no estimates of either the number or the consumption of youth alcoholics.
duced productivity, motor vehicle crashes, and crime, but it does not distinguish between internal and external abuse costs. We make that distinction, classifying $26.1 billion as external costs and the remaining $90.6 billion as internal costs. With this allocation, which is explained in the Appendix, external abuse costs averaged $127 per gallon of pure alcohol (ethanol) consumed by abusers in 1983, and internal abuse costs averaged $441 per gallon. Assum ing that marginal external abuse costs equal average external costs, we estimate E at $127. Similarly, we estimate A at $441. These estimates are conservative (low), since the RTI estimates do not provide a full accounting of abuse costs. Also, observed abuse costs reflect the present level of taxation and therefore underestimate the costs that would arise if taxes were zero.

We estimate the pretax price of alcohol, P, by the net-of-tax selling price per gallon of alcohol content, averaged across all beverages. From the Distilled Spirits Council of America (DSCA, 1985a) this amount was $102.66 in 1983.

There are no separate estimates for abusers and nonabusers of income and price elasticities of demand, and hence there is no evidence that abusers and nonabusers respond differently to price. But there is evidence that alcohol taxes and prices influence cirrhosis mortality rates (Philip Cook, 1981, and George Tauchen, 1982), auto fatality rates (Cook, 1981), and youth motor vehicle death rates (Henry Saffer and Michael Grossman, 1987), all of which are consequences of abusive consumption. Thus, it is plausible that $\eta_A > 0$ and not implausible.

\[ \text{Table 1 — Estimated Optimal Tax Rates} \]

<table>
<thead>
<tr>
<th>Cases*</th>
<th>Estimated Tax Rate Based on:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equation (6) (percent)</td>
</tr>
<tr>
<td>I. Best-guess</td>
<td></td>
</tr>
<tr>
<td>( m = .265, E = 127, A = 441, )</td>
<td>51</td>
</tr>
<tr>
<td>( x_B / x_A = 1.42, \eta_B / \eta_A = 1^a )</td>
<td></td>
</tr>
<tr>
<td>II. Same as I except ( \eta_B / \eta_A = 2^c )</td>
<td>32</td>
</tr>
<tr>
<td>III. Same as I except ( \eta_B / \eta_A = 4^d )</td>
<td>19</td>
</tr>
<tr>
<td>IV. Same as I except ( m = .35 )</td>
<td>51</td>
</tr>
<tr>
<td>V. Same as I except ( x_B / x_A = 1.9 )</td>
<td>43</td>
</tr>
<tr>
<td>VI. Same as I except ( E = 85 )</td>
<td>34</td>
</tr>
<tr>
<td>VII. Same as I except ( A = 294 )</td>
<td>51</td>
</tr>
</tbody>
</table>

*All estimates assume \( P = 102.65 \), the 1983 average pretax price per gallon of alcohol.

Abusers and nonabusers are equally responsive to price changes in that they have the same compensated price elasticity.

Abusers are only one-half as responsive to price changes as nonabusers.

Abusers are only one-fourth as responsive to changes as nonabusers.

\[ ^{11} \] We have converted the quantity of each beverage to its ethanol equivalent. The assumption implicit in this conversion is that the ill effects of alcohol consumption flow from the quantity of ethanol consumed, independent of its beverage source. The conversion factors are .046, .12, and .4 gallons of ethanol per gallon of bear, wine, and spirits, respectively (DSCA, 1985).

\[ ^{12} \] For a review of studies dealing with the price elasticity of demand for alcoholic beverages, see NIAAA (1987). Also see Stuart Schweitzer et al., 1983; Cook and Tauchen, 1982; Robin Room, 1984, R. E. Kendall et al., 1983; David Levy and Neil Sheflin, 1983, 1985; Stanley Orstein and David Levy, 1983; Douglas Coate and Grossman, 1988; Grossman et al., 1987; and Jon Nelson (1988a,b). The demand for alcohol by an alcoholic is generally believed to be quite inelastic. However, even if this is true for most alcoholics, aggregate demand by addicted consumers may be sensitive to price. See Barthold and Hochman, 1988, for an explanation of why adjustments may be discontinuous (all or nothing), and why consumption of an addictive good by a population may be price-sensitive even though individuals' demand are perfectly inelastic over some range of prices.
that $\eta_B / \eta_A = 1$. We estimate optimal tax rates for a range of values of $\eta_B / \eta_A$. \(^{13}\)

The estimates of optimal tax rates presented in Table 1 are conservative in that they are based on values of $m$ and $X_B/X_A$ that appear to be high and values of $E$ and $A$ that appear to be low. That is, although the true values of $m$, $E$, $A$, and $X_B/X_A$ may in fact be different than assumed, these parameters seem unlikely to take on values that would imply lower optimal tax rates than those shown in Table 1.

