Economics and Antihealth Behavior: The Economic Analysis of Substance Use and Abuse

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Economists study the allocation of scarce resources among competing alternatives. One of the basic assumptions of economic theory is that individuals have limitless desires but limited budgets and therefore must make choices among the different alternatives, or goods, they desire. Markets facilitate these choices by determining the monetary price associated with each choice. Given these prices, individuals determine the best way to spend their limited budgets and still satisfy their most important desires. Economists refer to this process as constrained utility maximization and rational choice.

When individuals decide to buy a particular good at a specified price, they must be willing to pay the price that is being charged. Therefore, economists view price as a measure of a good's worth to the people who buy it. When the cost of a previously chosen alternative rises, individuals are faced with a new decision. They either can dedicate more of their limited budget to the more costly good, which requires that they reduce their purchase of the other alternatives, or they must reduce their purchase of the now more costly good so as to keep their consumption of the other goods the same (or some combination of the two). One of the fundamental principles of economic theory, known as the law of demand, implies that individuals will consume less of a good as its price rises. This means that an inverse relation will exist between the price of a good and the quantity demanded of that good, implying a downward-sloping demand curve.
Some have argued that the demands for tobacco, alcohol, and illicit substances of abuse differ from the demands for most other consumer goods because of the addictive nature of these products. The belief is that individuals do not choose to reduce their consumption of addictive substances when the price of these goods rises because doing so would force addicted individuals to experience withdrawal. Indeed, in the past, many researchers have viewed addictive consumption as an irrational behavior and therefore presumed it fell outside the realm of standard economic analysis (Elster, 1979; Friedman, 1962; Schelling, 1984; Winston, 1980).

This chapter reviews work that applies economic principles to the analysis of substance use and abuse. Specifically, we examine the impact of prices and public policies on the demands for tobacco, alcohol, and illicit drugs and on related outcomes. The findings from these studies clearly demonstrate that even in the case of addictive commodities, the law of demand still applies. Given the well-documented health and other consequences of substance use and abuse, policies lowering use, particularly by youth, are likely to result in significant long-run improvements in health.

THE ECONOMIC APPROACH TO STUDYING HEALTH BEHAVIOR

Economic models of behavior detrimental to health, which have at their foundation the basic principles of consumer choice outlined previously, are not a relatively recent phenomenon. The fundamental ideas behind contemporary economic models of addiction, for example, were first outlined in Marshall’s (1920) Principles of Economics. Despite the skepticism that quickly arose from both inside and outside the profession, economic models of antihealth behaviors continued to evolve from a series of pioneering works by Strotz (1956), Houthakker and Taylor (1966, 1970), Pollack (1970, 1976, 1978), Hammond (1976), Stigler and Becker (1977) and Becker and Murphy (1988). Although these models almost exclusively have been used to describe addictions to particular substances developed over time, the framework is general enough to include more moderate health-related behaviors, such as healthy eating, exercise, and sleep.

A key to understanding how these basic models of consumer choice can be applied to health-related behaviors lies in how economists define price. To economists, price includes not only the monetary cost associated with purchasing a product, but also the time and other costs involved with buying and using that product. In the case of tobacco, for example, economists consider general public smoking restrictions as well as youth access restrictions as components of the price of tobacco because they raise the time, effort, and potential legal costs associated with smoking for adults and
youths. Likewise, in the case of alcohol, the value of the time spent obtaining alcoholic beverages and the expected legal costs associated with underage drinking often are included as additional components of price when considering demand by youths. Conversely, policies that lower the penalties associated with possessing particular substances, such as marijuana decriminalization, lower the full cost of using these substances.

Just as the legal risks and penalties associated with use are considered to be components of price, so, too, are the perceived current and future health risks. For example, as consumers perceive greater health risks from cigarette smoking or drug use, perhaps due to warning labels on packaging or anticonsumption media campaigns, their demand for these products diminishes. Similarly, for those who are addicted to these products, the cost associated with cessation is also included. Thus, the full price of a good can be thought of as having four basic components: (1) monetary cost, (2) availability and time cost, (3) potential legal cost, and (4) potential health cost. When economists study the demand for alcohol, tobacco, and other substances, efforts are made to include not only the monetary price of these products, but also measures of the other costs associated with consuming them.

Although principally concerned with price effects, economists recognize that several other factors also influence the demand for particular products and try to incorporate these factors into their models. Disposable income is clearly an important factor influencing demand, because it is typically the main factor constraining the individual's choices. In general, consumption of most goods rises as income rises. Economists refer to these kinds of goods as normal goods. For some products, however, consumption falls as income rises. These are defined as inferior goods. An individual's tastes or preferences also will influence demand, but because these factors are difficult to measure, economists usually include sociodemographic characteristics as indicators of tastes. Examples of frequently utilized sociodemographic variables include gender, race and ethnicity, age, household structure, educational status and attainment, religious and family upbringing, marital status, and employment status.

Additionally, many recent economic studies of substance use have tried to account for the addictive nature of tobacco, alcohol, and other drug use. These models explicitly incorporate the intertemporal links in consumption by making current consumption decisions dependent on past choices, thus incorporating the tolerance, reinforcement, and withdrawal associated with addictive consumption. Tolerance is modeled by assuming that current satisfaction is lower when past consumption of an addictive substance is higher. Reinforcement refers to the positive effects of prior consumption on current consumption and is modeled by assuming that the additional satisfaction received from a unit of current consumption of the addictive substance is higher when past consumption is higher. Withdrawal refers to the negative
effect on utility due to physical discomfort that occurs when the individual tries to quit use of the substance and is modeled by assuming current satisfaction is lower when addictive consumption is terminated. Two frameworks for modeling addictive behavior have been developed in the economics literature: myopic and rational models.

