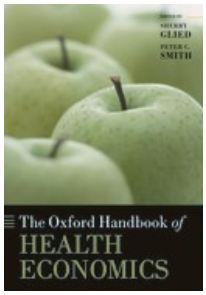

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CHAPTER

10 Economics of Health Behaviors and Addictions: Contemporary Issues and Policy Implications

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Abstract

This article attempts to provide an overview of the response of economic research on unhealthy substances to these challenges and opportunities. It devotes considerable attention to new econometric methodologies that have been used to assess the causal determinants of dangerous behavior. It introduces models, which economists use to understand consumers' use of unhealthy substances, and discusses the economic approach to substance use policy. It provides an overview of some of the interesting questions being asked in modern empirical research. Numerous reviews for policy relevant findings such as the price-elasticity of the demand for cigarettes and alcohol are discussed. This article complements such reviews and offers a critical perspective on the research challenges behind empirical estimates of even apparently simple economic concepts.

Keywords: economic research, methodologies, behavior, price-elasticity, empirical estimates

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10.1 Introduction

SOME of the most important health-related decisions take place outside the health care sector, including when we choose to consume substances that are bad for our health. Worldwide, there are an estimated 1.2 billion smokers, two billion users of alcohol, and 185 million users of drugs such as marijuana, cocaine, and heroin. While not all use of alcohol and other drugs is harmful, the WHO estimates that there were ninty-one million people negatively affected by their own alcohol use disorders and another fifteen million by drug use disorders in 2002 (〈http://www.who.int/mental_health/en/=〉).The WHO also attributes more than five million deaths each year to tobacco use, about two million deaths each year to alcohol use, and 200,000 deaths each year to drug use. These excess deaths, and-related morbidity, reflect the increased risks of chronic illnesses and accidents related to substance use. In its burden of disease calculations, the WHO estimates that tobacco use accounts for about 4 percent of the disability-adjusted life years (DALYs) lost worldwide, alcohol use accounts for another 4 percent of lost DALYs, and drug use accounts for about 1 percent of lost DALYs.

Smoking, alcohol, and drug abuse and dependence are not only unhealthy for the individual consumers, but have broader consequences for others as well. Deaths and DALYs lost due to substance use include the
p. 207 victims of second-hand tobacco smoke, ↳ victims of crime and drunk drivers. Substance use and the policies to combat it create societal costs beyond health consequences. For example, it is estimated that in 2002 the US spent about $25 billion to arrest and imprison drug offenders and another $6 billion in efforts to reduce the supply of illicit drugs (NIDA). In the US private payers and the public sector jointly fund substance abuse treatment. A national survey found that 59 percent of substance abuse treatment facilities received federal, state, or local government funds (Substance Abuse and Mental Health Services Administration 2007).

In different times and places policymakers have used wide ranging approaches to reduce the consumption and societal harms of unhealthy choices. The list includes approaches such as: information, taxation, regulation, prohibition, and litigation. Mass media and school-based campaigns to inform consumers of the health consequences of smoking, alcohol abuse, and drug use are a mainstay of modern public health policy that focuses on prevention. What were once called “sin taxes” on cigarettes and alcohol are now widely supported as public health measures. Cigarette and alcohol sales are also often subject to special regulatory efforts including advertising bans and limits on the number of licensed outlets and their hours of operation. Most countries totally prohibit the sale, possession, and consumption of certain substances. Because of their almost universal, blanket prohibitions, marijuana, cocaine, heroin, and other drugs are known as “illegal drugs,” as distinguished from legal substances like tobacco and alcohol and pharmaceutical products that treat medical conditions. Many countries also enact targeted prohibitions of generally legal substances in specific circumstances; common examples include restaurant smoking bans, driving while intoxicated, and restrictions on youth through drinking age minimums. The most notable example of litigation as a public health measure is the Master Settlement Agreement (MSA) between the tobacco industry and forty-eight US states. The MSA resulted in a tax-like hike in cigarette prices, new anti-smoking media campaigns, and new restrictions on cigarette advertising and other tobacco industry practices.

In addition to public policies, medical treatments are available to help substance users and abusers. Smokers are more likely to quit successfully if they use a pharmaceutical smoking cessation product such as a nicotine replacement therapy (Fiore et al. 2000). In the US alone, the cessation product industry's estimated retail sales are nearly $1 billion annually (Market-Research 2005). In 2006 there were 1.8 million annual admissions to US facilities that provide treatment for alcohol and drug abuse (Substance Abuse and Mental Health Services Administration 2008).

Understanding the unhealthy consumption of substances creates intertwined challenges and opportunities for the field of economics. Addiction to harmful substances appears to challenge the standard neoclassic assumption that consumers make rational, utility-maximizing choices. The simple answer—that people derive enough utility from the consumption of the substances that they willingly accept the health consequences—seems an unsatisfactory explanation for many people's struggles with addiction. As will be discussed in more detail below, economists' efforts to understand addictive behavior have led to the theory of rational addiction as well as behavioral economics models that incorporate hyperbolic discounting and cue-triggered addiction.

p. 208 The consumption of unhealthy substances has also been a fertile source for empirical research questions and controversies. Estimates of basic economic concepts like the price-elasticity of demand take on policy relevance. For example, a cigarette tax hike might be an attractive policy tool to reduce smoking if the price-elasticity of demand for cigarettes is -0.5, but not if the price-elasticity is -0.05. Another body of econometric research at the intersection of health and labor economics explores the labor market consequences of substance abuse, including lost human capital, lowered productivity, and lost jobs. The fundamental problem for these empirical studies is to identify causal effects, either of public policies on substance use outcomes, or of substance use on labor market outcomes. Economics offers a systematic conceptual framework and a set of sophisticated econometric tools to take on these difficult empirical challenges.

This chapter attempts to provide an overview of how economic research on unhealthy substances responds to these challenges and opportunities. In the following sections we introduce models which economists use to understand consumers' use of unhealthy substances, discuss the economic approach to substance use policy, and provide an overview of some of the interesting questions being asked in modern empirical research. The scope of our review is admittedly limited. In particular, we do not attempt to provide a comprehensive review or meta-analysis of empirical findings. Numerous reviews of that sort already exist, especially for policy relevant findings such as the price-elasticity of the demand for cigarettes and alcohol (Gallet and List 2003; Wagenaar, Salois, and Komro 2009). We hope this chapter will complement such reviews and offer a critical perspective on the research challenges behind empirical estimates of even apparently simple economic concepts.

