

Considering Marijuana Legalization

Insights for Vermont and Other Jurisdictions

Jonathan P. Caulkins, Beau Kilmer, Mark A. R. Kleiman, Robert J. MacCoun,
Gregory Midgette, Pat Oglesby, Rosalie Liccardo Pacula, Peter H. Reuter



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Preface

Marijuana legalization is a controversial and multifaceted issue that is now the subject of serious debate. In May 2014, Governor Peter Shumlin signed Act 155 (S. 247), which required the Secretary of Administration to produce a report about various consequences of legalizing marijuana. This document was prepared for the Secretary of Administration in response to that legislation. It aims to inform the debate in Vermont but does not make a recommendation about whether Vermont should change its marijuana laws. The study was supported by the State of Vermont and by Good Ventures, a philanthropic foundation that makes grants in consultation with GiveWell, an organization that researches charities and advises donors.

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Questions or comments about this report should be sent to the project leader, Beau Kilmer (Beau_Kilmer@rand.org). For more information on the RAND Drug Policy Research Center, see <http://www.rand.org/multi/dprc.html> or contact the director (dprc@rand.org).

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Summary

Marijuana legalization is a controversial and multifaceted issue that is now the subject of serious debate. Since 2012, four U.S. states have passed ballot initiatives to remove prohibition and legalize a for-profit commercial marijuana industry. In December 2013, Uruguay became the first country to experiment with legalization nationwide; the Netherlands tolerates only retail sales and does not allow commercial production. Voters in Washington, D.C., recently took the more limited step of passing an initiative to legalize home production and personal possession. All of these moves were unprecedented. The effects are likely to be complex and will be difficult to fully assess for some time.

Vermont already made important changes to its marijuana laws by passing a bill to allow medical-marijuana dispensaries in 2011 and decriminalizing possession of up to 1 oz. of marijuana for personal use in 2013. In May 2014, Governor Peter Shumlin signed Act 155 (S. 247) (Vermont State Legislature, 2014b), which required the Secretary of Administration to produce a report about various consequences of legalizing marijuana. We prepared this document for the Secretary of Administration in response to that legislation. It aims to inform the debate in Vermont but does not make a recommendation about whether Vermont should change its marijuana laws. Values and how Vermonters weigh the potential outcomes will shape that decision. The goal of this report is to provide a foundation for thinking about the various consequences of different policy options while being explicit about the uncertainties involved.

Chapter One sets the stage for the current debate about marijuana policy and presents a general overview of the report. Most importantly, it reminds readers that U.S. federal law still prohibits the production, distribution, sale, and even possession of marijuana. However, the U.S. Department of Justice (DOJ) has issued guidelines in the form of memos to its prosecutors setting out priorities for the allocation of federal enforcement resources. Deputy Attorney General James M. Cole's memo from August 2013 (Cole, 2013) suggests that DOJ will tolerate state-legal marijuana activities as long as they have "strong and effective regulatory and enforcement systems that will address the threat those state laws could pose to public safety, public health, and other law enforcement interests" (p. 2). The memo highlights eight enforcement priorities for the federal government: preventing the distribution to minors, preventing enrichment of gangs and criminal enterprises, preventing diversion to other states, preventing dealing other drugs, preventing violence or the use of weapons, preventing drugged driving and exacerbation of other public health consequences associated with marijuana use, preventing growing marijuana on federal land or in federal reserves, and preventing possession on federal property. These are administrative guidelines and so could be withdrawn or changed at any time.

Chapter Two describes the marijuana landscape in Vermont. Marijuana prevalence in Vermont is already among the highest in the nation, particularly among young adults. Twelve percent of the state's population over 12 years old and nearly 30 percent of those ages 18 to 25 reported using marijuana in the past month (Substance Abuse and Mental Health Services Administration [SAMHSA], 2014a), and those under age 21 account for about 20 percent of the state's marijuana use. Chapter Two also presents new estimates of marijuana consumption (15 to 25 metric tons [t]), users' spending on marijuana (\$125 million to \$225 million), and the net cost of enforcing marijuana prohibition (on the order of \$1 million) in the state. Because misleading or exaggerated numbers sometimes hijack legalization debates, this chapter aims to provide a factual foundation for serious discussion. Great uncertainty surrounds all figures associated with a black market; therefore, ranges of values better represent the current state of knowledge than point estimates do.