Myopic models assume that individuals behave shortsightedly and ignore all future consequences associated with current use of a substance. In these models, higher past consumption of the addictive substance leads to higher current consumption. Similarly, higher current consumption results in a stronger desire, or taste, for that good in the future, but the myopic individual ignores this effect because of an infinite discount rate on future consumption. Several of these models treat tastes as endogenous, implying that past and current consumption of an addictive substance change future preferences for that substance (e.g., Hammond, 1976; Houthakker & Taylor, 1996, 1970; Pollack, 1970, 1976). Others treat tastes as fixed, or exogenous, capturing addiction through the assumption that an accumulation of past consumption affects current consumption because of a built-up tolerance for the drug.

The rational addiction framework models addictive behavior within the standard rational, utility-maximizing paradigm of economics (e.g., Becker & Murphy, 1988). In these models, an individual's taste for an addictive good does not change over time, but the demand in terms of quantity consumed for that good may change due to the addictive nature of that good. Rationality, in these models, implies that the future consequences of past and current consumption are considered when making current consumption choices. This contrasts with the myopic models, which assume that the future implications of addictive consumption are ignored when making current consumption decisions.

Generally, the demand functions that are derived by economists through constrained utility maximization are tested empirically with a variety of aggregate and individual-level data, using diverse econometric and other statistical methods. Many studies use aggregate, time-series data for the United States or for specific geographical units. Other studies employ pooled cross-sectional time-series data consisting of annual observations for countries, states, counties, cities, or other geographical units over time. Tax-paid sales and a variety of outcomes related to substance use and abuse are used in these studies. All of these measures are considered to be aggregate measures of use, because a particular individual's behavior cannot be identified. More recently, many economic studies of substance use employ self-reported measures of use and outcomes related to use taken from national survey data. These frequently are referred to as individual-level data. The use of these alternative data sets allows economists to capitalize on the substantial cross-sectional and intertemporal variations in price and control policies that exist for tobacco, alcohol, and other drugs.
EMPIRICAL EVIDENCE

Tobacco

There has been a surprisingly consistent finding in the relatively large economics literature that increases in cigarette prices are associated with reductions in cigarette smoking among the general population (National Cancer Institute, 1993; U.S. Department of Health and Human Services [USDHHS], 1989, 1992, in press). The consensus estimate of the price elasticity of demand for cigarettes that has emerged from these studies ranges from −0.3 to −0.5. Economists use the price elasticity of demand to explain how responsive consumption is to changes in the price of a good; it is defined as the percent change in consumption that results from a 1% increase in price. A price elasticity of demand ranging from −0.3 to −0.5, therefore, implies that a 10% increase in the price of cigarettes would reduce overall cigarette consumption in the general population by 3% to 5%.

Furthermore, economists found that the effects of increased cigarette prices are not limited to reductions in the number of cigarettes smoked by smokers. They also lead to significant reductions in smoking prevalence. These reductions in smoking prevalence reflect both increased smoking cessation among smokers and reduced smoking initiation among potential young smokers (Chaloupka & Grossman, 1996; Evans & Farrelly, 1996; National Cancer Institute, 1993). For example, Evans and Farrelly used 13 years of data from the National Health Interview Surveys (NHIS) and found that approximately one half of the impact of price on reducing adult smoking is on the decision not to smoke.

Early studies of youth and young adult smoking concluded that they were even more sensitive to changes in cigarette prices than were adults (Lewit & Coate, 1982; Lewit, Coate, & Grossman, 1981). Although this finding was contradicted by two later studies that used small samples from the Second National Health and Nutrition Examination (Chaloupka, 1991; Wasserman, Manning, Newhouse, & Winkler, 1991), more recent studies using larger samples confirmed the earlier result (Chaloupka & Wechsler, 1997; Chaloupka & Grossman, 1996; Evans & Farrelly, 1996). Evans and Farrelly, for example, pooled data from 13 surveys of the NHIS conducted from 1976 through 1992 and estimated an overall price elasticity of demand for young adults, ages 18 to 24, that was 50% larger than their estimate for adults ages 25 to 39 and nearly three times as large as their estimates for the full sample. Similarly, Chaloupka and Grossman estimated the price elasticity of demand for cigarettes by youths to be −1.31 using data on more than 110,000 eighth, tenth, and twelfth graders from the 1992-1994 Monitoring the Future Surveys (MTFS). They concluded that a 10% increase in cigarette prices would reduce youth smoking by 13.1%. Their estimates implied that the number of youth
smokers would decline by nearly 7%, and that average cigarette consumption by young smokers would be reduced by more than 6% in response to a 10% price increase. Similarly, Chaloupka, Tauras, and Grossman (1997) found that both the prevalence and frequency of youth smokeless tobacco are inversely related to price. Given that nearly all smoking and other tobacco use initiation occurs by the time youths graduate from high school and that smoking habits become firmly established in young adulthood, these estimates suggest that substantial tax increases would be an effective way to achieve long-run reductions in smoking in all segments of the population.