10.2 Economic Models of Substance Use

Economists have developed a rich set of theoretical analyses to explore consumers' decisions to use unhealthy substances or bads. A useful starting place is to consider a simple model of health-related consumption (Grossman 1972). The consumer is assumed to make choices about substance use and other consumer goods to maximize her utility. Her choices are constrained by the amount of income and time she has available, and by a health production function that shows how her choices to smoke, drink, and so on are related to health consequences. The mathematical condition for the optimization problem is the commonsense rule that the consumer should use the substance until the expected marginal benefits just equal the expected marginal costs. Importantly, the marginal costs of substance use include the monetary price of the substance as well as the health costs. “Corner solutions,” where the consumer chooses to consume a zero quantity, are common for many substances. Indeed, many or most consumers would probably be deterred from the use of substances like tobacco or heroin just by the health costs, even if they were available free of charge.

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10.2.1 Rational Addiction

The simple economic model of consumer behavior just sketched above is a static or "timeless" model that does not explore how consumption decisions are related over time. This is an obvious limitation, particularly for the study of addictive substances. In the theory of rational addiction the consumer is assumed to make choices about substance use to maximize her lifetime utility (Becker and Murphy 1988). The consumer's preferences for consumption are related over time through the assumption that people who consumed the substance in the past and have an addictive capital stock enjoy a higher marginal utility of consuming the addictive substance today. The rational addiction model incorporates features of addiction such as tolerance and withdrawal that are used in clinical diagnostic criteria (e.g. the Diagnostic Statistical Manual of the American Psychiatric Association). However, in other ways this economics approach to addiction departs from the way many clinicians approach addiction. According to the theory of rational addiction, addictions can be healthy (e.g. exercise), unhealthy (e.g. cocaine) or unrelated to health (e.g. opera). The rational addiction model thus does not make or require strong distinctions between addictions and habits, or even between substance addictions and learning to appreciate opera. The key is that the rational addict is forward-looking and recognizes that her choices to consume today will affect her marginal utility of consuming in the future. This can be contrasted with a myopic addict who fails to look forward and ignores the future consequences of today's consumption decisions.

Becker and Murphy 1988 argue that their model of rational addiction can explain many features of addictive consumption, and generates new predictions. The model's dynamics involve two unstable steady states, one with low and one with a high level of consumption. This fits a general pattern for addictive substances, where many consumers are not addicted (at the low consumption steady state) but a minority consumes very high levels. Moreover, for a given person, a life-cycle shock such as losing a job can move the consumer from the low- to the high-consumption state. The model can explain other features of addiction such as "cold turkey" quitting. The model can be extended to allow consumers to learn about, and make mistakes regarding, their propensity to become addicted (Orphanides and Zervos 1995).

10.2.2 Time Inconsistency

Like other dynamic models in economics, the model of rational addiction assumes that when a consumer makes trade-offs between her current and future utility, she systematically discounts the future. This preference is captured by the discount rate, which indicates the consumer's marginal rate of substitution between today's utility and future utility. However, based on research in psychology and behavioral economics, Gruber and Koszegi 2001 propose modifying the rational addiction model to incorporate
p. 210 hyperbolic discounting. The mathematical formulation of hyperbolic ↳ discounting means that the consumer displays a taste for immediate gratification: at any given moment, the person has an extra bias for the present period over the future. This is termed a "present bias." This results in time inconsistency: the marginal rate of substitution between periods $t+1$ and $t+2$ is different from the perspective of time t(when both $t+1$ and $t+2$ are in the future) than it will be from the perspective of time $t+1$, when period $t+1$ is the present period. The taste for immediate gratification seems to fit many addictions, and empirical estimates from the rational addiction model that do not allow for hyperbolic discounting tend to yield implausibly high discount rates. The hyperbolic discounting model also predicts that the consumer might use a self-control or commitment device to overcome her time inconsistency. For example, Hersch 2005 provides empirical evidence that smokers who plan to quit are more likely to support laws that ban smoking in public places, perhaps because these laws serve as a commitment device that will help them carry through their plans to quit.

Smoking, over-eating, and excessive drinking can be explained in part by a strong bias for consumption in the present over in the future beyond the standard discounting. Smoking, over-consuming alcohol, and

over-eating are all activities that produce short-term satisfaction but longer term negative consequences. The impulsivity of present-bias leads to "time-inconsistent preferences." In the present moment persons choose to consume the substance which they later regret. This is sometimes construed as "being of two minds": the present-oriented mind wants to binge, while the futureoriented mind knows it will regret it and wishes it could exercise more self-control. There is some evidence that different parts of the brain are active in the short-term versus long-term planning activities.

10.2.3 Cue-triggered Addiction

Bernheim and Rangel (2004) develop yet another intertemporal model of addiction that focuses on cue-triggered addiction. In their model the consumer operates in either a cold or hot mode of decision-making. In the cold mode, properly functioning decision processes lead consumers to choose their most preferred alternatives. In the hot mode, the consumers' decision-making processes are dysfunctional so their decisions and preferences may diverge from that which result from decision-making in their cold period. Making decisions in the hot period can result in use of an addictive substance, e.g. even when a person would resist alcohol in the cold period, she would consume in the hot period. Similar to the idea of an addictive stock, in this model the probability of entering the hot mode is assumed to depend upon the consumer's history of substance use, as well as choice of lifestyle and random events. The addict knows that she makes bad decisions while in the hot mode, so she chooses lifestyles accordingly. For example, a recovering addict might avoid places or people associated with her former use. This feature of the model is somewhat similar to the idea of a commitment device in the hyperbolic discounting model.