Chapter Three reviews what the current scientific literature has found about the consequences associated with marijuana consumption. This literature has fundamental limitations; notably, although marijuana use is *correlated* with many adverse outcomes, it is much harder to ascertain whether marijuana use *causes* those outcomes. In addition, the effects of marijuana use in the past, under prohibition, might not accurately predict the effects of marijuana use in the future under some alternative legal regime. To date, researchers have based their findings largely on observational data that reflect use of a substance containing largely unmeasured amounts of cannabinoids. Furthermore, no one knows precisely how legalization will affect use—specifically, the extent to which heavy or harmful use will rise, which is directly relevant for understanding the public-health and safety consequences. Nor can one know how the product might change (e.g., potency, mode of use) or how these changes might influence the relationships between use and harms identified here. Thus, it is difficult to say whether the associations identified in the past are an accurate assessment of those that will exist in the future.

With those caveats in mind, the literature does identify some clear acute and chronic health effects, especially of frequent, high-dose marijuana use. Acute risks include accidents and impaired cognitive functioning while intoxicated, as well as anxiety, dysphoria, and panic. Longer-term risks of persistent heavy use include dependence and bronchitis. Some evidence suggests other serious risks for heavy marijuana users, particularly with psychotic symptoms (which is not the same as being diagnosed with schizophrenia), cardiovascular disease, and male testicular cancers. Although the literature showing a relationship between marijuana use and crime is extensive, there is little evidence that use itself increases criminal behavior, so one would not expect legalization to have important effects on nondrug crime in Vermont. Finally, the literature persistently identifies a negative association between marijuana use and school attendance and achievement, but it has not yet definitively determined whether this association is causal.

The chapter considers other consequences, such as possible effects of sustained and heavy marijuana use on the intelligence quotient (IQ), long-term cognitive functioning, brain development, mental illness, lung cancer, and workplace productivity. The current state of the scientific literature in each of these areas is insufficient to determine the extent to which marijuana use is causally linked to any of these outcomes, but we anticipate substantial gains in our knowledge of the true nature of these effects in the future.

The chapter also considers some of the potential benefits of marijuana use and some advantages of no longer enforcing laws against marijuana, including medical benefits, gains in

personal liberties, and the benefits of reduced arrest and sanctioning of marijuana offenders. It is important to remember that, although alternative policies will impose risks, current policies are by no means free of measurable harm; arrest and time in jail both damage health and well-being. Fines can also be significant: For someone who works close to the minimum wage in Vermont, paying a \$200 fine for possessing less than 1 oz. of marijuana could consume the take-home pay from the better part of a full week of work.

The indirect effects of legalization on use and abuse of other substances could easily outweigh the importance of the marijuana-related outcomes themselves. Unfortunately, uncertainty concerning these indirect effects for alcohol and other drugs is even greater than is the uncertainty concerning legalization's effect on marijuana-related outcomes. This ambiguity places severe limits on the confidence anyone should have in predictions about whether legalization will be a net gain or a net loss for society. In particular, legalization proponents (and opponents) sometimes make confident predictions that marijuana legalization will reduce (or increase) alcohol abuse, but the evidence is inconclusive. Agnosticism is the only truly defensible position on the effects that marijuana legalization could have on alcohol-related outcomes. There is stronger evidence that marijuana and tobacco are complements, so we might expect increases in marijuana use to bring greater tobacco use. There is also suggestive evidence that increased marijuana availability might reduce problems with diverted pharmaceutical opioid painkillers.

Chapter Four emphasizes what we hope will become the principal message of this report: Legalization is not simply a binary choice between making the production, sale, and possession of the drug legal on the one hand and continuing existing prohibitions on the other. Legalization encompasses a wide range of possible regimes, distinguished along at least four dimensions: the kinds of organizations that are allowed to provide the drug, the regulations under which those organizations operate, the nature of the products that can be distributed, and price. These choices could have profound consequences for the outcomes of legalization in terms of health and social well-being, as well as for job creation and government revenue.

