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HEALTH BENEFITS OF INCREASES IN ALCOHOL AND CIGARETTE TAXES

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ABSTRACT

Health taxes on alcohol and cigarettes imposed by the Federal government of the United States have been very stable since 1951. This paper summarizes research that shows that increased taxation, which results in higher prices, would discourage alcohol abuse and cigarette smoking. One striking finding is that a policy to raise the Federal excise tax on beer in line with the rate of inflation over the last three decades would cut motor vehicle fatalities of 18 to 20 year olds, many of which are alcohol-related, by about 15 percent, saving more than 1,000 lives per year. A second is that over 800,000 premature deaths in the cohort of Americans 12 years and older in 1984 would be averted if the Federal excise tax on cigarettes were restored to its real value in 1951.

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I. Introduction and Background

For more than a decade, the Federal government of the United States and various state and local governments have been involved in campaigns to discourage cigarette smoking and to reduce deaths from motor vehicle accidents by curtailing alcohol abuse. The antismoking campaign dates to the issuance of the First Surgeon General's Report on Smoking and Health in 1964. This campaign has consisted primarily of policies designed to increase public knowledge of the harmful effects of cigarette smoking and to restrict advertising by cigarette manufacturers. The major elements of the campaign have been the Fairness Doctrine of the Federal Communications Commission, which resulted in the airing of antismoking messages on radio and television from July 1, 1967 to January 1, 1971, and the Public Health Cigarette Act of 1970, which banned prosmoking cigarette advertising on radio and television after January 1, 1971.

Other Federal government policies designed to discourage smoking include the requirement, beginning in July 1966, of a health warning in all cigarette advertising and on every package and the strengthening of this warning at the time of the imposition of the advertising ban in 1971. In addition, the Federal Trade Commission began monitoring the tar and nicotine content of various brands of cigarettes in 1967. Subsequently, the cigarette industry voluntarily agreed to include the FTC

measurement in all advertising. Finally, Federal agencies have required the separation of smokers and nonsmokers on vehicles in interstate passenger transportation, and many state and local governments have required the provision of no smoking areas in public places and in the workplace.

The antidrinking campaign dates to the mid 1970s. One major element of this campaign has been the upward trend in state minimum legal ages for the purchase and consumption of alcoholic beverages. This trend began with the increase in the legal drinking age in Minnesota from 18 to 19 years of age in 1976, and an additional 27 states had increased their legal drinking age by the time that Congress passed the Federal Uniform Drinking Age Act of 1984. This legislation allows the Federal government, through its control of Federal highway funds, to intercede in a legislative area traditionally reserved for the states. Five percent of a state's Federal highway construction fund allocation for the fiscal year 1987 were withheld if that state's minimum legal drinking age was below 21 on October 1, 1986, and 10 percent will be withheld from each future fiscal year allocation in which its drinking age is below 21. In July 1988 Wyoming became the 28th state to pass a law complying with the act, and currently all 50 states and the District of Columbia have a drinking age of 21.[1]

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[1]The increases in the legal drinking age documented above represent a dramatic reversal of the downward trend between 1970 and 1975. In that period, 29 states lowered their drinking age to conform with a Federal shift in the voting age from 21 to 18 in 1970.

A second major element of the antidrinking campaign is reflected by more severe penalties for the conviction of drunken driving, the allocation of additional resources to apprehend drunk drivers, and an easing in the standards for apprehension and conviction. Between 1977 and 1984, the number of states with laws that permitted a law enforcement officer to administer a preliminary breath test to a driver reasonably suspected of driving under the influence of alcohol before arrest rose from 13 to 22 [Bureau of Justice Statistics 1979; National Highway Traffic Safety Administration (NHTSA) 1985]. Ross (1984) reports that, in 1982, 378 bills relating to drunken driving were introduced in 37 states, and 38 of these became law in 25 states. According to NHTSA (1985), 100 new state laws pertaining to drunken driving were enacted between December 1983 and December 1984.

While the above policies are vehicles to discourage cigarette smoking and alcohol abuse, increased taxation, which results in higher prices, is another policy that might significantly reduce these behaviors. These are not simply hypothetical policy options. For example, although the Federal excise tax rate on cigarettes remained at 8 cents per pack from November 1, 1951 through the end of 1982, there were several attempts to increase it during the late 1960s and the 1970s because of the concern over the health effects of cigarette smoking. Moreover, there is evidence that some states increased their cigarette excise taxes as a result of the antismoking

publicity that followed the issuance of the Surgeon General's Report in 1964. In 1965 there were 23 state and local tax increases compared with no more than a dozen in any of the preceding 14 years (Kellner 1973). These state and local taxes continued to increase over time in many states, although in most cases the rates were increased to raise revenue rather than to discourage smoking per se. In recent years the rate of increase has abated in part because of tax revenue losses due to smuggling of cigarettes from high-tax to low-tax states. For instance, states increased their cigarette excise tax rates 34 times between 1970 and 1975 but only 14 times between 1975 and 1980 (Lewit 1982).