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10.2.4 Empirical Tests of Models of Addiction

The preceding brief overview illustrates advances in theoretical economic models to better understand addictive behavior. It is also useful at this point to provide a very brief overview of empirical tests of the different economic models of substance use. A large body of empirical work estimates the extent to which consumer demand for various substances responds to prices and public policies. Although the empirical specifications used are not necessarily tightly linked to a specific theoretical model, the empirical results provide general support for the economic approach to substance use. For example, as Grossman 2005 argues: "in my view, Becker and Murphy's main contribution is to suggest that it is a mistake to assume that addictive goods are not sensitive to price. Even if one does not accept all the aspects of their model, one can examine this proposition in the context of the standard theory of consumer behavior." Some empirical work provides more formal empirical tests, particularly of testable predictions that distinguish rational from myopic addiction. These tests provide evidence for rational (forward thinking) addiction to cigarettes, alcohol, cocaine, and coffee. However, the same empirical approach also yields evidence of rational addiction to milk, eggs, and oranges, which suggests the empirical tests as implemented to date may be problematic (Auld and Grootendorst 2004). Future empirical tests might usefully focus on other implications of the rational addiction model, including predictions that price hikes will have different impacts on demand depending upon whether they are temporary or permanent, and whether they are anticipated or unanticipated. To date, empirical tests have also not been able to test the rational addiction model against a model with hyberbolic discounting. For example, both the rational addiction and the hyperbolic model suggest that future prices matter for today's consumption and there is little empirically to select one model over the other (Gruber and Koszegi 2001). However, there may be additional tests to distinguish the models; for example, the hyperbolic discounting model predicts that consumers will invest in self-commitment devices. Similarly, evidence of behavior aimed at avoiding cues would be consistent with a cue-based model but not rational addiction.

10.3 Economic Approach to Substance Use Policy

Economics offers two types of insights into public policy towards substance use. First, welfare economics yields normative propositions about when public policies that reduce substance use will improve social welfare. Second, empirical economics provides evidence about which policies will be effective in reducing substance use and improving substance use-related outcomes. This section focuses on the welfare
p. 212 economics of substance use policy; the next section discusses empirical studies. Neoclassical welfare ↳ economics underlies many policy recommendations. Behavioral economics is being used more recently to forge resolutions to problems of addiction.

10.3.1 Neoclassical-based Policies

According to neoclassical welfare economics, when markets work fairly well goods and resources are allocated effciently. Thus, the government should not intervene unless there are critical market failures. Provision of information, corrective taxes, and regulations are three broad classes of public policy approaches that address market failures relating to addictive goods. In the framework of neoclassical welfare economics, prohibition could be justified only when the market failures are so extreme that it is optimal to allocate no resources to producing the substance in question.

10.3.1.1 Provision of Information

In the case of addictions, one market failure could be lack of information on the long-term health costs of present consumption. Provision of information is a (neo-)classic role for government for several reasons. Accurate, accessible, and ample information can help individuals to make utility-maximizing decisions. Further, economies of scale in the development and distribution of the information make it such that a single supplier of information would be most effcient. In addition, because information is a public good, the private sector would tend to under-supply health information. Also, the possibility that private sellers might provide misleading information extends the role of the government to addressing misinformation. According to the neoclassical view, once individuals are provided with the information (and assuming no other critical market failures), they (not the government) are most capable of deciding the utility-maximizing consumption levels.

A prime example of the provision of information on the health harms of addictive substances occurred with the landmark 1964 US Surgeon General Report on smoking and health and similar reports in other countries, which publicized some of the health hazards of smoking. Mandated warning labels on tobacco and alcohol products are more recent examples of the role of the government in providing information.

10.3.1.2 Corrective Taxation

If a substance user imposes external costs on others, then there is a role for government to align the costs incurred by the user so that she considers the full cost to society of consumption when she decides, say, to smoke or drive drunk. Through corrective (Pigovian) excise taxes, the external costs are, in effect, internalized. The price the individual faces when buying the substance includes not only the market price, but also the tax which reflects the marginal harm imposed on society. Thus taxes on cigarettes and alcohol can help to correct the health harms of passive smoking and the risk of drunk driving that are imposed on others.

p. 213 The standard neoclassical economic criteria for determining the optimal tax on a substance is that the tax should be levied to reflect the marginal negative externalities. However, it can be difficult not only to

empirically estimate the size of the negative externality, but also to determine the full and appropriate range of factors to include as external costs. Attempts to quantify the external costs of smoking illustrate these challenges. An early landmark study suggested that the then prevailing tax on cigarettes was higher than the marginal negative impact imposed on society (Manning et al. 1989). This study recognized that while smokers have higher health care costs that are shared due to group health insurance coverage, they die earlier than non-smokers and are thus less likely to draw their actuarially full share from financially pooled pension plans. This "benefit" to others from the shared financial programs helped to o set the other negative externalities of smoking.

The Manning et al. study was a relatively early study and did not include a number of negative externalities that have since received more attention. These include impacts of: (1) smoking mothers on the fetus and infants; (2) passive smoke on others at home, at work, and in pubic places; (3) teen smoking on their peers; (4) family smokers on others' propensity to smoke (Falba and Sindelar 2008); and (5) the impact of other regulations such as smoking bans.

In a more recent study, Sloan et al. (2004) provide estimates of the marginal per pack social cost imposed by smokers. They estimate that the external costs typically measures are valued at $2.20 per pack. However, to the extent that current life insurance plans charge a premium for smokers, the externalities are dramatically reduced. Sloan et al. (2004) also values the impact on family members other than the smoker and terms these "quasi-external" costs. They estimate that these quasi-externalities borne by family members (e.g. second-hand smoke and harm to the fetus of pregnant women smoking) are relatively large. When these are also considered, Sloan et al. find that current tobacco taxes are not high enough to reflect the full set of external effects.

In addition to the challenges of correctly estimating the external costs of substance use, there are additional challenges to implement optimal corrective taxes. Because taxation is often a blunt instrument, it can be difficult to levy a tax that exactly matches the marginal social cost to each drink or cigarette. Deadweight loss can occur with alcohol taxation because only some drinkers impose negative externalities on others (Pogue and Sgontz 1989; Kenkel 1996). Drunk drivers pose a risk to others on the road while an individual having a glass of wine at home at dinner may not. In contrast, most smokers impose harm on others through second-hand smoke, risk of fire, and collectively financed medical care.

Regressivity and revenue also come into play in discussions of the optimal taxes on substances (e.g. Remler 2004; Colman and Remler 2008). The revenues from tobacco and alcohol excise taxes are appealing to the government. They provide a steady stream of funds. However, theses taxes are regressive as low education individuals spend a disproportionate percentage of their income on tobacco (Busch et al. 2004a). In addition, smokers in the US are likely to have lower levels of education and are more likely than average to
p. 214 have a mental health problem, thus the tax is likely to fall most heavily on ↳ these disadvantaged groups. On the other hand, to the extent that these populations are suffering the most harm to their health, if the tax encourages them to stop smoking, their health will benefit the most as well (Warner 2000). Colman and Remler 2008 find that while low-income smokers are somewhat more price-elastic, they are also so much more likely to smoke that the tax is nonetheless regressive.