Since we have found no evidence that abusers and nonabusers have significantly different price elasticities of demand, the "best-guess" estimates are perhaps those that assume $\eta_B / \eta_A = 1$. However, to show the sensitivity of the estimates to relative demand elasticities, optimal tax rates for $\eta_B / \eta_A = 2$ and $\eta_B / \eta_A = 4$ are also presented (Cases II and III). Cases IV–VII estimate the optimal tax rates when the parameters $m$, $X_B/X_A$, $E$, and $A$ differ by one-third from the values assumed in Case I, and the difference is in the direction that implies a lower tax rate. \(^{14}\)

The tax rates of Table 1 are best thought of as averages of the combined federal, state, and local taxes applicable to all alcoholic beverages. They are based on the dollar magnitude of abuse costs estimated for 1983 and the 1983 average net-of-tax price of alcohol, $102.65. Optimal per unit (per gallon) taxes can be calculated by multiplying the ad valorem rates of Table 1 by the 1983 average price of alcohol; carrying out this calculation yields optimal per gallon taxes of $53$ and $314$ for the two tax formulas in the best-guess case.

The average tax rate on alcohol—alcohol taxes as a percentage of the net-of-tax value of alcohol sold—was 24 percent in 1983, down from 54 percent in 1955. \(^{15}\) Therefore, the 1983 optimal tax rate, conservatively estimated, appears to be about double the actual rate in the standard welfare economics case, and much higher in the case of equation (9). For the actual 1983 rate of alcohol taxation to have been optimal, abusers would have to be less than half as responsive to income and price changes as nonabusers (see Cases II and III of Table 1).

\(^{13}\)In the optimal tax formulas, demand is approximated as a linear function over the range of price change caused by alcohol taxes. Average (abuser and nonabuser) elasticities for the same range of price change are therefore the appropriate elasticity measures. They should be long-run measures, since considerable time may be required for consumers to adjust fully to tax (price) changes. The problems of obtaining appropriate elasticity estimates are made less severe by the fact that optimal tax rates depend on the ratio of nonabuser-to-abuser elasticities rather than their individual values. When elasticity values have been needed, as in the calculation of tax-induced changes in consumption, abuse costs, and consumer surplus, we have used weighted averages of the elasticity estimates that Nelson (1988a) reports for individual beverages. See Thomas Pogue and Larry Sgonz (1987) for further discussion of aggregation issues and procedures.

\(^{14}\)In a related study, Charles Phelps, 1988, estimates optimal tax rates for beer. He finds that beer taxation significantly reduces both beer consumption by youths and the auto fatalities that they cause; fatalities drop 33 percent in response to a 20 percent tax and 40 percent in response to a 30 percent tax. He concludes that this lifesaving effect alone justifies a beer tax between 22 and 48 percent. Phelps' paper is a careful and helpful analysis of what is presently known about the link between alcohol taxes and deaths due to drunken driving. However, it is weakened as a guide for alcohol tax policy by the omission of two potentially important effects of beer taxation. First, if other alcoholic beverages are substitutes for beer, then Phelps' estimates overstate the amounts by which a tax on beer alone reduces total consumption, drunken driving, and auto fatalities. Second, beer taxation may reduce abuse costs other than auto fatalities. As Phelps recognizes, the first omission implies an upward bias in his estimates of the optimal tax rate on beer, while the second omission implies a downward bias. Therefore, until we know more about the effects of these omissions, we do not know whether the optimal tax on beer falls within or outside the range of rates estimated by Phelps.

The more general point is that it is difficult to prescribe an optimal tax for one beverage without also specifying how substitute beverages are taxed. Phelps' optimal tax estimates make no allowance for the probable substitution away from beer that would occur if the tax were imposed. He does note that taxing other beverages (liquor and wine) would prevent such substitution. But he does not estimate the welfare consequences of imposing such taxes in addition to a beer tax; nor does he provide a framework for doing so.

\(^{15}\)The tax rate is estimated by public revenues from alcohol as a percentage of retail expenditures minus public revenues; these percentages are estimates of the actual tax rates applied to the various beverage categories, averaged across states in each of the years. Source: (DSCA, 1978, 1985a,b).
### Table 2—Estimated Changes in Abuse Costs, Revenues, and Welfare from Implementing Optimal Tax, 1983 Conditions