Of course, the Federal excise tax rate on cigarettes was raised to 16 cents per pack effective January 1, 1983, as part of the Tax Equity and Fiscal Responsibility Act of 1982. As in the case of the recent state excise tax increases, the Federal excise tax was raised to expand tax receipts rather than to discourage smoking. This increase resulted in a tax that was 100 percent smaller than the 32 cent rate required to restore the cigarette tax to its real value in 1951. Nevertheless, the real price of cigarettes (the nominal price divided by the Consumer Price Index) rose by 36 percent between 1981 and 1986 (Harris 1987) after falling by 13 percent between 1960 and 1980 (Monthly Labor Review various years; Tobacco Institute 1987).[2]

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[2]The legislation which raised the Federal excise tax from 8 cents to 16 cents contained a clause which provided for the resumption of the old 8 cent rate at the end of fiscal 1985.

Increased taxation of alcoholic beverages has been virtually ignored by the Federal and state governments in the antidrinking campaign. Instead, the Federal excise tax rates on liquor (distilled spirits), beer, and wine remained constant in nominal terms between November 1, 1951 and the end of fiscal 1985. During this period, the Federal government taxed spirits at the rate of $10.50 per proof gallon (one gallon of 100-proof liquor, which is the equivalent of 50 percent alcohol by volume), beer at the rate of $.29 per gallon (approximately 4.5 percent alcohol by volume), and wine at the rate of $.17 per gallon (between 11.6 percent and 21 percent alcohol by volume).[3]

Partly as a result of the stability of the Federal excise taxes and the modest increases in state and local excise taxes, the real price of alcoholic beverages has declined substantially over time. Between 1960 and 1980, the real price of spirits fell by 48 percent, the real price of beer fell by 27 percent, and the real price of wine fell by 20 percent (Cook 1981). While 28 states raised their drinking age from 1976 through 1984, real alcoholic beverage prices continued to fall: 27 percent for liquor, 12 percent for beer, and 19 percent for wine (Bureau of Labor Statistics various years). Thus, as argued by Cook and

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After half-dozen temporary extentions, Congress made the 16 cent rate permanent in 1986.

[3]The Federal excise tax rates on beer and wine are specified on a wine gallon of beer and a wine gallon of wine. A wine gallon is a measure of liquid volume, regardless of alcohol content. The standard U.S. wine gallon contains 231 cubic inches at 60 degrees Fahrenheit.

Tauchen (1982), if alcohol abuse is sensitive to price, a government policy of declining real excise tax levels actually may be exacerbating this problem.

Indeed, a number of proposals have been made to correct the erosion in the real value of the Federal excise tax rates on all forms of alcoholic beverages since 1951 and to prevent future erosion by indexing tax rates to the rate of inflation or by converting to an ad valorem alcoholic beverage excise tax system (for example, Moore and Gerstein 1981; Luks 1983; Cook 1984; Harris 1984; Becker 1985; Jacobson and Albion 1985). Of course, the Federal excise tax rate on distilled spirits was raised from $10.50 per proof gallon to $12.50 effective October 1, 1985, as part of the Deficit Reduction Act of 1984. But this increase produced a tax that was over 200 percent smaller the $42.00 rate required to restore the spirits tax to its real value in 1951. Moreover, the tax rates on beer and wine were not changed.

To the extent that smoking participation, the quantity of cigarettes consumed by smokers, and alcohol consumption, particularly excessive consumption, are inversely related to price, real increases in Federal cigarette and alcohol excise tax rates should reduce premature deaths due to smoking and fatal motor vehicle accidents regardless of the primary purpose of the tax hikes. Therefore, in Section II of this paper, I summarize research by my colleagues and me on the responsiveness of youth alcohol use and motor vehicle death rates to variations in the price of alcohol (Grossman, Coate, and Arluck 1987; Saffer and

Grossman 1987a, 1987b; Coate and Grossman 1988). To highlight the magnitude of the price effects, the responsiveness of these two outcomes to price is compared to their responsiveness to increases in the legal drinking age. In Section III of the paper, I review research by my colleagues and me on the impacts of changes in cigarette prices on age-specific smoking participation rates and on the quantity of cigarettes consumed by smokers (Lewit, Coate, and Grossman 1981; Lewit and Coate 1982). I devote more attention to the alcohol research than to the cigarette research because the former is much more recent and because the implications of the cigarette studies for the 1983 increase in the Federal excise tax rate on cigarettes have been considered by Harris (1982, 1987), Lewit (1985), and Warner (1986). In the final section of the paper, I qualify some of the conclusions reached in Sections II and III and consider some implications of the rational model of addictive behavior developed by Becker and Murphy (1988) for the evaluation of alcohol and cigarette excise tax increases.

It is particularly important to focus on teenagers and young adults in the context of the antidrinking campaign because motor vehicle accident mortality is the leading cause of death of persons under the age of 35, and alcohol is involved in over half these fatal accidents. In 1984 persons under the age of 25 accounted for 20 percent of all licensed drivers but 35 percent of all drivers involved in fatal accidents (NHTSA 1986). These figures are even more dramatic than they appear because members

of the young driver group do not drive nearly as much as older drivers (Voas and Moulden 1980). It is also important to focus on youths because alcohol abuse in adolescence appears to be associated with alcohol abuse in adult life (Blane and Hewitt 1977; Rachal et al. 1980). Thus, policies to prevent the onset of this behavior by adolescents might be the most effective means to reduce it in all segments of the population. Similar comments apply to cigarette smoking since it is an habitual behavior that begins early in life. Moreover, age at onset of smoking is negatively correlated with the amount smoked and the incidence of negative health effects (for example, Hammond 1966; Ippolito, Murphy, and Sant 1979).