Studies that applied economic theories of addictive behavior to the demand for cigarettes found that the long-run effects of price on cigarette demand is approximately double the short-run effects (Becker, Grossman, & Murphy, 1994; Chaloupka, 1991; Keeler, Hu, Barnett, & Manning, 1993). Short-run, in these models, refers to the relatively immediate effects of a price change on current consumption, whereas long-run refers to the cumulative impact of a permanent price change on use in all periods. These theoretical models, which attempt to capture the acquired tolerance, reinforcement, and withdrawal associated with consumption over time, predict that the long-run effect of a price change on demand will be larger than the more immediate effect because a permanent change in price will have a cumulative downward effect on consumption over time. Indeed, this is what is found. The long-run price elasticity of demand for cigarettes from these models ranges from −0.6 to −1.0, as compared to a range from −0.3 to −0.5 for short-run elasticities of demand.

Furthermore, relevant studies found that cigarette smoking is behaviorally addictive in the sense that past smoking decisions have a significant effect on current smoking. Some of the models (e.g., Becker & Murphy, 1988) assume that addicts are somewhat farsighted in their decisions, implying that future consequences of their addiction will lead to changes in the current decision. Empirical tests of these so-called rational addiction models find that cigarette smokers do take into account future effects of smoking in their current decision (Becker et al., 1994; Chaloupka, 1991, 1992; Chaloupka & Grossman, 1996).

As with changes in the monetary price of cigarettes, a number of studies provided evidence that tighter smoking restrictions, which increase the time cost and potential legal cost associated with tobacco use, reduce smoking among adults (Chaloupka, 1992; Chaloupka & Saffer, 1993; Evans, Farrelly, & Montgomery, 1996; Ohfsedt, Boyle, & Capilouto, 1998; Wasserman et al., 1991). Relatively comprehensive restrictions on smoking in public places, particularly restrictions on smoking in workplaces, generally are found to be associated with both lower smoking prevalence and lower average daily cigarette consumption. Evans et al., for example, used survey data to examine the impact of workplace policies on smoking prevalence and intensity among workers. Their statistical model allowed for the possibility that workers
self-select work sites based on their own smoking status and the workplace smoking policies. Their estimates suggested that workplace smoking bans reduce the probability of adult smoking by 5% and reduce average daily consumption among smokers by 10%. Chaloupka and Saffer (1995) used annual state-level data from 1975 through 1985 to examine the impact of smoking restrictions on aggregate cigarette sales. After controlling for the possibility that the state restrictions merely reflect general antismoking sentiment in the state (i.e., that smoking laws are endogenous), they found that relatively comprehensive restrictions on smoking in public places led to reductions in smoking.

There is a much smaller literature examining the impact of smoking restrictions on youth tobacco use, but it generally is found that public and school restrictions are effective at reducing smoking by youths (Chaloupka & Wechsler, 1997; Pentz et al., 1989; Wasserman et al., 1991). Using a sample of more than 16,000 students from 140 colleges and universities, Chaloupka and Wechsler (1997) found that stringent restrictions on smoking in public places significantly reduced the likelihood that college students smoke, and even weak restrictions were effective at reducing the quantity consumed by those who choose to smoke. Wasserman et al. used several waves of the NHIS from the 1970s through the 1980s to construct an index of antismoking regulations and found that increasing state restrictions on smoking from just a few public places to the most comprehensive restrictions would reduce overall teenage cigarette consumption by more than 40%.

Much less is known about the impact of youth access restrictions on the consumption of tobacco by youths, even though this has been the focus of recent antismoking campaigns. Chaloupka and Grossman (1996) examined the impact of a variety of state and local limits on youth access using data from the 1992 through 1994 MTFS. They found that minimum legal purchase ages for cigarettes, requirements that signs indicating the minimum purchase age be posted where tobacco products are sold, restrictions on vending machine cigarette sales, limits on the distribution of free samples of tobacco products, and vendor licensing provisions related to tobacco generally have no significant effect on youth smoking. Chaloupka and Grossman hypothesized that the lack of a significant finding was due to the relative weak enforcement of these restrictions in many states. This is consistent with what has been found by DiFranza, Norwood, Garner, and Tye (1987) and others that minimum purchase age laws have little success in reducing minors' access to tobacco because the laws are poorly enforced. Chaloupka and Pacula (1998), on the other hand, found that comprehensive and aggressive enforcement of and high compliance with the limits on youth access do lead to significant reductions in youth smoking.

Evans and Farrelly (1996) considered the compensating behavior of smokers in response to changes in price. In particular, using detailed data collected
in the 1979 and 1987 NHIS regarding the brand of cigarette smoked, Evans and Farrelly developed several measures of smoking intensity, including total millimeters of cigarettes smoked and total tar and nicotine consumed daily. They found that smokers in higher tax states are more likely to smoke longer cigarettes and to smoke higher tar and nicotine cigarettes than smokers in lower tax states. They found that, for some groups, this compensating behavior is large enough to offset the health benefits of the reduced cigarette consumption that would result from a tax increase. Based on these findings, Evans and Farrelly argued that if higher cigarette taxes are being used to reduce the health consequences of smoking, then it would be more appropriate to tax cigarettes based on tar and nicotine content.

Moore (1996), however, presented some contrasting evidence that suggests that higher cigarette taxes and prices do have significant health benefits. Using annual state-level data on tobacco-related mortality rates for the period from 1954 to 1988, Moore concluded that increases in cigarette taxes lead to significant reductions in smoking-related deaths. His estimates imply that a 10% increase in the cigarette tax would lead to approximately 6,000 fewer deaths from smoking each year in the United States.