In determination of the optimal tax, distributional issues sometimes have to be balanced against efficiency gains. For example, revenue raised through the tobacco taxes could, in theory, be used to compensate poor smokers. However, while policymakers, public health advocates, and others suggest that the revenues from sin taxes should be earmarked for addressing the "sins," economists believe that sources and uses of revenue should be separate issues. Economists argue that funds should be used to maximize the marginal societal gain, regardless of their source.

Negative externalities can alternatively be mitigated by subsidizing a good or service that reduces the externality. For example, federal and state governments subsidize drug and alcohol treatment and tobacco quit lines. Treatment for illicit drugs helps the drug user as well as victims of drug-related crime. Treatment for alcoholism can reduce drunken driving crashes that hurt others. Smoking cessation services and medications can reduce passive smoke, cigarette-related fires and the peer effect of smoking.

10.3.1.3 Regulation

Regulations are an alternative policy approach to address market failures. Youths are often restricted from use of addictive substances on several grounds including that they underestimate the negative impact of use. Many countries ban cigarette advertisements in most or all media (Saffer and Chaloupka 2000); alcohol advertising bans are also fairly common (Saffer 1991). Regulations that restrict the number of retailers licensed to sell alcohol and their hours of operation may help reduce the negative externalities of alcohol abuse. Regulations can target the sources of external costs such as drunken driving laws reduce externalities (Kenkel 1993). Similarly, as noted above, regulating or banning smoking in public places targets an important source of external costs from smoking. Calculations of the optimal tax on alcohol or cigarettes should take into account other public policies, for example Kenkel 1996 finds that with tough drunk driving laws, the optimal tax on alcohol is lower. Regulations can also require, rather than prohibit, certain behavior. For example, drug offenders and drunk drivers sometimes must seek treatment.

10.3.1.4 Prohibition

Prohibiting use is a more stringent form of regulation which has been used over time, for youths and specific drugs. The federal government has made the sale and use of some drugs illegal for all ages and in all circumstances. For instance, in the United States the sale and use of cocaine and heroin is illegal and punishable by prison and sentencing. Morphine and oxycotin, by contrast, are sold legally when prescribed by a physician; in other cases, sale and use are illegal. Methadone can be provided by licensed clinics, but
p. 215 black market and street market sales are illegal. The welfare impact of the criminalization ↳ of drugs is a hotly debated policy issue with many suggesting that the negative externalities associated with this prohibition outweigh the gains.

10.3.2 Behavioral Economics and Public Policy

The relatively new field of behavioral economics, which combines psychology and economics, provides insights into addictive behavior and helps provide the basis for policies to combat addiction and adverse health habits. The new view advocated in the field of behavioral economics is that government can use knowledge of the addicted individuals' predictable misperceptions, errors in judgment and lack of will-power to design effective interventions that improve welfare.

Instead of assuming that individuals are strictly rational, psychologists and behavioral economists have documented that individuals sometimes behave in seemingly irrational, but still often predictable, ways. Pouring out a bottle of alcohol to prevent drinking but then going out to buy another would be one example. Further, a person's willingness and ability to make the full set of calculations necessary to maximize lifetime utility are bounded. This concept is termed “bounded rationality” (Kahneman and Tversky 2000). Daniel Kahneman, psychologist, shared the Nobel Prize in Economics in 2002 with Vernon Smith, an economist, for work in this area. Bounded rationality implies that people cannot always make decisions in their own best interest, even using their *own* criteria as to what would be best for them.

Further, lack of will-power to follow through on decisions is also thought to affect behavior, especially with regard to addictive substances. Lack of will-power leads individuals to seek ways to “pre-commit” to

certain behavior, such as abstaining from smoking or drinking. This may explain why smokers support restrictions on smoking in worksites and public places (Hersch 2005); the restrictions may deter their consumption even though they suffer from low will-power. Gamblers, for example, will put themselves on black ball list at casinos because they know that they cannot control their own gambling obsession.

Behavioral economists include other elements of psychology as well as economics in analyzing issues and formulating solutions. For example framing of decisions and the salience of impacts of decisions have been found to affect decision-making. Consequently, these factors have been used in forging policy solutions. For example, it is thought that it is not only the content of information that affects decisions, but also how the information is framed and presented. Some countries, e.g. Canada and Singapore, require graphic warning labels to be put on cigarette packs rather than simply providing factual information.

The behavioral economics perspective provides an expanded view of the role of government in affecting individual decision-making, especially with respect to addictions and health habits. The government can identify and address situations in which the individual systematically makes "irrational" or biased decisions and could benefit from improved self-control. This expanded role of government contrasts to the
p. 216 neoclassical ↳ perspective which contends that government should not interfere in individual decisions because individuals know best their preferences, and even if individuals make mistakes, the government would not do better on average. From the neoclassical perspective, expanding beyond the realm of correcting market failures would be paternalistic and counterproductive. However, according to behavioral economics, helping people make and implement decisions is not always paternalistic, can be unavoidable, and should be done by addressing systematic biases (see for instance Camerer et al. 2003.) Asymmetric policies that help those who most need and want help while not distorting choices of others may be best at maximizing overall welfare (O'Donoghue and Rabin 2003).

The behavioral economic view is that systematic biases can be harnessed to develop effective policies and interventions. For example, if the present-bias always results in failed attempts to quit, then the solution may be to make the decision to abstain more attractive to counterweight the present bias. One example discussed below is to pay people to abstain from substance use. Another example might be drug courts that allow an arrested drug user to avoid jail by getting treatment and abstaining from drug use. Lack of will-power may also systematically occur in predictable situations, for example, when addicted individuals see cues that arouse their desires to smoke, drink, or use drugs. Smoking bans may help indirectly people stop smoking by preventing smokers from seeing others smoke in public places thus enabling them to more easily avoid cues that arouse their own desire to smoke.

10.3.3 Welfare Effects of Public Policies

The alternative models of addiction have different welfare predictions and policy prescriptions. For example, taxing cigarettes could be welfare enhancing if it is correcting for externalities and/or if it is serving as a pre-commitment device. However, the optimal level of taxation might be different under each model of behavior. The standard neoclassical model suggests that the optimal tax on addictive negative habits should depend only on externalities. In contrast, the time-inconsistent (e.g. present biased or hyperbolic discounting) model would suggests that "internalities" that users impose on themselves could be considered as well in calculating the optimal tax level as well (Gruber 2002). For example, Gruber and Koszegi 2000 found that under the time-inconsistent model, internalities are about $30 per pack of cigarettes, which is 100 times the size of the estimated externalities from smoking. However, using cues-based model of addiction, one would conclude that taxes in excess of externalities would distort "cold state" choices without reducing problematic "hot state" usage by much.