II. Alcoholic Beverage Prices, Legal Drinking Ages, and Youth Alcohol Abuse

In a project funded by the National Institute on Alcohol Abuse and Alcoholism, Douglas Coate, Henry Saffer, Gregory Arluck, and I present the first set of estimates of the responsiveness of youth alcohol use and motor vehicle death rates to variations in the price of alcohol (Grossman, Coate, and Arluck 1987; Saffer and Grossman 1987a, 1987b; Coate and Grossman 1988). In addition, we examine the sensitivity of these two outcome measures to increases in the legal drinking age. Research on the responsiveness of youth motor vehicle deaths and alcohol use to the price of alcoholic beverages is particularly timely in light of the proposals to raise Federal excise tax rates on alcoholic beverages discussed in Section I. Moreover,

although beer is the drink of choice among youths who drink alcoholic beverages, the alcohol in liquor is taxed three times as heavily as the alcohol in beer. This has led to suggestions to equalize the tax rates on the alcohol in all forms of alcoholic beverages by raising the tax on beer (for example, Harris 1984; Jacobson and Albion 1985).[4]

Research on the sensitivity of the outcomes at issue to legal drinking ages is valuable given the volatility in state minimum drinking ages in the 1970s and 1980s and the adverse reaction to Federal uniform drinking age legislation. Originally, the penalties imposed on states with a drinking age below 21 by the Federal Uniform Drinking Age Act of 1984 were scheduled to expire at the end of fiscal 1988. In response to this provision, Texas and Nebraska adopted laws that called for a revocation of the 21 drinking age as soon as the legislation expired. To counteract these laws, the Federal legislation was made permanent in 1986. South Dakota challenged the constitutionality of the 1984 Federal Uniform Drinking Age Act in a suit before the Supreme Court, which was supported by 8 additional states. In June 1987, the Court ruled against South Dakota.

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[4]Under the Federal excise tax on liquor of $10.50 per gallon of liquor (50 percent alcohol by volume) in effect prior to October 1, 1985, one gallon of alcohol in liquor was taxed at the rate of $21. Since the Federal excise tax on beer is $.29 per gallon and since one gallon of beer contains 4.5 percent alcohol by volume, the tax rate on one gallon of alcohol in beer is $6.44. The alcohol in liquor is taxed fifteen times as heavily as the alcohol in wine, and the proposals mentioned above also contain provisions to correct this distortion.

One of the basic aims of our research is to compare the impact of a uniform minimum age of 21 for the purchase of alcohol in all states on youth alcohol use and motor vehicle mortality with that of one or more of the policies to raise the Federal excise tax rates on alcoholic beverages described above. Of course, an effectively enforced prohibition of alcohol consumption in this age group clearly should have a larger impact on their consumption and fatalities than an increase in excise tax rates. This issue is not clearcut at the empirical level only because of the problem of evasion. Underage youths can obtain alcohol from their older siblings or friends. In addition, they can purchase fake identification cards or buy alcohol in stores that do not bother to demand proof of age. This type of evasion simply is not possible with an excise tax hike, so that the responsiveness of youths to the price of alcohol determines the change in consumption and therefore the motor vehicle death rate.

Even if adult consumers of alcoholic beverages are relatively unresponsive to price, this need not be the case for youths. Given the habitual nature of alcohol abuse, adult users, who almost always will have been users for longer periods of time than youths, may be less sensitive to price than youths. In addition, the fraction of disposable income that a youthful drinker spends on alcohol probably exceeds the corresponding fraction of an adult drinker. It is well known that the uncompensated (money income-constant) price elasticity of a good

rises in absolute value as the fraction of income spent on that good rises. Finally, bandwagon or peer effects are much more important in the case of youth drinking than in the case of adult drinking. That is, youths are more likely to drink if their peers also drink (Blane and Hewitt 1977; Rachal et al. 1980). As shown by Leibenstein (1950) and by Lewit, Coate, and Grossman (1981), the presence of bandwagon or peer effects increases the price elasticity of demand.[5]

The research on youth alcohol use employs two data sets: the first National Health and Nutrition Examination Survey (NHANES I), conducted by the National Center for Health Statistics (NCHS) between May 1971 and June 1974, and the second National Health and Nutrition Examination Survey (NHANES II), conducted by NCHS between February 1976 and February 1980. The research on youth motor vehicle accident mortality is based on a time series of state cross sections for the period from 1975 through 1981. All aspects of the research capitalize on substantial differences in legal drinking ages among states and on substantial differences

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[5]In a penetrating economic analysis of rational addiction over the life cycle, Becker and Murphy (1988) show that the effect of habit formation or peer pressure on price responsiveness depends on whether the price variation is permanent or temporary, whether the magnitude of the effect is measured by the slope or the elasticity, and whether the outcome pertains to the probability of consuming the addictive good or to consumption given participation. In certain cases, adults can be more responsive to price than youths in their model, while in other cases the reverse holds. Becker and Murphy's model also questions the conventional wisdom expressed above that adult price elasticities of demand for addictive goods should be relatively small. Their work is discussed in more detail in Section IV.

in alcoholic beverage prices among states primarily due to differences in state excise tax rates on these beverages. We concentrate on beer prices and beer excise tax rates in the research because beer is the most popular alcoholic beverage among youths. State beer excise taxes on a can of 24-twelve ounce cans during the period at issue ranged from a low of 4.5 cents in Wyoming to a high of $2.28 in Georgia.