<table>
<thead>
<tr>
<th></th>
<th>Abusers as Responsive as Nonabusers&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Abusers One-Half as Responsive as Nonabusers&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>η_A</strong></td>
<td>-.35</td>
<td>-.175</td>
</tr>
<tr>
<td><strong>η_B</strong></td>
<td>-.35</td>
<td>-.35</td>
</tr>
<tr>
<td><strong>η_A</strong></td>
<td>-.7</td>
<td>-.35</td>
</tr>
<tr>
<td><strong>η_B</strong></td>
<td>-.7</td>
<td>-.7</td>
</tr>
<tr>
<td><strong>Change in Tax Rate (Percentage Points)</strong></td>
<td>27</td>
<td>8</td>
</tr>
<tr>
<td><strong>Decrease in Consumer Surplus, Nonabusers ($Billion)</strong></td>
<td>$.863</td>
<td>$.198</td>
</tr>
<tr>
<td><strong>Decrease in Consumer Surplus, Abusers ($Billion)</strong></td>
<td>$.610</td>
<td>$.070</td>
</tr>
<tr>
<td><strong>Decrease in External Costs ($Billion)</strong></td>
<td>$2.008</td>
<td>$.308</td>
</tr>
<tr>
<td><strong>Decrease in Internal Costs ($Billion)</strong></td>
<td>$6.974</td>
<td>$1.068</td>
</tr>
<tr>
<td><strong>Increase in Revenue ($Billion)</strong></td>
<td>$11.877</td>
<td>$3.947</td>
</tr>
<tr>
<td><strong>Decrease in Consumption (Million Gallons)</strong></td>
<td>36.2</td>
<td>9.3</td>
</tr>
</tbody>
</table>

<sup>a</sup> Calculated for best-guess tax rates of Table 1 and the corresponding parameter values. The uncompensated price elasticity of -.7 assumed in column 2 is an approximate weighted average of the elasticities for beer, spirits, and wine reported in Nelson (1988a).

<sup>b</sup> Calculated for same parameter values as columns 1 and 2 except that price elasticities are assumed to be only one-half as large for abusers as for nonabusers.

The tax change for columns 1 and 2 is the optimal 51 percent tax rate for Case 1 and equation (6) reported in Table 1 minus the average actual tax rate for 1983 of 24 percent. Similarly, the change for columns 3 and 4 is the optimal rate of 32 percent for Case II and equation (6) minus the actual rate.

Since a doubling of the 1983 average tax rate would still have left it somewhat short of the 1955 rate, the estimated optimal rates are not as large as they might appear at first glance.<sup>16</sup> Furthermore, optimal per unit rates would presumably be higher for 1987 than for 1983 because of inflation since 1983. Taking account of this inflation leads to optimal taxes for 1987 that are about 15 percent higher than the estimates for 1983, assuming that the dollar costs of abuse per gallon of alcohol consumed increased at least as rapidly as the general level of prices. Adjusting for inflation brings the best-guess taxes up to $61 and $352 per gallon for equations (6) and (9), respectively.

Table 2 presents estimates of the revenue and welfare effects under 1983 conditions of bringing alcohol taxes up to the optimal rate defined by equation (6). Column 1 shows that increasing taxes to an average rate of 51 percent (the best-guess case) would reduce external costs by $2.008 billion, reduce consumer surplus (abuser and nonabuser) by $1.473 billion, and generate a welfare gain as defined by equation (4) of $5.35 billion. In addition, it would reduce internal abuse costs by $6.974 billion and increase alcohol tax revenue by $11.9 billion. (Recall that our analysis assumes that revenues are rebated to consumers.) Column 2 presents estimates based on the same assumptions as column 1 except that income and price elasticities are twice as large in column 2 as in column 1.

The approximate doubling of the average level of alcohol taxation in these two cases would require somewhat more than a four-
fold increase in federal taxes, which accounted for 46 percent of total alcohol tax revenue in 1983. While this appears to be a very large increase, it would only restore federal alcohol taxes to their 1951 real levels, since the consumer price index quadrupled from 1951 through 1983.

The estimates in the third and fourth columns of Table 2 show the effects of the smaller tax increase that would be optimal if abusers are only half as responsive to tax changes as nonabusers.

III. Concluding Comments

The estimates of Table 1 show that determining alcohol tax rates on the basis of efficiency criteria—the optimal tax framework—does not in itself greatly limit the range of tax rates. Either taxation near the present level or very high taxation may be optimal, depending on the values of key parameters and whether alcoholism is viewed as a disease. Optimal tax rates cannot be determined with precision until more is known about these influences.

Nevertheless, available information points to a tentative conclusion that the average tax rate should be at least as high as, and probably double, the present rate of about 25 percent, even in the standard welfare case. Significantly higher rates may be called for if it is accepted that alcoholism is a disease that causes alcoholics to lose rather than gain utility from alcohol consumption. As more is learned about the causes and consequences of alcohol abuse, our analytical framework is general enough that the appropriate tax rate adjustments can be easily calculated.