Whether provision of information would be a welfare-enhancing policy and how to provide the information would also depend on the assumed model. If individuals lack will-power, not information, then additional information will not likely improve welfare. Similarly, if it is not strictly availability of information but rather ability to accurately perceive information, provision of information per se will not enhance welfare.
p. 217 Individuals may perceive information in a biased way (Viscusi 1992; Sloan et al. 2004). ↳ While people sometimes overestimate the risks of smoking for the average smoker, smokers inaccurately report that their personal risks are lower than the average smoker, and only slightly above the risks of non-smokers. Youths inaccurately report that they will be able to stop smoking when they want. Alternatively, even a highly knowledgeable addict may make poor choices in hot mode.

Time-inconsistency, cue-based model, and lack of will-power all suggest that some regulations that restrict access could enhance welfare. For instance, increasing the difficulty of obtaining an addictive substance on short notice while in "hot state" could enhance welfare. Example of restrictions on access include: hours and age restrictions on access to alcohol and tobacco; smoking bans; and making the use and sale of certain drugs illegal. All of these policies may be particularly important for reducing substance use during hot periods. In contrast, if the demand for addictive substances is rational, then such restrictions would reduce the welfare of users, even though they would address some negative externalities.

Whether a policy is welfare enhancing depends in part on the underlying model of addictive behavior and health habits. However, as indicated above, empirical analysis has been unable to identify which model is the most appropriate and compelling.

10.4 Empirical Research into the Economics of Substance Use

In addition to developments in theoretical approaches and the welfare economics of substance use, there is a large and growing body of empirical research into the economics of substance use. Our intent here is to highlight important issues in several strands of empirical research, including: the impact of cigarette taxes and other tobacco control policies on smoking; the relationships between alcohol consumption and adverse health and social outcomes; and behavioral economic research on substance abuse interventions. The discussion is intended to showcase interesting research and issues, but is far from comprehensive. Space constraints preclude discussion of many additional empirical studies that explore a variety of fascinating questions about the economics of substance use.

10.4.1 Cigarette Taxes and Smoking Bans

Federal, state, and some city governments have implemented policies to reduce smoking and to mitigate the impact of smoking on non-smokers. The arsenal of policies to reduce tobacco use is broad and drawn largely (but not exclusively) from the areas discussed above: provision of information, regulation and taxation. Most of the empirical research relates to taxation, so we focus primarily on the impact of taxation.
p. 218 There is a smaller ↳ literature on smoking bans which we discuss briefly. Taxation and bans on smoking are considered to be two of the more powerful public policies to address tobacco use.

10.4.1.1 Taxation

Typically, empirical economic research does not address the normative questions from welfare economics about the proper role of government in tobacco control. Instead, the research attempts to answer apparently simpler and more practical questions such the extent to which tobacco taxes reduce the number of smokers and the quantity of cigarettes smoked. The answers to these depend on the price-elasticity of demand. The more price-elastic the demand, the more likely smokers are to quit smoking and cut back in quantity, and the less likely non-smokers are to initiate smoking or relapse after quitting. A consensus about the price-elasticity would aid policymaking, however, research in this area is evolving.

With that caveat in mind, the large body of empirical studies on cigarette demand are often seen as reaching a consensus that the overall price-elasticity of demand is in the relatively narrow range of -0.3 to -0.5 (Manning et al. 1989; Viscusi 1992; Chaloupka and Warner 2000; Gallet and List 2003). According to this consensus, cigarette demand is inelastic, but not perfectly so. As a result, tax increases would be expected to modestly reduce smoking and yield increased revenues. This combination is attractive to public health policymakers. Research on the price-elasticity of cigarette demand in population sub-groups is thinner. Some reviews claim that there is also a consensus that youth smoking is substantially more price-elastic than adult smoking (e.g. Chaloupka and Warner 2000). However, a number of recent studies that use longitudinal data find evidence that higher prices increase cessation but have little or no impact on smoking initiation in the US (Douglas and Hariharan 1994; Douglas 1998; DeCicca, Kenkel, and Mathios 2002, 2008), Britain (Forster and Jones 2001), and Spain (Nicolas 2002). These findings suggest that taxes may not be as effective as previously thought in preventing initiation and, in general, protecting youths. Studies have also analyzed price-elasticity differences by education, income, gender, and race/ethnicity (e.g. Farrelly et al. 1998; Stehr 2007; Colman and Remler 2008). The results of these studies are more often conflicting about which population sub-groups have more or less price-elastic cigarette demand.

There have been several important developments in empirical economic research on the price-elasticity of smoking. First, there has been steady progress in the available data. Instead of national or state-level aggregate sales data, increasingly researchers use individual-level data from either cross-sectional or longitudinal surveys. Second, appropriate econometric modeling has progressed as richer data have become available. The analysis of aggregate data only provides estimates of how total cigarette sales vary with the average price of cigarettes. With cross-sectional data, the standard econometric approach often uses a two-part model. The two-part model provides separate estimates of the price-elasticity of smoking participation, and the price-elasticity of daily cigarette consumption, conditional on participation. With longitudinal data, it is possible to decompose smoking participation into two separate processes—the decision to start ↳ smoking and the decision to quit—in which each are possibly governed by different factors (DeCicca, Kenkel, and Mathios 2008). For youths, both decisions are critical; for adults, the decision process differs. As almost no adults initiate smoking for the first time, their participation relates more closely to the decision to quit and the ability to remain smoke-free without relapse (Ayyagari and Sindelar 2008).

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In 2000, an estimated 70 percent of smokers said they wanted to quit, and 41 percent had tried to quit during the preceding year; however, only some quit successfully and a large number of these relapse. Becker and Murphy 1988: 693) point out that rationality does not rule out the possibility that smokers may have to experiment and fail before they learn a successful method to quit. Alternatively, this behavior might be better understood in terms of behavioral economics with its emphasis on self-control problems, relapse in response to cues, and the consequent demand for pre-commitment devices. With regard to cues of a different sort, Avery et al. 2007 found that advertising of smoking cessation products encouraged smokers to quit both directly because they bought and used these products and indirectly, possibly as reminders or cues to stop smoking.