The project contains estimates of demand functions for youth alcohol use in NHANES I (Grossman, Coate, and Arluck 1987) and NHANES II (Coate and Grossman 1988) and logit motor vehicle accident mortality regressions (Saffer and Grossman 1987a, 1987b). In the demand functions we focus on alcohol use by youths aged 16 through 21 and add alcoholic beverage prices and legal drinking ages to the NHANES surveys based on a given youth's place of residence. In the motor vehicle accident mortality research, logit regressions are estimated for three age groups: youths aged 15 through 17, 18 through 20, and 21 through 24. The real beer price (the nominal price divided by the annual Consumer Price Index) is employed as a regressor in the beer demand functions.[6] Because price data were not available in all years in the period from 1975 through 1981 (see Saffer and

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[6]In the NHANES I study, beer prices were taken from a special one-time survey by the Bureau of Labor Statistics (1973). In the NHANES II study, they were taken from unpublished data on the price of a single leading brand of medium-priced, nationally sold beer obtained by Stanley Ornstein (see Ornstein and Hanssens 1985). The specific brand is confidential. Prices are reported in two unidentified major markets in each state in January and July of 1976, 1977, and 1978 and in January of 1979.

Grossman 1987a), the cost of beer is given by the sum of the Federal and state excise tax rates on beer divided by the annual CPI for the U.S. as a whole in the mortality regressions. State-specific beer prices and excise tax rates are highly correlated in years in which both were available.[7]

Youths who reside in a state with a high legal drinking age may be able to purchase alcohol in a border state with a lower legal drinking age. To deal with this phenomenon in the alcohol use studies, we create a dichotomous variable that equals one for youths who live within 20 miles of a state with a lower legal drinking age. With the own-state legal drinking age held constant, the coefficient of the border age variable in the demand functions should be positive. To deal with the border phenomenon (out-of-state purchases) in the motor vehicle mortality research, we create a variable that equals the difference between the own-state drinking age and the border-state age (if the difference is positive) multiplied by the fraction of the population of the state in question who live in counties near the border state. With the resident-state drinking age held constant, an increase in the border variable reflects a reduction in the border-state drinking age or an increase in the fraction of the population who live in counties near the border

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[7]State excise tax rates on wine and liquor are poor proxies for the prices of wine and liquor in control (monopoly) states because such states derive most of their revenue from the sale of wine and liquor from the price markups rather than from the excise taxes. This comment does not apply to state excise tax rates on beer because beer is sold privately in monopoly states.

state, both of which should cause the motor vehicle fatality rate to fall.[a]

In all aspects of the research, efforts are made to control for (hold constant) determinants of alcohol use and fatal motor vehicle accidents other than alcoholic beverage prices or taxes and legal drinking ages. All demand functions include as regressors the youth's age, a dichotomous variable that identifies blacks, a dichotomous variable that identifies females, and real family income (money family income divided by the CPI). The motor vehicle regressions include real per capita income, vehicle miles traveled per licensed driver, the fraction of the population aged 15 through 24 who are licensed drivers, and a dichotomous variable that identifies states that require inspection of motor vehicles every year.

In some specifications of the alcohol use and motor vehicle mortality regressions, we try to take account of the potential role of "drinking sentiment" in the endogenous determination of

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[a]The border age variable described above is modified in cases in which there is more than one border state, each of which has a lower drinking age than the own state. We do not attempt to control for incentives to purchase alcohol in border areas with lower prices, which tends to understate the price effect in absolute value in the demand function. This is a more important problem in aggregate state cross-sectional alcohol demand studies which employ a sales variable as opposed to actual consumption. Here the price effect tends to be overestimated if one does not control for incentives to purchase alcohol in border areas with lower prices. Lewit, Coate, and Grossman (1981); Lewit and Coate (1982); and Becker, Grossman, and Murphy (1987) discuss this issue in detail in the context of the estimation of cigarette demand functions at the micro and aggregate levels. For discussions in the context of the demand for alcohol, see Wales (1968); Cook and Tauchen (1982); Ornstein and Hanssens (1985); Grossman, Coate, and Arluck (1987); and Nelson (1988).

alcoholic beverage prices or taxes, legal drinking ages, and alcohol consumption. This is accomplished by including the fractions of the population who are Mormons, Southern Baptists, Catholics, and Protestants (excluding Southern Baptists and Mormons) and the fraction of the population who reside in "wet" counties (counties that permit the sale of alcoholic beverages) as regressors in some specifications.[9] Drinking sentiment refers to cultural and taste variables that may either encourage or discourage alcohol consumption. For example, antidrinking sentiment should be relatively widespread in states in which those religious groups that oppose the use of alcohol, such as Mormons and Southern Baptists, are prevalent. Antidrinking sentiment also should be an important force in states in which a higher-than-average fraction of the population reside in "dry" counties (counties that prohibit the sale of alcoholic beverages). These states may enact high alcoholic beverage excise tax rates as part of the political process. In this