Although Colorado and Washington State have adopted the for-profit commercial (or so-called alcohol) model and Alaska and Oregon are in the process of doing so, that strategy is just one of a dozen options available to jurisdictions seeking to change their marijuana laws. The chapter describes 12 supply alternatives to status quo prohibition, breaking them down into three groups:

- the two options most commonly discussed in the United States
 - Retain prohibition but decrease sanctions.
 - Implement an alcohol-style commercial model.
- eight options that find a middle ground between those commonly discussed
 - Allow adults to grow their own.
 - Allow distribution only within small co-ops or buyers' clubs.
 - Permit locally controlled retail sales (the Dutch coffee-shop model).
 - Have the government operate the supply chain (government monopoly).
 - Have a public authority operate the supply chain.
 - Permit only nonprofit organizations to sell.
 - Permit only for-benefit companies to sell.
 - Have very few closely monitored for-profit licensees.

- two extreme options
 - Increase sanctions.
 - Repeal the state’s prohibition without creating any new, product-specific regulations.

We then compare these strategies across a set of criteria likely to be important to policymakers and voters.

The key point made by identifying this range of approaches is that the debate in the United States has focused largely on just two options that are near the ends of the spectrum (merely easing sanction severity or jumping all the way to entrusting supply to profit-oriented private industry). Policymakers have largely ignored many available intermediate options.

Each of these strategies about whom the law would allow to produce and distribute marijuana is itself really a broad category of options encompassing considerable scope for fine-tuning. Moreover, a bad implementation of a good strategy might perform less well than a wise implementation of an inferior one. So picking a strategy is more the beginning of a discussion and design process than an answer to the question of what should be done. Nevertheless, important consequences flow from the strategic choice of who may produce and supply marijuana. It is very important to systematically consider the potential effects of each option. In particular, the marketing and lobbying muscle of a for-profit industry is likely to influence the future trajectory of marijuana policy.

Chapter Four also highlights a point to which we refer as the American federalism dilemma. A state monopoly option is—arguably—the most attractive supply model of legalization for protecting public health while reducing or even eliminating the black market. However, federal agents could enter state monopoly stores and arrest state employees for violating the Controlled Substances Act (Pub. L. 91-513, 1970, Title II). On the other hand, federal law cannot prevent states from going to the far end of the policy spectrum and choosing the supply strategy that could—arguably—create the most damage to public health (repealing state prohibition while instituting no marijuana-specific regulatory structure).

Chapter Five focuses on how to derive revenue from marijuana. Taxes and fees are often thought of as primarily revenue-raising devices, but, in the case of marijuana, their collateral consequences could outweigh revenue in importance. The consequences could be good or ill—reduced heavy use and use by minors and reduced risks of export on the one hand, increased risk of in-state black-market activity on the other. Both revenue and collateral consequences will depend on setting of tax levels, a task complicated by a nascent industry that is likely to drive pretax prices down dramatically over time for basic forms of the product and to evolve in ways that are difficult to foresee.

Policymakers also need to determine how, and at what stage of production, taxes will be collected and to determine the base—the measuring stick, such as price or weight—for any tax.

An ad valorem tax—meaning one based on sales value, as with a typical sales tax—is simple to implement but will fall if market prices fall. If the policy goal is to keep the after-tax price at some target level, ad valorem taxation is not the way to go. An ad valorem tax could also allow gaming—meaning manipulation of price—to evade taxes. For example, stores could use marijuana as a loss leader to bring customers in to buy other products, or even give it free to people who buy something else (e.g., restaurants giving customers marijuana to increase food sales the way that bars give away salted nuts to increase alcohol sales).

A tax on the gross weight of marijuana produced or sold is less at risk of manipulation, but it creates an incentive for producers to pack as much intoxicating power as possible into as little plant material as possible and thus gives a market advantage to highly potent forms of marijuana. For those who believe that those forms are more dangerous than less potent forms, that counts as a disadvantage of taxation on gross weight.