As in other areas of empirical microeconomics, recent empirical research also increasingly focuses on estimating the causal effect of cigarette prices on smoking. Much of the variation in cigarette prices stems from variation in cigarette tax rates across jurisdictions or over time. Cigarette tax rates are not randomly set, but arise from political processes: for example, across US states and European countries, cigarette taxes tend to be low in tobacco-producing regions. Thus, cigarette tax levels may be aligned with hard-to-observe factors such as anti-smoking sentiment, confounding the relationship between taxation and smoking rates. Some recent studies address this concern by relying on repeated cross-sections (Farrelly et al. 2001; Gruber and Zinman 2001). Such studies can then include state fixed effect variables to control for hard-to-observe influences such as state anti-smoking sentiment. This general approach faces a dilemma. On the one hand, there may be insufficient within-state variation in taxes or prices to allow precise estimates. On the other hand, the within-state variation that does exist may itself be associated with changes in unobserved influences. As another approach, DeCicca et al. (2008) develop a direct measure of state anti-smoking sentiment, and include it as a control variable in their models of youth smoking.

10.4.1.2 Smoking Bans

In addition to cigarette taxes, empirical economic research investigates the impact of many other tobacco control policies on smoking. Cities, states, and countries around the world have passed clean indoor air laws in increasing numbers (USDHHS 2000). The Adda and Cornaglia (2006) study stands out among health economic studies for its use of a direct measure of passive smoke. Their study examined cotinine (a metabolite of nicotine) and showed that on average, smoking bans have no impact on the exposure of non-smokers. However, by evaluating smoking bans by setting they found that laws that ban smoking in shopping malls, schools, and public transportation reduce exposure, while bans in recreational public places
p. 220 increase exposure. Their interpretation is that ↳ recreational bans drive smokers to smoke in private places, thus increasing family members', especially children's, exposure to environmental tobacco smoke. Other indirect effects / unintended consequences of bans have been shown to include: (1) more intensive (compensatory) smoking by smokers (Adda and Cornaglia 2007); (2) a reduction in the demand for alcohol, a potential complement to smoking (Picone et al. 2004; Gallet and Eastman 2007); and (3) an increase in alcohol-related traffic fatalities following bans on smoking in bars, perhaps due to increased miles driven by drivers wishing to smoke and drink (Adams and Cotti 2008).

The precursor to public bans was private bans in the workplace. In one of the first national evaluations of workplace smoking bans, Evans et al. 1999 found that workplace bans reduced smoking prevalence as well as the number of cigarettes smoked by those who continued to smoke. While they found that workplace bans were more likely to be adopted in firms where workers had better health habits, their results were largely robust to this potential endogeneity of the bans. A similar selection bias may apply to public bans as well as tobacco taxes, as indicated above.

10.4.2 Alcohol Consumption and Adverse Health and Social Outcomes

Alcohol consumption presents more complex analytical problems as compared to smoking because most drinking is without negative consequences, while some has adverse externalities and internalities. In the US and many other countries, most adults drink alcoholic beverages, and most drinking is not harmful. In fact, it is increasingly well-established that moderate consumption of alcohol reduces cardiovascular health risks (NIAAA 2003). At the same time, alcohol abuse and dependence pose major health risks (NIAAA 2000). In the US, alcohol is involved in about 40 percent of traffic fatalities. Long-term alcohol abuse exerts harmful effects on many of the human body's organ systems, including the liver and the immune, cardiovascular, and skeletal systems.

An active line of empirical economic research focuses on the relationships between alcohol consumption and health-related outcomes such as traffic fatalities and unsafe sexual activity, as well as social outcomes including unemployment, reduced earnings, lowered schooling attainment, and criminal activity. Empirical research has addressed two types of questions about the relationships between alcohol and adverse outcomes. First, some studies focus on the policy question of whether alcohol control policies such as excise taxes reduce adverse outcomes. Second, other studies focus on the related social science question of whether excessive alcohol consumption plays a causal role as a determinant of adverse outcomes.

Making sense of the complex empirical relationships between alcohol control policies, alcohol consumption, and various outcomes requires careful and sophisticated econometric analysis, guided by an appropriate conceptual framework. Economic models of household production provide an appropriate conceptual framework for the analysis of many alcohol-related outcomes. For example, econometric
p. 221 studies of drunk driving ↳ conceptualize alcohol consumption as an input with a negative marginal product in the household production of traffic safety. Similarly, the commonsense idea that alcohol has a negative marginal product in the production of human capital motivates studies of the impact on drinking on schooling. Bray 2005 specifies a model of alcohol's impact on wages through its effect on the formation and accumulation of human capital.

The conceptual framework implies a simple structural econometric model consisting of two equations: a demand function that shows drinking as a function of alcohol taxes and other policies; and a production function that shows an outcome (such as traffic safety or human capital formation) as a function of drinking. Studies that focus on policy questions often substitute the demand function into the production function, to yield a reduced-form equation that shows an outcome like traffic safety as a function of alcohol taxes and other policies. This approach is useful for policy analysis, because it provides a direct estimate of the impact of a policy-manipulable variable like taxes on outcomes of interest. Studies that focus on social science questions also use the structural approach to estimate a structural equation that shows a causal effect of alcohol consumption on the outcome in question.

Policy-focused studies in health economics have contributed useful estimates of links between various alcohol control policies and various outcomes. Saffer and Grossman 1987 spell out the reduced-form approach in their study of the impact of beer taxes and the legal drinking age on youth traffic fatalities. Their estimates imply that a combination of a uniform drinking age of 21 and a beer tax increase could have reduced youth traffic fatalities by 54 percent. Examining the same policies but another outcome, in their reduced-form work Cook and Moore 1993 estimate that higher drinking ages and higher beer taxes increase the probability that adolescents eventually graduate college. Carpenter 2005 estimates the reduced-form relationship between underage drunk driving laws (known as zero tolerance laws) and the rate of sexually transmitted diseases. He finds that these laws reduce the gonorrhea rate among white male teenagers by about 14 percent. The plausibility of this reduced-form relationship is supported by previous research suggesting alcohol abuse is a risk factor for unsafe sexual activity, and by Carpenter's (2004) previous finding that zero tolerance laws reduce heavy episodic drinking by young males by 13 percent.