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[9]The religion variables are state-specific in the motor vehicle fatality regressions and county-specific in the alcohol consumption demand functions, where they pertain to the youth's county of residence. The fraction of the population who reside in wet counties is state-specific and is not used in the demand functions. Saffer and Grossman (1987b) develop an alternative methodology to control for drinking sentiment in the mortality equation. We construct and estimate a simultaneous equations model in which an unobserved variable measuring the pressure to pass a 21-year-old minimum drinking age law, for example, depends on the mortality rate in the absence of the law. Although our results are somewhat sensitive to alternative specifications, they suggest that the tax and legal drinking age effects obtained by more conventional methods are conservative lower bound estimates. Moreover, the relative ranking of the two estimates is not affected by biases associated with endogeneity.

situation, the tax coefficients that emerge from regressions that omit drinking sentiment overstate in absolute value the true parameters. On the other hand, states in which prodrinking sentiment is widespread (antidrinking sentiment is weak) and alcohol consumption is large may enact high excise tax rates because the taxation of alcohol is an attractive source of revenue. In this case, the tax effects are understated if drinking sentiment is excluded from the regressions. Similar comments can be made with respect to drinking age effects that do not control for drinking sentiment and with respect to the estimated price and drinking age effects in the demand functions.

We find that the use of alcohol by youths is inversely related to the prices of alcoholic beverages and to the legal drinking age in both NHANES I and NHANES II. The beverage-specific price and legal drinking age are particularly important determinants of beer consumption. This is a key result because beer is the drink of choice among youths who consume alcoholic beverages. The negative and statistically significant price and legal drinking age effects are by no means limited to reductions in the fraction of youths who consume beer infrequently (less than once a week). Instead, the fractions of youths who consume beer fairly frequently (1-3 times a week) and frequently (4-7 times a week) fall more in absolute or percentage terms than the fraction of infrequent drinkers when price or the legal drinking age rises. Along the same lines, the fractions of fairly heavy (3-5 cans on a typical drinking day) and heavy (6 or more cans on

a typical drinking day) youthful beer drinkers decline more in absolute or percentage terms than the fraction of light (1-2 cans on a typical drinking day) drinkers in response to price or drinking age increases. These are striking findings because frequent, fairly frequent, heavy, and fairly heavy drinkers are likely to be responsible for a large percentage of youth motor vehicle accidents and deaths.

We also find negative and statistically significant real beer tax effects in the motor vehicle accident mortality regressions for youths aged 15 through 17, 18 through 20, and 21 through 24. Negative and significant drinking age effects are obtained for youths aged 18 through 20. Moreover, positive and significant coefficients of the border variable are obtained for this cohort.

With regard to the magnitudes of the beer consumption effects at issue in NHANES II (the most recent sample), a Federal policy that simultaneously taxes the alcohol in beer and liquor at the same rates and offsets the erosion in the real beer tax since 1951 would have reduced the number of youths who drink beer frequently (approximately 11 percent of all youths) by 32 percent during the period of NHANES II and would have reduced the number of fairly frequent beer drinkers (approximately 28 percent of all youths) by 24 percent. The enactment of a minimum uniform drinking age of 21 in all states would have reduced the number of frequent drinkers by 28 percent and the number of fairly frequent drinkers by 11 percent.

With regard to motor vehicle accident mortality, the drinking age policy would have reduced the number of 18-through-20-year-olds killed in motor vehicle crashes by 8 percent in the period 1975-81. A policy that fixed the Federal beer tax in real terms since 1951 would have reduced the number of lives lost in fatal crashes by 15 percent, while a policy that taxed the alcohol in beer at the same rate as the alcohol in liquor would have lowered the number of lives lost by 21 percent. A combination of the two tax policies would have caused a 54 percent decline in the number of youths killed.

The preceding figures suggest that, if reductions in youth alcohol consumption and motor vehicle accident deaths are desired, both a uniform drinking age of 21 and an increase in the Federal excise tax rate on beer are effective policies to accomplish this goal. They also suggest that the tax policy may be more potent than the drinking age policy. Indeed, according to our computations, the lives of 1,022 youths aged 18 through 20 would have been saved in a typical year in the 1975-81 period if the Federal excise tax on beer had been indexed to the rate of inflation since 1951. On the other hand, the lives of 555 youths aged 18 through 20 per year would have been saved if the drinking age had been 21 in all states of the U.S.

III. Micro Cigarette Demand Studies

In two related studies Eugene Lewit, Douglas Coate, and I have obtained age-specific cigarette price elasticities for

smoking participation and for the quantity smoked conditional on smoking (Lewit, Coate, and Gossman 1981; Lewit and Coate 1982). The first study is limited to youths aged 12 through 17. The second study considers persons aged 20 through 74 and contains demand functions for three separate age groups (20 through 25 years, 26 through 35 years, and over 35 years). Both studies use information on the city and state of residence of each respondent in a given survey to add a measure of the price of cigarettes to that survey. The resulting series incorporates variations in state and municipal excise and retail sales tax rates on cigarettes. It is important to emphasize that interstate differentials in cigarette prices are substantial; retail cigarette prices are approximately 50 percent higher in high-tax states than in low-tax states.

The Lewit-Coate-Grossman (1981) study is based on Cycle III of the U.S. Health Examination Survey. This is a national sample of 6,768 youths that was conducted between March 1966 and March 1970 by the National Center for Health Statistics (NCHS). The Lewit-Coate (1982) study is based on the 1976 U.S. National Health Interview Survey conducted by NCHS. The sample is comprised of 28,033 individuals between the ages of 20 and 74.