Taxation per unit of tetrahydrocannabinol (THC) has many attractive features but depends on accurate and honest testing procedures.

In any case, policymakers need to decide how to tax concentrates and edibles, as opposed to herbal marijuana; those product forms have been growing in market share in states with medical dispensaries or commercial sales. A combination of strategies is also possible, such as taxing THC or weight for some products at the production stage and value at the retail stage.

Like taxation, regulations present opportunities for shaping who consumes, what they consume, where they consume, and how they consume—and, hence, a range of consumption-related consequences. That is the topic of **Chapter Six**. Regulation can influence prices, product variety, product consistency, product safety, and the information provided to consumers. It can also affect the extent of diversion to minors and leakage beyond Vermont's borders. The chapter highlights dozens of regulatory decisions, paying special attention to types of products allowed, cannabinoid content (e.g., THC, cannabidiol [CBD]),¹ retail outlets and delivery services, sales to nonresidents, pricing control strategies, prevention and countermarketing, vertical integration, and local autonomy.

Regulations can be costly to enforce, burden those regulated, and create opportunities for evasion. The greater the incentive to break the rules, the greater the enforcement effort required to maintain them. Burdensome regulations can also limit the speed and completeness with which the legal market displaces the illicit market. Policymakers face a complex task in seeking the right balance among all these competing considerations. Implementation is also an issue; even apparently well-designed regulations can fail if not effectively enforced.

Chapter Six highlights two higher-level decisions that will shape the regulatory environment. First, what agency will be in charge of developing and monitoring regulations (e.g., the Department of Health, Department of Liquor Control, Department of Public Safety, Department of Taxes)? In balancing commercial interests with public welfare, different agencies' cultures could affect their willingness to supplement conventional regulation for any article of commerce with extra efforts that reflect unique concerns about marijuana as a commodity. On the other hand, a regulatory agency needs more than a disposition to regulate; it also needs experience in rule making and capacity to enforce its rules.

Second, how much flexibility will policymakers build into the regulatory system? Because nobody knows how best to regulate legal marijuana, early-adopting states will be learning by doing and by making mistakes along the way. That implies a need for flexibility. On the other hand, there is danger of regulatory capture, with regulators drifting over time toward more industry-friendly postures. So those designing a legal regime must decide how much discretion

¹ The marijuana plant contains dozens of cannabinoids and another 300 possibly active chemicals, many with unknown effects and interactions. To date, two cannabinoids have received the greatest attention: delta-9 THC (commonly known as THC) and CBD. THC is the main psychoactive compound in marijuana that causes people to feel high, while CBD is a naturally occurring counterbalance to that compound that, when present in sufficient amounts, can reduce the sensation of feeling high and reduce anxiety, which THC sometimes promotes. Cannabinoid receptors are found throughout the body, and both THC and CBD have other properties that make them potentially medically useful (Hermann and Schneider, 2012; Koppel et al., 2014).

they will give to regulators to adapt and adjust over time and what checks will be put in place against regulatory capture.

Chapter Seven explores the costs of regulating legal marijuana. Although it is difficult to pin down precise dollar figures, creating and implementing a regulatory regime would require time, effort, and resources. The burden will depend on the type of regime being considered, but it is not hard to imagine that the start-up costs could be in the low to mid single-digit millions of dollars in Vermont—which is more than Vermont now spends enforcing its marijuana prohibition.

Chapter Seven also provides a framework for thinking about the possible effects on consumption and state revenue. If Vermont legalized marijuana in a way that eliminated the black market *and* no other nearby state followed suit, then Vermont might, in theory, be able to generate \$20 million to \$75 million in tax revenues annually on sales to Vermont residents. Nearly 40 times as many current marijuana users live within 200 miles of Vermont's borders as live in Vermont (Figure S.1). So if Vermont legalized before any other states in the Northeast, marijuana tourism and illicit exports could be substantial and could, in theory, put Vermont's annual tax revenues in the hundreds of millions. However, if the federal government intervened to stop such cross-border traffic or if another state in the Northeast decided to legalize marijuana and set lower tax rates, these potential revenues might not materialize. Indeed, because legal marijuana can flow across borders in either direction, Vermont's prospects of deriving considerable tax revenue even from its own residents would become much less promising if one of its immediate neighbors were to legalize with low taxes. It is not clear that Vermont has any long-run comparative advantage in hosting the industry.