Most recent empirical studies that take a more structural approach use the method of instrumental variables (IV) to estimate the causal treatment effects of drinking on outcomes. The IV method is necessary because observed statistical associations between excessive alcohol consumption and adverse outcomes do not necessarily reflect causation. One problem is that important unobservable factors might jointly determine drinking and outcomes, so the associations are spurious, not causal. For example, Kenkel and Ribar (1994) suggest that deficient childhood backgrounds or personality disorders might be important unobservable factors driving the negative relationship between alcoholism and earnings. The IV method exploits the exogenous variation in the IVs as natural or quasi-natural experiments that create variation in drinking that is uncontaminated by unobserved individual factors that jointly drinking and outcomes. Since 1990 or so the economics profession has made important advances in understanding the properties of the IV

p. 222 method in practical applications. Much of the attention has ↳ focused on the problem of establishing the validity of the instrument and on the weak IV problem (Murray 2006). Another line of econometric research extends the IV approach to applications with heterogeneous treatment effects (Auld 2006). Yet another active line of econometric research focuses on the application of the IV method to inherently non-linear models (Angrist 2001; Bhattacharya, Goldman, and McCaffery 2006; Terza, Bradford, and Dismuke 2008). These applied econometric problems—the suitability and strength of the IVs, heterogeneous treatment effects, and non-linearities—are often relevant for IV studies of alcohol-related problems. Recent econometric advances open up some important lines of inquiry for future studies of alcohol-related problems.

Although some econometric issues remain, the IV method is especially well-established in US studies of the impact of problem drinking on labor market outcomes such as earnings and unemployment (Kenkel and Ribar 1994; Mullahy and Sindelar 1996; Terza 2002). More recently, this line of research has been extended to study the labor market consequences of problem drinking in other countries, including the UK (MacDonald and Shields 2001, 2004), the Netherlands (van Ours 2004), and Finland (Johansson et al. 2007). The method has also been applied to study other outcomes including the consequences of underage drinking, such as delayed high-school graduation (Renna 2007) and delinquency and criminal activity (French and Maclean 2006). Taken together, this body of econometric research supports a general consensus that problem drinking has serious labor market consequences.

Empirical research also sheds light on the complexity of the relationships between alcohol consumption and labor market consequences. The complexity is partly but not entirely due to the distinction between moderate and abusive alcohol consumption. For example, the negative relationships between alcoholism and earnings appear to vary by gender and across the life-cycle (Mullahy and Sindelar 1991, 1993). More surprisingly, a series of studies provide evidence that drinkers earn more than their non-drinking peers (Berger and Leigh 1988; French and Zarkin 1995; Zarkin et al. 1998; MacDonald and Shields 2001; and van Ours 2004). These findings suggest that while abusive alcohol consumption might be penalized in the labor market, moderate drinkers might earn more than non-drinkers because they are healthier.

Although empirical economic studies of alcohol-related problems explicitly or implicitly refer to models of individual behavior, it should be kept in mind that the observed data are equilibrium outcomes. For example, alcohol's impact on wages reflects not only alcohol's impact on the individual's productivity, but also the extent to which the labor market penalizes low productivity. This leads to the testable prediction that problem drinkers will tend to face larger wage losses in flexible labor markets than in labor markets with long-term union contracts or other rigidities. The importance of equilibrium behavior is not confined to labor markets. Traffic safety provides a non-market example. Because they expect many impaired drives to be on the road after New Year's Eve parties, many non-drinkers refrain from driving or drive especially cautiously on New Year's Eve. These endogenous responses will tend to mask the true structural relationship between an individual's drinking and driving ability. Similarly, the observed relationship
p. 223 between alcohol consumption and crime reflects the endogenous behavior ↳ of both criminal o enders and their potential victims. Alcohol-abusing potential victims may take fewer precautions, making them more vulnerable. In this situation there are two channels for alcohol control policies to reduce crime through reducing excessive alcohol consumption: by reducing criminal behavior; and by increasing precautionary behavior among potential crime victims.

10.4.3 Alcohol Taxes

Assessing the optimal tax for alcohol is complicated by the fact that most drinking is not harmful and thus a tax on alcohol will engender both deadweight losses and as well as gains from the reduction in externalities. A first step in assessing the welfare impact is to estimate the overall impact of taxes on alcohol demand and then to estimate the heterogeneity by groups. There is considerable range in estimates of the price-elasticity of demand for alcohol with variation likely attributable to data type (aggregated or individual) and source (national, cross-sectional), age groups (often youths), measure of consumption, price (beer, wine or spirits, separately or an average), use of tax rate versus price, econometric methods and other factors. Wagenaar et al. (2009) conduct a formal meta-analysis and review of 1003 estimates of the price and tax elasticities of demand for alcohol from 112 studies. See also Leung and Phelps (1993) for an earlier review. Grossman et al. (1998) review the evidence for youths specifically. Wagenaar et al. conclude that alcohol prices and tax rates significantly reduce consumption of alcohol. Using the simple mean effect across all of the studies, they find price-elasticities for beer, wine, and spirits to be respectively: -.46, -.69, and -.80. Using more-sophisticated meta-analysis techniques, including weighting the study outcomes by the precision of the estimates, they find smaller estimates of the elasticities. Specifically they find the elasticities for beer, wine, and spirits to be respectively: -.17, -.30 and -.29. They estimate the overall price-elasticity for alcohol to be -.44 based on studies using aggregate level data and -.03 for studies using individual level data. For heavy drinkers, the elasticity is estimated to be -.28.

While these meta-estimates are extremely useful benchmarks, there is potential heterogeneity by age, race, and tax versus price of alcohol that are masked. For example using data from the 1993 NHIS and self-reported number of days with five or more drinks, Kenkel 1996 finds the elasticity of -.5 for men and more than double this for women (-1.3). For youths, while most studies find that the initiation of use of alcohol, the amount consumed conditional on drinking and the overall drinking rate are sensitive to price, statistically significant effects are not always found (Chaloupka and Wechsler 1996). Manning et al. (1995) find that the price-elasticity of demand for alcohol varies by consumption levels. They use a two-part model and find that the price-elasticity for the number of drinks, conditional on being a drinker is insignificantly different from zero while price significantly affects the decision to drink (elasticity of -.55). Using quantile regression they find that the most price responsive drinkers are the moderate drinkers. The median drinker
p. 224 has a price-elasticity of -1.19. The lowest quantile ↳ drinker has a price-elasticity of -0.55 while the heaviest two quantiles have elasticities of -0.49 and 0.12 respectively; all but the latter are significant. Manning et al. conclude that there is heterogeneity in the price-elasticities and that failure to differentiate these groups could conceal important policy-relevant information.