As these studies demonstrate, economists have been able to shed substantial light on smoking behavior. It is now firmly established that smokers are responsive to changes in the price of cigarettes. Moreover, it is widely accepted that smoking by youth and young adults is more responsive to price than is smoking by adults. Furthermore, models that account for the addictive nature of smoking find that the long-run effect of price on smoking is larger than the short-run impact. Stronger smoking restrictions, particularly restrictions on smoking in public and private workplaces, are found to be effective at decreasing smoking prevalence and average daily consumption among youth and adults. Smoking among youth, however, is generally not responsive to limits on youth access to tobacco products unless they are comprehensive, aggressively enforced, and complied with highly.

**Alcohol**

Considerable attention has been given to the effect of price on the demand for alcohol in the economics literature. Perhaps this is because of the increased awareness of alcohol-related problems, such as drunk driving and the consequent motor vehicle accident fatalities, domestic violence, and other crime. Numerous studies have been conducted employing aggregated state and national data as well as individual-level data. Although economists are in agreement that price clearly influences the quantity of alcohol consumed, estimates of the degree of responsiveness to price vary from study to study and from population to population. For example, Leung and Phelps' (1993) review of the economics literature that analyzed aggregate-level data
for the general population found that the estimated price elasticity for beer ranges from −0.12 to −1.07. They concluded, based on these studies, that their best guess of the price elasticities for beer, wine, and distilled spirits are −0.3, −1.0, and −1.5, respectively. This suggests that beer consumption is far less sensitive to changes in price than wine and distilled spirits consumption. They noted that recent work using individual-level data suggests that alcohol demand may be even more responsive to price than their best guesses indicate. Recent studies by Grossman, Chaloupka, and Sirtalan (1998); Beard, Gant, and Saba (1997); Kenkel (1993, 1996); Manning, Blumberg, and Moulton (1995); Baltagi and Griffin (1995); and Moore and Cook (1995) used individual-level data and generally found price elasticities larger than those from aggregate studies.

Economists also have found that responsiveness to price varies by consumption level (Cook & Moore, 1993a; Kenkel, 1996; Manning et al., 1995; Mullahy & Sindelar, 1994). Manning et al., using data from the 1983 NHS, found that moderate drinkers are the most responsive to changes in the price of alcohol, with an estimated price elasticity of −1.19, and both lighter and heavier drinkers have price elasticities that are closer to zero. Kenkel (1996) found somewhat different results using the 1985 wave of the survey. He estimated an average price elasticity of moderate drinking of −0.78. He further calculated separate elasticity estimates for heavy drinking by gender and found that heavy drinking among men is much less price sensitive than is heavy drinking among women, with the estimated price elasticities being −0.52 and −1.29, respectively.

Applications of the addiction models to alcohol consumption reveal generally similar findings to those that are found in the tobacco literature (Grossman et al., 1998; Moore & Cook, 1995). Grossman et al. (1998) applied the Becker and Murphy (1988) rational addiction model to the consumption of alcohol by young adults using longitudinal data from the MTFS. They found consistent evidence that increases in the full price of alcohol, resulting either from higher monetary prices or higher minimum legal drinking ages, significantly reduce drinking among young adults. Furthermore, they found strong evidence that drinking in this age group is addictive in the sense that there is a strong interdependency of past, current, and future alcohol consumption. They estimated an average long-run price elasticity of demand of −0.65, which is over twice as large as the estimate they got when addiction is ignored (−0.29). They also found that the long-run price elasticity of demand is approximately 60% larger than their estimate of the short-run elasticity.

Moore and Cook (1995) estimated both a myopic and rational model of addiction using data from the National Longitudinal Survey of Youth (NLSY) and found that, in both cases, consumption remains sensitive to changes in the full price of alcohol. They, too, found that the long-run elasticity of demand is significantly larger than that of the short-run elasticity of demand.
Studies focusing on drinking by youths and young adults consistently find that these populations are even more sensitive to changes in the price of alcohol than are adults (Chaloupka & Wechsler, 1996; Coate & Grossman, 1988; Cook & Moore, 1993a; Grossman, Coate, & Arluck, 1987; Laixuthai & Chaloupka, 1993). Grossman, Chaloupka, Saffer, and Laixuthai (1994) reviewed the literature on the effects of increased prices and minimum legal purchase ages for alcoholic beverages on youth drinking based on a number of nationally representative data sets. Their review indicated that youth drinking, including heavy drinking, is significantly related to alcoholic beverage prices, taxes, and minimum legal drinking ages. Grossman et al. (1987), for example, estimated the beer price elasticity for youth at \(-3.05\) and spirits price elasticity at \(-3.83\).

More recently, Chaloupka and Wechsler (1996) explored the relation between various measures of alcohol availability and youth drinking and binge drinking using data from the 1993 Harvard College Alcohol Survey. They found a strong positive relation between alcohol availability and drinking, particularly binge drinking. Furthermore, they found a strong negative relation between the strength of state-level policies related to drinking by youth and young adults and all measures of drinking. Their findings support those of others who have found that changes in the full price of alcohol lead to larger reductions in heavy or frequent drinking by youths and young adults.

In addition to examining the effects of price on alcohol consumption, a number of economists have studied the impact of the full price of alcohol on the negative consequences of alcohol use and abuse, including drinking and driving, alcohol-related accidents, liver cirrhosis mortality and other health consequences, and violence and other crime.