The current magnitude of external costs reflects existing institutions and practices in a number of areas—health-care finance, insurance, education, laws, and law enforcement. Policy and institutional changes in these and other areas might well reduce external costs and thereby decrease optimal alcohol taxes as estimated in this paper. Examples include making health and accident insurance premiums dependent on alcohol use, cutting government programs that provide support and treatment for abusers and their families, and increasing penalties for specific abuses. We do not argue against such changes. But until they are made, available evidence suggests that the excessive consumption of abusers and the external abuse costs that they generate can be reduced by taxing alcohol. Furthermore, although the optimal tax would change as institutions change, it would not be zero as long as abusive consumption is price-sensitive and generates Pareto-relevant external costs at the margin.

REFERENCES


APPENDIX TO

Appendix

Our analysis holds in its essential elements if we relax the assumption of only one alcoholic beverage and derive the optimal uniform tax rate to be applied to every type of beverage. With \( i \) beverages having net-of-tax prices of \( P_i \) per unit of alcohol the welfare change from a uniform tax at rate \( t \) is

\[
W = -tE \sum_i \eta_{Ai} X_{Ai} + yt^2 \sum_i \eta_{Ai} P_i X_{Ai} + t^2 \sum_i \eta_{Bi} P_i X_{Bi}, \quad \eta_{Ai} > 0.
\]

The elasticities in equation 4a are defined as those applying when all beverage prices are increased by the same proportion, that proportion being the tax rate \( t \). The first order condition for maximizing \( W \) is

\[
\frac{\partial W}{\partial t} = -E \sum_i \eta_{Ai} X_{Ai} + t \sum_i \eta_{Ai} P_i X_{Ai} + t \sum_i \eta_{Bi} P_i X_{Bi} = 0.
\]

Solving equation 5a for \( t \) gives the optimal tax rate:

\[
t = \frac{E}{P^* \left[ 1 + \frac{\sum_i \eta_{Bi} P_i X_{Bi}}{\sum_i \eta_{Ai} P_i X_{Ai}} \right]}, \quad \eta_{Ai} > 0,
\]

where \( P^* = \frac{\sum_i \eta_{Ai} P_i X_{Ai}}{\sum_i \eta_{Ai} X_{Ai}} \) is an average of beverage prices. If the ratio of nonabusive-to-abusive consumption is the same for all beverages and the ratio of nonabuser-to-abuser demand elasticities is likewise the same, then equation 6a can be written

\[
t = \frac{E}{P^* \left[ 1 + \frac{\eta_B X_B}{\eta_A X_A} \right]}, \quad \eta_A > 0,
\]

where \( X_B/X_A \) and \( \eta_B/\eta_A \) are the common consumption and elasticity ratios.
Equations 6b and 6 differ only in the measurement of price. P in equation 6 is the price of the hypothetical beverage "alcohol," which we have measured by an average of beverage prices.

Our estimates of t are based on equation 6 rather than 6a because we do not know whether and how abuser and nonabuser demand elasticities and consumption shares differ across beverages. If we had evidence that they do differ, it would be a simple matter to apply equation 6a; our simplifying assumptions therefore reflect data limitations rather than a narrow analytical framework.

The remainder of this appendix explains how we obtained the data used to generate the estimates reported in Tables 1 and 2.

**Abusive consumption**

Tables A.1 and A.2 outline the main dimensions of alcohol production and consumption. From a 1979 survey of adult alcohol use and problems (Clark and Midanik, 1982) we classify alcohol abusers as persons who report at least one alcohol-related problem (loss of control; dependence; binge drinking; health worries; problems with a spouse, friends, police, accidents, a job).

The heaviest-drinking 5 percent of the adult population, a group consisting of persons who drink more than 2 ounces of alcohol daily, consumes 50 percent of all alcohol (Moore and Gerstein, 1981, pp. 28-29). About 60 percent of this group are abusers in that they report at least one alcohol-related problem. We assume therefore that abusers consume 60 percent of the amount consumed by the heaviest-drinking 5 percent of the adult population, which amounts to 30 percent of all consumption by adults.

The next heaviest-drinking portion of the population (28 percent) consumes about 45 percent of all alcohol. We estimate (from Clark and Midanik, 1982) that 23 percent of these persons are abusers, who account for
Table A.1

Alcohol Use by Adult Population, 1983

<table>
<thead>
<tr>
<th>User Category</th>
<th>Number (millions)</th>
<th>Share of all adults (percent)a</th>
<th>Share of adult drinkers (percent)b</th>
<th>Share of adult consumption (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total adultsc</td>
<td>171.8</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>56.7</td>
<td>33</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Drinkers</td>
<td>115.1</td>
<td>67</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Nonabusers</td>
<td>97.6</td>
<td>57</td>
<td>85</td>
<td>60</td>
</tr>
<tr>
<td>Abusersd</td>
<td>17.5</td>
<td>10</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>Alcoholics</td>
<td>10.3</td>
<td>6</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Nonalcoholics</td>
<td>7.2</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

a The percentage of adults who abstain from alcohol consumption is from Clark and Midanik (1982), based on a 1979 survey of adult alcohol use and problems. The 33 percent figure for 1979 is consistent with the results of surveys taken over a number of years (NIAAA, 1983); it is assumed to apply to the 1983 adult population. The percentages of adults classified as nonabusers, abusers, and alcoholics for 1985 (NIAAA, 1986) are assumed to apply to the 1983 population.