Using both the Panel Study of Income Dynamics (PSID) and the Health and Retirement Study (HRS), Dave and Saffer 2007 find the drinking participation elasticity to be between -.05 and -.04 for younger individuals in the PSID, and -.22 to -.11 for HRS participants over age 55. Conditional on being a drinker, the tax elasticity of conditional demand (measured as the average number of drinks per day) is estimated to be between -.08 to -.27 depending on the specification. Chronic drinkers have a tax elasticity on this intensive margin of -.27 indicating that even heavy drinkers are at least as, if not more, price sensitive than other drinkers. This contrasts to the findings of Manning et al. above in which the moderate drinkers were found to be the most price sensitive. Also using the HRS, Ayyagari et al. 2009, find heterogeneity in the price-elasticity across latent groups-based using finite mixture models. One latent group is significantly responsive to price but the other is unresponsive. Differences between these two groups can be explained in part by the behavioral factors of risk aversion, financial planning horizon, forward looking, and locus of control.

10.4.4 Behavioral Economic Research and Substance Abuse Interventions

10.4.4.1 Present-bias and Small Incentives Change Behavior

Present-bias can explain why smokers who want to quit do not and why individuals who want to restrain their alcohol intake, say at a party, fail to do so. Behavioral economics suggests that by changing the incentives to give extra incentives to resist harmful behavior, the present-bias may be at least partially overcome.

A large number of studies have shown that an incentive system designed to give small payments conditional on abstaining from smoking or using illicit drugs can help users abstain. Immediate payments conditional on the "pro-social" behavior of abstaining is used to align the consequences of long-term behaviors with the consequences for current behaviors. One line of research analyzes the effectiveness of reducing drug use by paying drug users to abstain from using drugs (for a review, see Lussier et al. 2006). This strategy, in which small but escalating payments are given conditional on objective measures of abstaining, is known as contingency management (Petry et al. 2005; Sindelar, Elbel, et al. 2007; and Sindelar, Olmstead, et al. 2007). It is surprising that such small payments can make a big difference given that the real gains to quitting are much higher. Drug users are at higher risk of death from overdose, contracting HIV/AIDS and sexually transmitted disease, losing their job, experiencing family disruptions, and being arrested. That such small payments are effective at improving cessation when such huge potential health and social benefits are not
p. 225 can be explained better by behavioral ↳ economics than by neoclassical economics. The small payment bolsters will-power and tips the scales in favor of short-term abstaining to gain the long-run goal of permanent abstinence. Other studies indicate the effectiveness of similar incentive payments in smoking cessation (Volpp et al. 2006; Finkelstein et al. 2007).

10.4.4.2 Lack of Will-power and Pre-commitment Mechanisms

Even if individuals make utility-maximizing decisions carefully, they may not have the will-power to follow through on their own decisions. Self-control is needed to enact utility-maximizing decisions; however, self-control is in short supply. Although economists model self-control through use of discount rates, psychologists conceive self-control problems as a lack of will-power (Baumeister and Vohs 2003). Smokers who are trying to quit often start smoking again when they see cues, even cues as small as an ash tray, which arouse their desire to smoke. Cues trigger emotional states and make resisting temptation more difficult. In cold periods, individuals may decide they will no longer indulge. But when triggered by situational cues, e.g. in a hot state, the person drinks more than she had planned. This lack of self-control dooms attempts to quit smoking, using drugs, and abusing alcohol.

Pre-commitment devices are demanded in so-called "cold" periods so that the person does not succumb to the addiction in the later "hot" periods of arousal. Individuals who give in to cues in hot periods repeatedly may realize the same problem is going to happen again and again. In a "cold" period, they may choose to enroll in a treatment program or may take advantage of "pre-commitment devices." In the behavioral economics literature, the smokers, drinkers, and drug users who realize that they are going to succumb to the addictive substance are called "sophisticates" because they realize their tendencies and take preventive steps. In contrast, so-called "naives" are oblivious of this failing of theirs and cannot plan ahead to address the inevitable use of drugs.

Moving to a dry county in which alcohol is not sold may serve as a pre-commitment device that reduces the opportunity to drink on short notice. Similarly, finding a job in smoke-free environment would aid smoking cessation. A surprising number of smokers have been found to favor higher taxes on cigarettes—across a number of state polls on average 38 percent of smokers favored higher cigarette taxes (Campaign for

Tobacco Free Kids 2008)—and bans on smoking in public places (Hersch 2005). The smoking ban not only makes it more difficult for the smoker to light up, it also reduces environmental cues as others cannot smoke either. This smokers' support for constraints on smoking is harder to explain in a neoclassic framework because the option to smoke has value and self-control is not considered to be an issue. The support for such restraints is perhaps better understood as a pre-commitment device for smokers would who like to quit but find it difficult. This could be consistent with the "dual self" model, hyperbolic discounting and cues hot and cold model. Smokers, drinkers, and drug users who want to quit or cut back, and also know that they may lose the self-control to do so in response to certain cues and situations, may seek to avoid situations and/or take advantage of pre-commitment devices.

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10.5 Summary

Smoking, alcohol abuse, and use of illicit drugs are critical social problems. Economists have addressed these issues through modeling of addictive behaviors, positing policies, analyzing responses to policies, and assessing the welfare implications of policies. Taxation of tobacco and alcohol has been a frequent topic of empirical studies in economics in part because taxation addresses negative externalities, an important market failure. Relatively recently, behavioral economics has added new dimensions to the role of taxation including incorporation of "internalities" and considering taxation as a pre-commitment devices and addressing "internalities" as well. Other forms of government intervention have also been suggested based on models of addiction that supplement or replace the neoclassical decision-making model as applied to addictive substances. Smoking bans and other restrictions may deter individuals from obtaining substances in so-called "hot" periods in which their decision-making abilities may be reduced. Empirical evidence on public policies, especially the tax elasticity of demand paves the way for more precise welfare evaluations. Literature in these areas is getting more sophisticated in terms of econometric approaches (in particular in addressing causality) and also in assessing the heterogeneity of impacts. Future research could also apply these approaches and findings to other addictions such as over-eating, gambling, and misuse of prescription drugs. These areas are ripe for theoretical, empirical, and policy-related research.

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