It is consistently found that raising the full price of alcohol is an effective way of reducing fatal and nonfatal motor vehicle accidents, many of which are related to driving under the influence of alcohol (Chaloupka & Laixuthai, 1997; Chaloupka, Saffer, & Grossman, 1993; Kenkel, 1993; Mullahy & Sindelar, 1994; Ruhm, 1996; Saffer & Grossman, 1987a, 1987b). Using annual state-level data for the period from 1975 through 1981, Saffer and Grossman (1987a), for example, predicted that a policy indexing the beer tax to the rate of inflation since 1951 would have reduced 18- to 20-year-old motor vehicle accident fatalities by 15\%, and a uniform legal drinking age of 21 years would have lowered fatalities by 8\%.

Chaloupka et al. (1993) considered the effects of beer taxes, legal drinking ages, alcohol availability, and all major state-level policies related to drinking and driving on youth and adult motor vehicle accident fatality rates (including alcohol-involved fatality rates) using state-level data for the period from 1982 through 1988. The drunk driving policies they examined reflect factors that influence the expected legal costs of drinking and driving by raising the probabilities of arrest and conviction for DUI, as well as the penalties im-
posed on conviction. They concluded that increases in many aspects of the full price of alcohol, including increased beer taxes; higher legal drinking ages; and swift, certain, and severe penalties for drinking and driving would lead to significant reductions in motor vehicle accident fatalities related to alcohol.

More recent research using individual-level data similarly has concluded that increases in beer taxes and drinking ages, as well as strong laws related to drinking and driving, are effective at reducing self-reported drinking and driving and involvement in nonfatal traffic accidents (Chaloupka & Laixuthai, 1997; Kenkel, 1993; Mullaly & Sindelar, 1994).

Similarly, several studies have examined the effects of the full price of alcohol on liver cirrhosis mortality and other health consequences related to alcohol (Chaloupka, Grossman, Becker, & Murphy, 1992; Cook & Tauchen, 1982; Sloan, Reilly, & Schenzler, 1994). Cook and Tauchen, for example, estimated that a $1 increase in the tax on a proof-gallon of distilled spirits would have reduced cirrhosis deaths by 5.4% to 10.8% during the period covered by their data, contradicting the then conventional wisdom that heavy alcohol consumption was unresponsive to price. This finding was confirmed by Chaloupka et al. (1992) in their application of the rational addiction model to heavy alcohol consumption that used cirrhosis mortality as a proxy for heavy consumption. Using state-level data from 1961 through 1984, they concluded that overall alcohol consumption does not reflect addictive behavior but that heavy alcohol consumption does reflect addiction. They estimated that a 10% increase in the price of alcoholic beverages would reduce cirrhosis mortality by 8.3% to 12.8% in the long run.

Similarly, Sloan et al. (1994) found that other deaths related to alcohol use and abuse, including deaths where alcohol is the primary cause or a contributing cause—suicides, and deaths from drownings, falls, and other accidents—fall as the full price of alcohol increases due to increases in monetary prices, reductions in the availability of alcoholic beverages, or both. Likewise, Ohsfeldt and Morrisey (1997) found that the probability of a nonfatal workplace accident is inversely related to the price of alcoholic beverages.

Finally, several recent economic studies considered the relation between alcohol control policies and violence and other crime (Chaloupka & Saffer, 1992; Cook & Moore, 1995a; Markowitz & Grossman, 1997; Sloan et al., 1994). Cook and Moore (1995a), for example, examined state-level data on violent crime rates for the period from 1979 through 1987. They concluded that higher beer taxes would lead to significant reductions in rapes and robberies but would have little impact on homicides and assaults. In a more detailed analysis for the period from 1975 through 1990, Chaloupka and Saffer (1992) concluded that increases in the full price of alcoholic beverages resulting from increased beer taxes or reduced availability of alcohol would lead to reductions in all measures of crime, including homicides, rapes,
assaults, and various income-producing crimes. These findings generally are confirmed by the analysis of homicide rates by Sloan et al. (1994).

More recently, Markowitz and Grossman (1997) used individual-level data to examine the impact of the full price of alcoholic beverages on domestic violence directed at children. They found a strong inverse relation between the full price and both the probability of child abuse and overall violence toward children. For example, they estimated that a 10% increase in the beer tax would reduce the probability of child abuse by 2.2%, and reductions in the number of outlets licensed to sell alcoholic beverages would further reduce violence toward children.

Economic analysis, therefore, clearly demonstrates that drinking by adults, young adults, and youth is responsive to changes in the full price of alcohol. Generally, we find that young drinkers are more responsive than older drinkers. As with cigarettes, we find that long-term declines in drinking in response to price increases are larger than short-run declines due to the addictive nature of drinking. Contrary to popular opinion, economists find that heavy drinking and the health consequences associated with it, such as fatal and nonfatal motor vehicle accidents, cirrhosis mortality, suicides, drowning, and violent crime, are generally also responsive to increases in the full price of alcohol.