Based on the estimated demand functions, the smoking participation price elasticity equals -1.20 for teenagers, -.74 for 20-25 year olds, -.44 for 26-35 year olds, and -.15 for persons above the age of 35. The corresponding quantity smoked conditional on smoking price elasticities are -.25 for teenagers,

-.20 for the youngest group of adult smokers. -.04 for the middle age group, and -.15 for the oldest age group of adult smokers.

The principal message of the above findings is that an increase in the Federal excise tax rate on cigarettes is a potent policy to curtail smoking. This is because teenagers are more responsive to changes in the price of cigarettes than adults and because the price elasticity of smoking participation is much larger than the price elasticity of the quantity smoked by smokers. These factors mean that tendencies for smokers to compensate for reductions in the number of cigarettes consumed by switching to higher tar and nicotine brands, inhaling more deeply, or reducing idle burn can be ignored in evaluating the impact of excise tax changes. More importantly, the large teenage smoking participation elasticity implies that excise tax increases are very effective tools to prevent the onset of an habitual behavior.

Since the smoking participation rate of all age groups (the aggregate rate) is dominated by the adult rate, the short-run effect of an increase in the Federal excise tax rate would be modest. The long-run impacts of a tax hike should, however, be considerably more substantial. Given the evidence that individuals are unlikely to initiate smoking after age 21 (Centers for Disease Control and National Cancer Institute 1976), it is quite possible that the cohort of young persons who do not begin to smoke as a result of the tax increase would never become regular smokers. If the tax increase is maintained in real

terms, it would continue to discourage smoking participation by successive generations of youths. Thus, it would gradually impact the smoking levels of older age groups as the smoking-discouraged cohorts move through the age spectrum. As a consequence, over a period of several decades, aggregate smoking and its associated detrimental health effects would decline substantially.

Harris (1982, 1987) and Warner (1986) have used the smoking participation price elasticities reported by Lewit, Coate, and Grossman to forecast the impacts of the doubling of the Federal excise tax rate from 8 cents to 16 cents in 1983. They predict a decline in the number of adult smokers that ranges between 1.4 million and 2.0 million and a decline in the number of teenage smokers that ranges between 400,000 and 700,000.[10] Warner has also evaluated a policy to restore the excise tax to its real value in 1951 by raising the nominal rate from 16 cents to 32 cents. This policy would discourage approximately 800,000 teenagers from starting to smoke and would induce roughly 2.7 million adult smokers to quit.

Both Warner (1986) and Harris (1987) provide crude estimates of the health benefits of the above reductions in smoking. Warner assumes that one lifelong smoker out of every four dies prematurely of smoking-related illness. He calculates that the 8 cent tax increase in 1982 will ultimately avert 480,000 premature

[10]Due to data limitations and the temporary nature of the original 1982 legislation (see note 2), these predictions have not yet been compared with actual trends in the number of smokers.

deaths in the cohort of Americans 12 years of age and older in 1984. Moreover, this number would rise to 860,000 if the tax rate were set at 32 cents. Harris assumes that 9 percent of all smokers will not survive to age 65 as a result of their smoking. This suggests that an additional 100,000 persons will live to this age as a result of the price-induced decline in smoking participation due to the 1982 tax hike.

Lewit (1985) and Harris (1987) have examined the actual decline in per capita cigarette consumption following the 1982 tax increase. The real price of cigarettes rose by 26 percent between November 1, 1981 and November 1, 1984. Based on a price elasticity of -.47 for all age groups, per capita consumption should have declined by roughly 12 percent. In fact, the actual decline during this period ranged between 11 and 12 percent.

IV. Qualifications and Future Research

The empirical evidence summarized in Sections II and III suggests that substantial health benefits may accrue to increases in Federal excise taxes on alcohol and cigarettes. The conclusions reached in those sections must, however, be interpreted with caution. For example, consider the comparison between the legal drinking age policy and an increase in the Federal excise tax on beer. My colleagues and I have not provided enough evidence to justify the approximately eightfold (thirteenfold based on the 1984 CPI) increase in the Federal excise tax on beer that is implicit in the most comprehensive tax

policy that we consider (the one that simultaneously taxes the alcohol in beer and liquor at the same rates and offsets the erosion in the real beer tax since 1951). Excise tax hikes impose welfare costs on all segments of the population, while a drinking age policy is targeted at the group in the population that accounts for a disproportionate share of motor vehicle accidents and deaths. On the other hand, the enforcement and administrative costs associated with a uniform minimum drinking age of 21 may exceed those associated with the tax policy. Moreover, our results indicate that an excise tax increase lowers death rates of youths between the ages of 15 and 17 and between the ages of 21 and 24. These benefits do not accompany a rise in the drinking age. In addition, the tax policy may reduce fatal crashes involving persons beyond the age of 24. Of course, a substantial tax hike may stimulate the demand for illegally produced beer, suggesting that we have overestimated the effect of an eightfold increase in the Federal excise tax on beer unless the legal and illegal prices are the same.

Another consideration is that Becker (1968) has shown that the optimal way for a society to deter offenses is via a system of severe and fairly certain punishments. In the case of drunk driving, these might take the form of loss of driving privileges for long periods of time, mandatory community service, enrollment in alcohol rehabilitation programs, and prison sentences for repeat offenders. Of course, youthful drunk drivers may respond to an increase in the penalty for this offense only if the

probabilities of apprehension and conviction are nontrivial. If substantial resources must be allocated to raising these probabilities, the excise tax policy may be preferable to or complementary with a system of severe penalties. Moreover, severe and certain punishments for drunk driving do not address the problems caused by the link between youth alcohol abuse and adult alcohol abuse.