b Calculated from column (3)

c The population 18 years and older.

d Nonalcoholic abusers are defined as adults with "severe or moderately severe consequences of alcohol use such as job loss, arrest, or illness." Alcoholism is defined in terms of "alcohol dependence (at least one symptom of alcohol withdrawal or at least one symptom of loss of control plus one other symptom of dependence such as tolerance, excluding withdrawal.)"
Table A.2

Alcohol Consumption, Production Costs
and Public Revenues, 1983

<table>
<thead>
<tr>
<th></th>
<th>All beverages</th>
<th>Spirits</th>
<th>Wine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail expenditures (millions)</td>
<td>$63,080</td>
<td>$21,680</td>
<td>$7,750</td>
</tr>
<tr>
<td>Public revenues (millions)</td>
<td>$12,184</td>
<td>$6,897</td>
<td>$1,025</td>
</tr>
<tr>
<td>Production costs (millions)</td>
<td>$50,896</td>
<td>$14,783</td>
<td>$6,725</td>
</tr>
<tr>
<td>Public revenue ÷ production costs</td>
<td>.239</td>
<td>.467</td>
<td>.152</td>
</tr>
<tr>
<td>Gallons of alcohol (thousands)</td>
<td>495,792</td>
<td>172,453</td>
<td>62,340</td>
</tr>
<tr>
<td>Public revenue ÷ gallons of alcohol</td>
<td>$24.57</td>
<td>$39.98</td>
<td>$16.44</td>
</tr>
<tr>
<td>Production costs ÷ gallons of alcohol, an estimate of P</td>
<td>$102.66</td>
<td>$85.72</td>
<td>$107.88</td>
</tr>
</tbody>
</table>

---

a Retail expenditures minus public revenues

b Alcoholic beverages converted to gallons of alcohol

and Public Revenues from Alcohol Beverages, 1984/85.
10 percent of all alcohol consumption by adults

Together, these two groups (one-third of the adult population) account for 95 percent of all adult alcohol consumption, with 40 percent being consumed by abusers and 55 percent by nonabusers. Some adults in the remaining population report problems with alcohol, but the number is fairly small and so we allocate the remaining 5 percent of consumption to nonabusers. Nonabusers thus account for 60 percent of total adult consumption, and abusers, approximately 10 percent of the adult population, account for the remaining 40 percent.

A survey of youth drinking (Rachal et al., 1982) reported the amount of alcohol consumed by 10th through 12th graders; 31 percent were found to abuse alcohol. From these data we estimate that adolescents consume about 4 percent of all alcohol, of which 76 percent is consumed by young abusers. Adolescent abusers thus consume 3 percent of all alcohol. Total abusive consumption (adult plus youth) is about 41.4 percent of all consumption, giving \( \frac{X_B}{X_A} \) 1.42

This estimate of \( \frac{X_B}{X_A} \) is probably high for two reasons. First, problems with alcohol may be underreported. Persons who abuse alcohol may be reluctant to admit it, and alcoholics in particular tend to deny that they have problems with alcohol. Second, we have assumed that abusers and nonabusers consume in proportion to their numbers within three drinking categories (the proportion of the population that consumes 50 percent, the proportion that consumes the next 45 percent, and the remainder). However, within each drinking category, abusers may consume proportionately more alcohol than nonabusers. This may be the case even if abusers accurately report the amount that they drink. (The 1979 survey of adult alcohol use does not report separately the amount of alcohol consumed by those who do and do not report alcohol problems.)
Alcoholics' consumption

Clinical alcoholic patients report consuming 5 or more ounces of alcohol daily. If 5 ounces of daily consumption is typical of adult alcoholics, the estimated alcoholic population in 1983 would have consumed about 151 million gallons of pure alcohol, which is 30 percent of total alcohol consumption and 73.5 percent of all abusive consumption as estimated above. This gives a point estimate for $m$ (the proportion of total abusive consumption by nonalcoholic abusers) of .265. This estimate of $m$ is probably high in that it is based on the minimum consumption of clinical alcoholic patients. Also, the estimate assumes that the number of alcoholics is equal to the reported number of adult alcoholics. We know of no estimate of youth alcoholics. Given the small amount of alcohol consumed by adolescents, the error caused by omitting youth alcoholics is relatively small.