Illicit Drugs

Although considerable attention has been paid to the consumption of cigarettes and alcohol in the economics literature, there are significantly fewer empirical studies of the effect of illicit drug prices on drug use. This largely is attributed to two severe data limitations that make estimating demand equations for illicit drugs quite difficult. First, there are no aggregate data for illicit drugs comparable to the tax-paid sales data available for cigarettes and alcohol, and the few general population surveys that include questions pertaining to illicit drug use are plagued by validity and reliability concerns. As a result, many economists in the past have tried to estimate elasticities from either small, local samples of users or from annualized national crime or hospital data. Second, even less data are available on the prices people pay for the illicit drugs they consume and on the other aspects of the full price of these substances. Economists conducting the earliest research in this area, therefore, have been forced in many cases to use imperfect proxies for the prices of the drugs and to draw conclusions regarding actual price elasticities from these proxies. More recent research, however, has taken advantage of the more appropriate data that have become available on illicit drug use, drug prices, and control policies.

The majority of empirical studies on illicit drug use examine the effect of state decriminalization status on the demand for marijuana. States that
have decriminalized marijuana have lower penalties associated with possession of small amounts of the drug (typically less than 1 ounce). These lower penalties reduce the expected legal cost associated with consuming marijuana and should therefore increase the demand for marijuana.

Studies that have examined the impact of decriminalization on the consumption of marijuana in the general population have found this to be the case (Model, 1993; Saffer & Chaloupka, 1997). Using the 1988, 1990, and 1991 waves of the National Household Survey on Drug Abuse (NHSDA), Saffer and Chaloupka (1997) estimated that decriminalization increases the probability of marijuana use in the past month by about 8.4% and in the past year by about 7.6%. Similarly, Model found that decriminalization significantly increased the number of marijuana-related emergency room visits.

Studies that focused on youth and young adult populations, however, generally have found that decriminalization status has little or no consistent impact on demand (Chaloupka, Grossman, & Tauras, 1998; DiNardo & Lemieux, 1992; Johnston, O'Malley, & Bachman, 1981; Pacula, in press; Thies & Register, 1993). This does not imply that youths are insensitive to changes in the price of marijuana, however. Nisbet and Vakil (1972) used data from interviews with students at the University of California, Los Angeles, to examine the demand for marijuana and estimated a price elasticity of marijuana at \(-0.40\) to \(-1.51\). Likewise, Pacula (in press) found that youth 30-day marijuana prevalence is sensitive to changes in the crime-per-officer ratio, a proxy for the price of marijuana, using data from the 1984 NLSY. Finally, Chaloupka et al. (1998), using data from the 1982 and 1989 waves of the MTFS, found that consumption of marijuana by high school seniors was reduced by increases in the associated fines for possession.

Several recent studies have taken advantage of new information on cocaine prices available from the Drug Enforcement Agency's System to Retrieve Information from Drug Evidence (STRIDE) data set and examined the sensitivity of cocaine use to changes in its price (Chaloupka et al., 1998; DiNardo, 1993; Grossman & Chaloupka, 1998; Saffer & Chaloupka, 1997, 1998). Using state-aggregated data from the 1977 through 1987 surveys of the MTFS of high school seniors, DiNardo found that price had no significant effect on cocaine use by youths. Grossman and Chaloupka (1998), however, found a significant effect using the individual-level longitudinal data from the 1976 through 1985 surveys of high school seniors. Within the context of the Becker and Murphy's (1988) rational addiction model, Grossman and Chaloupka (1998) estimated a short-run price elasticity of \(-0.96\) and a long-run price elasticity of \(-1.35\) for young adult cocaine demand. Furthermore, their estimates are consistent with the hypothesis of rational addictive behavior.

Likewise, Chaloupka et al. (1998) used data from the 1982 and 1989 waves of the MTFS and found that youth consumption of cocaine is sensitive to changes in price. They estimated an overall price elasticity of youth
cocaine demand of \(-1.28\) for use in the past year and \(-1.43\) for use in the past month based on data from both survey years. Saffer and Chaloupka (1997) employed data that consisted mainly of adults and found that consumption of cocaine is still price-sensitive. Saffer and Chaloupka (1997) estimated an average participation elasticity for cocaine use in the past month of \(-0.28\) and an average participation elasticity for use in the past year of \(-0.44\) using data from the 1988, 1990, and 1991 waves of the NHSDA. Participation elasticities differ from overall price elasticities because they only examine the decision to use the drug, not the change in quantity consumed associated with the price change.

The empirical studies examining the influence of price on use of other illicit drugs is even sparser. Two early studies by Silverman and his colleagues suggested that the demand for heroin is inelastic (Brown & Silverman, 1974; Silverman & Spruill, 1977). Using a pooled cross-sectional time-series data set on 41 Detroit neighborhoods from November 1970 through July 1973, Silverman and Spruill found a price elasticity for heroin use of about \(-0.26\). They also found that property crime rates were positively and significantly affected by the price of heroin, whereas nonproperty crime rates are not.

More recent studies using price data from the STRIDE data set and consumption data from the 1988, 1990, and 1991 NHSDA reveal that heroin consumption is much more price-sensitive than previously thought (Saffer & Chaloupka, 1998, 1997). Saffer and Chaloupka (1997) reported price elasticities for heroin participation in the past month ranging from \(-0.82\) to \(-1.03\) and price elasticities for participation in the past year from \(-0.60\) to \(-1.02\). These estimates are consistent with findings from Bretteville-Jensen and Sutton (1996), who estimated the price responsiveness of 500 Norwegian heroin users using self-reported price and consumption data. They reported a price elasticity of heroin of \(-1.23\).