A third consideration is that there have been no previous published studies of the effects of beer taxes on youth motor vehicle fatalities. Cook (1981), however, finds that states that raised their excise tax rates on liquor between 1960 and 1974 experienced below-average increases or above-average reductions in motor vehicle deaths of persons of all ages, relative to states that did not increase their tax rates. He also estimates an elasticity of the motor vehicle death rate with respect to the price of liquor of -.7. On the other hand, Saffer and Grossman (1987a) report an elasticity of the motor vehicle death rate with respect to the price of beer of -.7 for 15-through-17-year olds and -1.3 for 18-through-20-year-olds and 21-through-24-year-olds.[11]

The preceding figures suggest that Saffer and Grossman's

[11]The elasticities presented by Saffer and Grossman assume that the beer industry is competitive and has an infinitely elastic supply curve, so that a tax increase is fully passed on to consumers. They also assume that the sum of the Federal and state excise tax on a case of beer accounted for 13 percent of the retail price of beer on average in the period 1975-81. Cook's computation is based on a liquor state excise tax share of approximately 7 percent.

estimates are reasonable. But Cook's research is based on the death rate of persons of all ages and employs relatively old data. Therefore, it would be extremely useful to replicate Saffer and Grossman's results with more recent data. This is one of the aims of a new project by Henry Saffer, Frank Chaloupka, and me (Grossman, Saffer, and Chaloupka in progress). This research employs motor vehicle death rates by age, state, and year for the period from 1975 through 1988. The use of age-specific motor vehicle accident mortality rates will enable us to detect differential responses to alcoholic beverage excise taxes or prices by persons of different ages. This information will enable us to evaluate more completely alternative policies to reduce fatal motor vehicle crashes by moderating alcohol abuse.

Very preliminary results from the Grossman-Saffer-Chaloupka project are contained in a paper by Saffer and Chaloupka (forthcoming). Using a time series of state cross sections for the period from 1980 through 1985, Saffer and Chaloupka focus on four outcomes: the motor vehicle accident mortality rate of persons of all ages; the nighttime (between 12 a.m. and 4 a.m.) fatality rate of persons of all ages, many of which are alcohol-related; and the same two mortality rates of youths between the ages of 15 and 24. The real beer tax has a negative and statistically significant effect on each of these four outcomes.

Levy and Reinhart (1988) also have replicated Saffer and Grossman's beer tax results in a time series of state cross sections for the years 1981 through 1984. Their dependent

variable is the motor vehicle accident mortality rate of youths aged 16 through 25. In addition, Levy and Reinhart report negative and significant spirits and wine, but not beer, "price" coefficients in a multivariate analysis of the death rate of persons of all ages. They attribute the insignificant beer effect to multicollinearity among the three prices. Moreover, beer is not as popular among adults as it is among youths.

Although Levy and Reinhart's results are valuable, more information is required concerning their beverage-specific price measures. These measures are given by beverage-specific total revenue per gallon from combined state and local collections. Two potential problems with these measures are that they include net profits in monopoly states and license fees in all states. Net profit per gallon depends in part on the cost of operation per gallon which in turn may be related to the number of gallons sold. Since the motor vehicle accident mortality rate also depends on alcohol consumption, the wine and liquor price effects may reflect in part causality from the death rate to revenue per gallon. Moreover, the sign of the relationship between price and net profit per gallon is ambiguous.[12] License fees are one-time,

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[12]Consider a monopolist who produces subject to constant average cost. If he faces a demand function with a constant price elasticity, price and profit per unit output (the difference between price and average cost) will rise in response to an exogenous increase in average cost. On the other hand, if the monopolist's demand function has a constant slope, price will rise but profit per unit output will fall as average cost rises. If the demand function has neither a constant slope nor a constant elasticity, the effect of an exogenous increase in average cost on profit per unit output is ambiguous.

rather than annual, payments, and it is misleading to add them to annual revenue sources such as excise taxes and net profits. A final difficulty is that these variables are subject to measurement error if total revenue and/or quantity is measured with error. This comment does not employ to the variable employed by Saffer and Grossman which pertains to the statutory state excise tax rate on a case of beer.

A final reason for treating the conclusions in the previous sections with caution is that the studies summarized in this paper do not incorporate insights provided by economic models of addictive behavior. The conventional wisdom, which I expressed in Section I and II, is that the addictive nature of alcohol abuse and cigarette smoking may mute the role of price for persons other than adults. A variety of empirical evidence contradicts this view. The best example is a study by Cook and Tauchen (1982). They examine variations in death rates from cirrhosis of the liver (a standard measure of excessive alcohol use) among states of the U.S. as well as variations in per capita consumption of distilled spirits.[13] They find that the state excise tax on distilled spirits has a negative and statistically significant effect on the cirrhosis death rate. Moreover, a $1 increase in the state excise tax lowers the death rate by almost the same percentage as it lowers per capita consumption (5.4 percent versus 7.2 percent). Cook and Tauchen conclude that "...liquor consumption, including that of heavy drinkers, is

[13]Cook and Tauchen's study is limited to license states.