Costs of abuse

Table A.3 presents estimates by the Research Triangle Institute (RTI) of the costs of alcohol abuse for 1980 and 1983. These estimates do not distinguish external costs of abuse from costs borne by abusers. Nor do they provide a full accounting of abuse costs many of which are difficult, if not impossible, to estimate. Our estimates of external costs from these data are in Table A.4, which also includes a list of the main categories of unquantified costs.

Treatment of abusers paid for by third parties is counted as an external cost. This was $6,148 million in 1980, and we adjusted this figure upward for 1983 by RTI's estimate of the rate of increase in total treatment and support cost over the period. Of course, third party payment of treatment costs could be eliminated as a source of external costs by eliminating taxpayer support.
Table A.3
Cost of Alcohol Abuse
(Dollars in Millions)

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment and support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>10,471</td>
<td>14,865</td>
</tr>
<tr>
<td>Support&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9,487</td>
<td>984</td>
</tr>
<tr>
<td>Mortality&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol abuse specific or related illness</td>
<td>14,456</td>
<td>18,151</td>
</tr>
<tr>
<td>Motor vehicle crashes</td>
<td>4,639</td>
<td></td>
</tr>
<tr>
<td>Falls</td>
<td>5,919</td>
<td></td>
</tr>
<tr>
<td>Fires</td>
<td>462</td>
<td></td>
</tr>
<tr>
<td>Other&lt;sup&gt;c&lt;/sup&gt;</td>
<td>287</td>
<td></td>
</tr>
<tr>
<td>Homicide</td>
<td>789</td>
<td></td>
</tr>
<tr>
<td>Suicide</td>
<td>2,358</td>
<td></td>
</tr>
<tr>
<td>Reduced productivity</td>
<td>50,575</td>
<td>65,582</td>
</tr>
<tr>
<td>Lost employment</td>
<td>4,105</td>
<td>5,323</td>
</tr>
<tr>
<td>Motor vehicle crashes&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2,185</td>
<td>2,667</td>
</tr>
<tr>
<td>Crime&lt;sup&gt;e&lt;/sup&gt;</td>
<td>2,347</td>
<td>2,607</td>
</tr>
<tr>
<td>Social welfare programs&lt;sup&gt;f&lt;/sup&gt;</td>
<td>38</td>
<td>49</td>
</tr>
<tr>
<td>Other&lt;sup&gt;g&lt;/sup&gt;</td>
<td>2,912</td>
<td>3,673</td>
</tr>
<tr>
<td>Victims of crime&lt;sup&gt;h&lt;/sup&gt;</td>
<td>172</td>
<td>192</td>
</tr>
<tr>
<td>Incarceration</td>
<td>1,801</td>
<td>2,979</td>
</tr>
<tr>
<td>Motor vehicle crash (lost time)</td>
<td>464</td>
<td>583</td>
</tr>
<tr>
<td>Total</td>
<td>89,526</td>
<td>116,674</td>
</tr>
</tbody>
</table>

<sup>a</sup> Support costs for health care provision: research, education, training, construction, health insurance administration.

<sup>b</sup> Lost output at a 6 percent discount rate.

<sup>c</sup> Primarily accidents, other than falls.

<sup>d</sup> Cost due to legal action, insurance administration, accident investigation and vehicle damage.

<sup>e</sup> Publicly financed criminal justice system, property damage, private expenditures related to crime attributable to alcohol abuse.

<sup>f</sup> Incremental administrative costs.

<sup>g</sup> Includes expenditures for highway safety and fire protection; outlays for fetal alcohol syndrome programs.

<sup>h</sup> Time lost by victims of crime.

### Table A.4

External Cost of Alcohol Abuse  
(Dollars in Millions)

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimated costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>6,148</td>
<td>8,726</td>
</tr>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Vehicle Crashes</td>
<td>5,617</td>
<td>6,965</td>
</tr>
<tr>
<td>Homicides</td>
<td>2,959</td>
<td>2,358</td>
</tr>
<tr>
<td><strong>Fetal alcohol syndrome</strong></td>
<td>3,253</td>
<td>4,273</td>
</tr>
<tr>
<td>Motor vehicle crashes</td>
<td>1,864</td>
<td>2,274</td>
</tr>
<tr>
<td>Crime</td>
<td>2,519</td>
<td>2,799</td>
</tr>
<tr>
<td>Highway safety and fire protection</td>
<td>848</td>
<td>1,043</td>
</tr>
<tr>
<td>Social welfare expenditures</td>
<td>38</td>
<td>49</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20,287</td>
<td>26,128</td>
</tr>
<tr>
<td><strong>Unquantified costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain and suffering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family members of abuser</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other victims of abuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airplane and pedestrian accidents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced productivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stolen property</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire and other property loss</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*a* Lost productivity and health treatment costs (mid-range estimate).