These estimates for the effects of price on illicit drug use are consistent with the evidence from the more extensive literatures on the demand for licit addictive substances. In particular, these studies found that illicit drug use is inversely related to price; that illicit drug demand by youth is more price-elastic than demand by adults; and, in the models accounting for the addictive aspects of consumption, that the long-run effect of price increases exceeds the short-run effect.

**Polydrug Use and Cross-Price Effects**

There is increasing evidence in the biomedical literature that the use of illicit drugs may heighten the effects of alcohol, just as drinking alcohol can heighten the effects of illicit drugs (National Institute on Alcohol Abuse and Alcoholism, 1993). These two behaviors, therefore, can reinforce each other. Indeed, recent statistics show that *polydrug use*, which is defined as the
concurrent use of more than one substance, has become a fairly common practice, particularly among abusers (Grant & Harford, 1990; Martin, Clifford, Maisto, & Earleywine, 1996). In 1994, for example, more than 97% of young adults in the NHSDA who reported currently using marijuana also reported currently using alcohol. These findings suggest that a complementary relation exists between the demands for licit and illicit substances, particularly alcohol and marijuana. Economists examine how changes in the price of one good affect the consumption of a second good to determine the relation between these goods. If consumption of one good rises in response to an increase in the price of a second good, then economists consider the goods to be substitutes. Conversely, if an increase in the price of one good leads to a reduction in the consumption of a second good, then economics consider these goods complements.

Two recent econometric studies that examined the relation between alcohol and marijuana use by youth found evidence that the two were substitutes rather than complements (Chaloupka & Laixuthai, 1997; DiNardo & Lemieux, 1992). DiNardo and Lemieux employed state-aggregated data from the 1980 through 1989 MTFS to estimate prevalence equations for alcohol and marijuana that included the price of alcohol, the minimum drinking age, and marijuana decriminalization. They found that marijuana decriminalization had a significant negative effect on the prevalence of alcohol use by high school seniors, and the minimum legal drinking age had a significant positive effect on the prevalence of marijuana use. Both findings support the hypothesis that alcohol and marijuana are substitutes for youths. Many of the own-price effects were not significant, however.

Chaloupka and Laixuthai (1997) used individual-level data on youth drinking and nonfatal motor vehicle accidents from the 1982 and 1989 MTFS along with aggregate data on youth motor vehicle accident fatality rates from the Fatal Accident Reporting System to study the relation between alcohol and marijuana use. They included the beer tax, marijuana decriminalization, and, in some equations, the money price of marijuana in their estimation of a drinking frequency and heavy drinking equations. They found that both the frequency of drinking and the probability of heavy drinking were inversely related to beer prices, positively related to the price of marijuana, and negatively related to state decriminalization. These findings again suggested that alcohol and marijuana are substitutes for youths. Moreover, they found that, for youths, the probability of a nonfatal or fatal motor vehicle accident is inversely related to the full price of alcoholic beverages but positively related to the full price of marijuana. Given the evidence on the relative risks of driving under the influence of alcohol or marijuana, they concluded that this reflects substitution between the substances.

Other recent studies, however, found a complementary relation between alcohol and marijuana as well as other illicit drugs for young adults and
adults (Pacula, 1997, in press; Saffer & Chaloupka, 1997, 1998; Thies & Register, 1993). All of these later studies employed individual-level data and estimated demand equations for alcohol and the other illicit substances, so it was possible in these studies to examine the cross-price effects in light of findings with respect to own-price effects. Thies and Register estimated the effect of marijuana decriminalization and minimum legal purchasing ages on the probabilities of alcohol, marijuana, and cocaine use with data taken from the NLSY. They found that state decriminalization status has a positive effect on alcohol and cocaine use, although it has no significant effect on heavy drinking or marijuana use. Using the same data, Pacula (in press) estimated the effects of changes in the full price of alcohol and marijuana on the probabilities of alcohol and marijuana use as well as the quantities consumed. She found that the tax on beer had a negative and significant effect on the decision to use both alcohol and marijuana, suggesting that the two substances are complements for her sample of young adults.

Saffer and Chaloupka (1997, 1998) conducted the most comprehensive analysis of cross-price effects among licit and illicit substances. Using a pooled sample of cross-sectional data from the 1988, 1990, and 1991 waves of the NHSDA, they estimated annual and monthly prevalence equations for alcohol, marijuana, cocaine, and heroin. A weighted average price of pure alcohol variable was included to capture the price of alcohol, state decriminalization status was included for the price of marijuana, and cocaine and heroin price information were added from the STRIDE data set. Saffer and Chaloupka (1997, 1998) found consistent evidence of a complementary relationship across all four drugs, with the exception of alcohol and marijuana, for which the evidence was mixed and depended on the population being examined.

To date, only one study has examined polydrug use while controlling for the addictive effects of consumption over time. Using a myopic model of multicommodity habit formation, Pacula (1997) estimated the youthful demands for alcohol and marijuana by gender. She included the tax on beer, minimum legal drinking age, decriminalization status, price of cigarettes, and a proxy for the monetary price of marijuana in all of her specifications. She found that for women, higher beer taxes reduce consumption of both alcohol and marijuana, implying a complementary relation. Similar evidence of a complementary relation was found in the demand equations for men. In addition to finding that the individual consumption of both substances was reinforced over time, Pacula (1997) also found for both men and women that previous use of marijuana significantly increased the current demand for alcohol, indicating that reinforcement can take place across substances.