quite responsive to price (1982, p. 387)."[14]

Given the above evidence, future research on the estimation of alcohol and cigarette demand functions both in aggregate and in micro data would be greatly enriched if it incorporates insights provided by Becker and Murphy's (1988) model of addictive behavior. Becker and Murphy assume that rational consumers maximize a utility function that at any moment in time depends on two goods: c and y. These goods differ because current utility also depends on a measure of past consumption of c but not y. Thus, c is addictive because an increase in the stock of c due to an increase in past consumption affects current utility. In particular, in the case of harmful addiction (the relevant case for cigarettes and alcohol), an increase in the stock lowers current utility but raises the marginal utility of current consumption of c. Consumers are rational in the sense that they take account of these effects in allocating their wealth between c and y. They maximize a well-behaved utility function (an indifference curve between c and y is convex to the origin) that is separable over time in c, y, and the stock of c but not in c and y alone.

Although the utility function is separable over time, Becker and Murphy show that the quantity demanded of the addictive good should be inversely related not only to the current price of the

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[14]Other evidence on the responsiveness of alcohol use and cigarette smoking by adults or by persons of all ages to price is summarized by Lewit, Coate, and Grossman (1981); Lewit and Coate (1982); Grossman, Coate, and Arluck (1987); and Grossman (1988).

good but also to its past and future prices.[15] Past prices are relevant because they affect past consumption of the addictive good, and an increase in past consumption due to a reduction in past prices raises current consumption. The future price is relevant because a reduction in it raises future consumption which lowers the "shadow price" of current consumption. Put differently, the demand function of a rational consumer exhibits the property of symmetry: increases in past or future consumption for whatever reason cause current consumption to rise. Becker and Murphy also show that the long-run response to a permanent price change should exceed the short-run response in the case of an addictive good. (These responses are defined below.) Since this property does not hold for a non-addictive good, the price elasticity of demand may be larger for the former than for the latter.

When the utility function is quadratic and the rate of depreciation on the addictive stock is 100 percent, the Becker-Murphy model generates a structural demand function for consumption at time t (c_t) of the form

$$c_t = \alpha_1 c_{t-1} + \beta\alpha_1 c_{t+1} + \alpha_2 p_t + \alpha_3 u_t + \alpha_4 u_{t+1}. \qquad (1)$$

Here β is the rate of time preference (time discount), p_t is the price of c_t, and u_t and u_{t+1} are unobserved variables that affect utility in periods t and t+1. Equation (1) is the basis of the

[15]The above predictions pertain to a demand function that holds the marginal utility of wealth constant. This is the standard demand function employed in life cycle utility maximization models.

empirical implementation of the model. Note that ordinary least squares estimation of the equation would lead to biased estimates of the parameters of interest. The unobserved variables that affect utility in each period are likely to be serially correlated. Even if these variables are uncorrelated, c_{t-1} depends on u_t, and c_{t-1} depends on u_{t+1} through the optimizing behavior. These relationships imply that an ordinary least squares estimation of the equation might incorrectly imply that past and future consumption affect current consumption, even when the true value of α_1 is zero. Put differently, past and future consumption are endogenous variables and must be treated as such in estimating the model.

Fortunately, the specification in equation (1) suggests a way to solve the endogeneity problem. The equation implies that current consumption is independent of past and future prices when past and future consumption are held constant; any effect of past or future prices on current consumption must come through their effects on past or future consumption. Provided that the unobservables are uncorrelated with prices in these periods, past and future prices are logical instruments for past and future consumption, since past prices directly affect past consumption, and future prices directly affect future consumption. Therefore, the empirical strategy amounts to estimating equation (1) by two-stage least squares, with past and future prices serving as instrumental variables for past and future consumption.

The statistical significance of the coefficient of future

consumption provides a direct test of a rational model of addiction against an alternative model in which consumers are myopic. In the latter model they fail to consider the impact of current consumption on future utility and future consumption. The parameters of the equation also allow one to compute the long- and short-run responses of consumption to a permanent decline in price. The long-run response is the effect on consumption of a change in price in all periods. The short-run response is the effect on consumption of a change in price in the current period and all future periods. (That is, past prices are held constant). These effects are obtained by solving the second-order difference equation in (1).

Becker, Murphy, and I (Becker, Grossman, and Murphy 1987) have applied the above model to the demand for cigarettes using a time series of state cross sections for the period from 1955 through 1985. The estimated coefficient of future consumption is positive and statistically significant. Thus, we reject the myopic model of addiction in favor of the rational model of addiction. The long-run price elasticity of demand for cigarettes of -.77 exceeds the short-run elasticity of -.44 by almost 100 percent. Moreover, our long-run elasticity is at the high end of existing estimates, suggesting that these estimates are biased because they do not take account of the addictive nature of cigarette consumption.[16]

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[16]Chaloupka (1988) obtains similar results in an empirical application of the Becker-Murphy model to a micro data set.

Currently, Becker, Murphy, and I are using the same model and data base to fit demand functions for distilled spirits and for excessive alcohol consumption measured by cirrhosis mortality. Similar models can be fit with micro data that contain alcohol consumption at several points in the life cycle. If our results for cigarettes also hold for alcohol, the price elasticity of demand for alcoholic beverages may be larger than the estimates contained in existing research, and the health benefits of increases in alcohol and cigarette excise taxes may be greater than those summarized in this paper.

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