*b* Includes emotional damage to family members; physical abuse; adverse effects on the psychosocial development of children of abusers; costs of counselling and emotional support. One might argue that the Coase theorem applies to abuse costs within the family, in which case Pareto-relevant external costs would not arise because family members would induce the alcoholic to curtail consumption when it generates welfare losses for them that exceed the alcoholic's gain. Although negotiation within the family regarding the alcoholic's behavior is not implausible, it strains credibility that negotiation would eliminate all Pareto-relevant externalities, especially where children are involved.

*c* Pain and suffering from accidents, bereavement, etc.

*d* The RTI estimate of reduced productivity includes only the reduced income of abusers. But abusers may also impose costs on employers and fellow employees, as evidenced by employer expenditures to cope with drug and alcohol abuse problems. See Boland and Berry (1977, pp. 42-43).

*e* The RTI treated the value of stolen property as an income transfer from victim to thief rather than as an abuse cost. Economic theory suggests that some value of stolen property is a real cost to society (see Friedman, 1986, Ch. 19).

*f* Abusers damage their own property through fires and motor vehicle collisions. These damages generate external costs to the extent that they are insured and insurance premiums do not reflect accurately abusers' accident rates. These are external costs in the sense that abusers do not have to account for them.

**Source:** Author's estimates from data in Harwood et al. (1984).
for treatment programs and either eliminating coverage for alcoholism
treatment from private health insurance or charging premiums that fully
reflect the additional costs that alcohol abuse generates. The current
magnitude of external costs therefore reflects existing institutions and
practices. And our estimate assumes that abusers as a group do not pay
significantly higher private health insurance premiums than nonabusers.

Since motor vehicle crashes (MVC) typically involve the abuser and
another party, we classified one-half the mortality costs due to MVC as
external cost. All of the mortality cost of homicides is considered an
external cost. The sum of these two costs was adjusted upward to 1983 by the
RTI's estimate of the rate of increase in total mortality costs over the
period.

The costs of fetal alcohol syndrome consist of income lost by the
victims, and the costs of health care and a variety of services. Most of
these costs are likely borne by the victim or third parties; we assume that
the abuser ignores all of these costs. For 1983, we increased the 1980
estimate by the rate of increase in total health expenditures (the major item
under this category).

The costs of motor vehicle crashes, exclusive of mortality costs, are
estimated for both years by RTI. The extent to which these costs are external
depends on how insurance premiums are set. If abusers pay in additional
insurance premiums an amount equal to the additional property damage that they
cause and all such damage is fully compensated by insurance payments, then
these costs are fully internalized. However, if abusers and nonabusers pay
the same insurance premiums, then the additional property damage costs that
abusers cause for themselves and others are external to the extent that they
are borne by policyholders who are nonabusers. Also, damages to others'
property are external costs to the extent that they are not compensated by insurance payments. Lacking the information needed to sort out all of these possibilities, we classify one-half of the property damage due to motor vehicle crashes as external cost.

Other categories we classify as external cost are crime, highway safety and fire protection, and the administrative costs of social welfare programs (see footnotes to Table A.3 for description of these items). The figures for both years for crime and social welfare are estimates by RTI. We increased police and fire protection expenditures to 1983 by the rate of increase in the implicit deflator for state and local government purchases of goods and services.

The remaining costs in Table A.3 are assumed to be borne by abusers. These are mainly the categories of reduced productivity and lost employment (measured as lower income of abusers), and death of the abuser due to alcohol-related illness. To generate conservative estimates of external costs, we have classified abuse costs as internal when there has been doubt. Specifically, support costs of about $1 billion (for research, training of personnel to treat consequences of abuse, construction of treatment facilities, and costs of administering insurance and treatment programs) have been classified as internal even though a share of such costs is surely external.

Table A.5 puts estimated abuse costs on a per gallon and per abuser basis.

Timing

The RTI estimates of abuse costs for 1983 are the result of drinking in 1983 and previous years. To measure the abuse costs of 1983 consumption we would have to know the abuse costs that 1983 consumption caused in 1983 and
Table A.5
Cost of Alcohol Abuse and Consumption
1983