The majority of studies to date have found a complementary relation between the demands for different substances. The mixed evidence with
respect to alcohol and marijuana can be attributed to differences in the level of aggregation of the data as well as to differences in the populations being studied. When individual-level data are employed, and demand equations for marijuana also can be estimated, the findings are generally supportive of a complementary relationship between alcohol and marijuana. Until good measures of the money price of marijuana are obtained, however, this cannot be known with certainty.

**IMPLICATIONS FOR PREVENTION POLICIES**

As this literature review demonstrates, economists have made significant contributions to our understanding of the policy-manipulable determinants of the demands for tobacco, alcohol, and other drugs. Several clear conclusions emerge from this literature. First, the demands for addictive substances are not exceptions to the law of the downward-sloping demand curve, perhaps the most fundamental principle of economics, that is, significant increases in the monetary prices of cigarettes and other tobacco products; alcoholic beverages; and marijuana, cocaine, heroin, and other drugs will lead to significant reductions in the use of these substances. Similarly, increases in the other costs of substance use, which can be achieved by limiting availability, increasing the expected legal costs associated with use and abuse, and providing new and better information on the health consequences of use and abuse will lead to reductions in alcohol, tobacco, and other drug use. Moreover, these reductions in use will not be limited to reductions in the frequency of use or quantity consumed by users, but will be accompanied by reductions in the prevalence of use. This implies that large increases in taxes on cigarettes and other tobacco products and alcoholic beverages will lead to substantial reductions in cigarette smoking, alcohol use and abuse, and related outcomes. In contrast, these estimates imply that the legalization of currently illegal drugs, which would almost certainly lead to sharp reductions in the prices of these substances, would lead to sizable increases in the use and abuse of illicit drugs.

Second, the price sensitivity of demand for addictive substances is inversely related to age. Thus, youth and young adults are significantly more responsive to changes in price than are older adults. Given that most substance use is initiated during the teenage years and that patterns of use are firmly established during early adulthood, this implies that large permanent increases in prices, which will lead to disproportionately large reductions in substance use and abuse among youth and young adults, are likely to be the single most effective means of achieving long-run reductions in tobacco, alcohol, and other drug use in all segments of the population. This finding helps explain some of the recent trends in youth cigarette smoking.
After several years of decline, cigarette smoking and marijuana use among youth have been rising. The increase in youth smoking occurred at nearly the same time that cigarette prices were cut sharply by all major producers, beginning with Philip Morris' 40-cent price reduction for its Marlboro brand. Even with subsequent increases in state cigarette taxes, the real (inflation-adjusted) price of cigarettes is still below its level prior to the price cuts. The same applies to youth marijuana use, which has been rising at the same time as the real, purity-adjusted price of marijuana has been falling steadily. In contrast, youth alcohol use has changed little in recent years, and real alcohol prices have remained steady.

Third, in addition to affecting the use of tobacco, alcohol, and other drugs, price increases, strong and consistent evidence shows, will lead to reductions in the consequences of use, including morbidity and mortality, accidents, violence and other crime, and more. This implies that policies that raise the perceived probabilities of arrest and conviction and increase the swiftness and severity of the penalties imposed on conviction for underage drinking, drinking and driving, illicit drug possession, and other illegal activities will lead to significant reductions in these behaviors.

A fourth key finding from this research is that the long-run effects of changes in the monetary price or other costs associated with tobacco, alcohol, or other drug use will be larger than the short-run impacts because of the addictive nature of demand. This has important implications for the revenue-generating potential of large increases in cigarette and alcohol taxes. These increases will lead to significant reductions in use in the short run; they also will lead to sharp increases in tax revenues, given the relative inelasticity of demand in the short run. However, because of the addictive nature of consumption, the impact of tax increases on demand will grow over time, leading to smaller long-run increases in revenues than would be observed in the short run.

Furthermore, econometric studies of alcohol, tobacco, and other drug use done in the context of economic models of addiction find strong evidence of nonmyopic behavior. This implies that the future consequences of addictive consumption are considered to at least some extent when making current smoking, drinking, and illicit drug-use decisions. A key implication of this finding is that new and better information on the long-term health consequences of substance use and abuse will lead to immediate reductions in smoking, drinking, and other drug use. This clearly is supported by the sharp declines in cigarette smoking that were observed in the mid- to late-1960s after the release of the first U.S. surgeon general's report on the health consequences of smoking. The same was observed for cocaine use in the latter half of the 1980s after the death of college basketball star Len Bias from a cocaine overdose. This implies that school-based education programs, counteradvertising campaigns, and other efforts to improve the quantity and
quality of information concerning the long-term consequences of substance use can lead to significant reductions in substance use and abuse.

Finally, the economic research on the demands for alcohol, tobacco, and other drugs suggests that there may be unintended consequences or benefits resulting from changes in control policies targeted at a single substance. For example, some studies concluded that stronger alcohol policies, although effective in reducing youth drinking and its consequences, may have led to increased marijuana use by teens. Several other studies, however, found evidence of a complementary relation between alcohol, marijuana, cocaine, and heroin use, implying that policies increasing the monetary price and other costs associated with the use of one of these substances would lead to reductions not only in the use of that substance but also in the use of the others. This is a relatively recent avenue of research by economists, and much more work clearly needs to be done before drawing definitive conclusions about the economic relations between various substances. Nevertheless, these findings do imply that the broader impact of policies directed at a particular substance must be considered before such policies are implemented.

REFERENCES


4. ECONOMICS AND ANTHEALTH BEHAVIOR


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