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. External and internal abuse costs</td>
<td></td>
</tr>
<tr>
<td>1. Total (billions)</td>
<td>116.7</td>
</tr>
<tr>
<td>2. Per abuser\textsuperscript{a}</td>
<td>6,669</td>
</tr>
<tr>
<td>3. Per gallon of alcohol consumed by abusers\textsuperscript{b}</td>
<td></td>
</tr>
<tr>
<td>B. External abuse cost</td>
<td></td>
</tr>
<tr>
<td>1. Total (billions)</td>
<td></td>
</tr>
<tr>
<td>2. Per abuser\textsuperscript{a}</td>
<td>1,496</td>
</tr>
<tr>
<td>3. Per gallon of alcohol consumed by abusers\textsuperscript{b} (an estimate of E)</td>
<td>127</td>
</tr>
<tr>
<td>C. Internal abuse cost</td>
<td></td>
</tr>
<tr>
<td>1. Total (billions)</td>
<td></td>
</tr>
<tr>
<td>2. Per abuser\textsuperscript{a}</td>
<td></td>
</tr>
<tr>
<td>3. Per gallon of alcohol consumed by abusers\textsuperscript{b} (an estimate of A)</td>
<td></td>
</tr>
<tr>
<td>D. Cost of consumption by alcoholics\textsuperscript{c}</td>
<td></td>
</tr>
<tr>
<td>1. Internal abuse cost plus cost of production\textsuperscript{b}</td>
<td></td>
</tr>
<tr>
<td>a. Total (billions)</td>
<td>82.2</td>
</tr>
<tr>
<td>b. Per alcoholic</td>
<td>7,976</td>
</tr>
<tr>
<td>c. Per gallon consumed</td>
<td></td>
</tr>
<tr>
<td>2. All abuse cost plus cost of production\textsuperscript{b}</td>
<td></td>
</tr>
<tr>
<td>a. Total (billions)</td>
<td>101.4</td>
</tr>
<tr>
<td>b. Per alcoholic</td>
<td>98,410</td>
</tr>
<tr>
<td>c. Per gallon consumed</td>
<td>671</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Based on adult abusers only, who account for the bulk of estimated abuse costs.

\textsuperscript{b} Estimates assume that abusers account for 4 percent of total consumption.

\textsuperscript{c} It is assumed that abuse cost per gallon of alcohol consumed is the same for all abusers, nonalcoholic and alcoholic. It is likely that average abuse cost per alcoholic exceeds the average for nonalcoholic abusers.
subsequent years, with the latter discounted to 1983 present values.

If alcohol consumption per year were constant over time and the abuse costs of that consumption were likewise constant, then the abuse costs occurring in a particular year would overstate the present value of the abuse costs attributable to that year's consumption. If this steady-state situation does not prevail, then abuse costs may be growing or falling through time. And actual costs for any year, such as the $116.7 billion estimate for 1983 may either overstate or understate the present value of the abuse costs attributable to that year's consumption.

It is unlikely that consumption and abuse costs are at steady-state levels. Abuse costs have probably been increasing because of increasing per capita consumption, increasing labor productivity (increasing the value of output lost due to abuse), and increasing real cost of medical care. It is possible that the abuse costs occurring in a particular year, the current cost of present consumption and past consumption, are equal to the present value of the current and expected future costs of current consumption. But we do not know whether this condition was met for 1983; it would be surprising if it were. We have no alternative to using the 1983 estimates of RTI in our tax formulas, recognizing that they may either overstate or understate the abuse costs attributable to 1983 consumption.

**Demand elasticities**

There is strong evidence that the aggregate demand for various alcoholic beverages is responsive to price (Nelson, 1988a, 1988b). But a popular perception is that this response is due largely to the influence of price on the consumption of moderate drinkers. Heavy drinkers, it is argued, will not reduce consumption when prices increase because a large proportion of these drinkers are addicted to alcohol.
This "conventional wisdom" is contradicted by a study (Cook and Tauchen, 1982) of the effect of taxes on the prevalence of alcoholism as measured by liver cirrhosis mortality rates. Cook applied a parametric estimation technique to annual data for 30 U.S. states over the period 1962-77 to determine the relationship between taxes on liquor and cirrhosis mortality rates. He estimated that a doubling of the U.S. federal liquor tax would reduce the cirrhosis mortality rate by 20 percent in the short run, and by a larger amount in the long run. From this result Cook concludes (1983, p. 195) that "if cirrhosis mortality rates are a reliable indicator of the prevalence of alcoholism, then it can be inferred that alcoholics' drinking habits are quite sensitive to the price of liquor."

Two other statistical studies also suggest that abusive consumption is affected by the price of alcohol. Cook (1981) found a negative relationship between the liquor tax and the auto fatality rate, and Saffer and Grossman (1987) found the same inverse relationship between beer tax rates and motor vehicle death rates for youth.

On the basis of Cook's study of taxes and cirrhosis mortality rates, at least two authors (Harris, 1984; Room, 1984) suggest that the uncompensated demand elasticities of abusers and nonabusers (\(e_A\) and \(e_B\), respectively) are roughly the same. According to Cook (1983), it is plausible that \(e_A > e_B\) because of the higher proportion of income that abusers (at least alcoholics) spend on alcohol. There is some support for this hypothesis from a study by Coate and Grossman (1986), who found that the fraction of youths who consume alcohol more heavily falls proportionately more than the fraction of infrequent drinkers when the price of beer increases. And, in Scotland, Kendall et al. (1983) concluded that price increases induced heavy drinkers and persons dependent on alcohol to reduce consumption by about as much as other drinkers.