More generally, the uncertain effects of Vermont legalizing depend very much on what neighboring states do about their own marijuana policies, and Vermont's actions could, in turn, affect their policies. The perceived loss of what those states believe to be their tax revenue to marijuana tourism in Vermont could motivate these other states to legalize marijuana. Regulation might be able to contain this cross-border trade to a degree, but containment would require enforcement and designing a regulatory regime with that objective in mind.

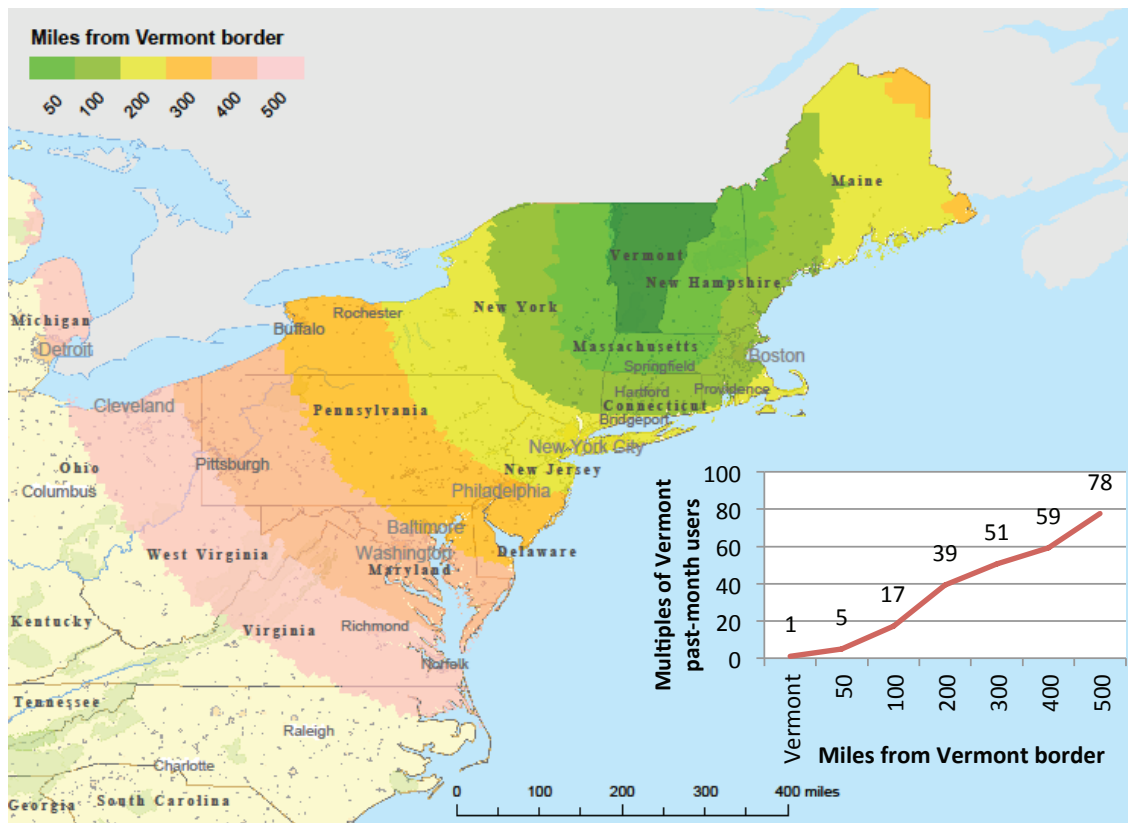
Chapter Eight argues that the decision to legalize marijuana involves multiple and possibly competing considerations. These include

- the extent of illicit transactions and the costs of efforts to suppress them
- the prevalence of substance-use disorders and the troubles they bring
- personal liberty and the benefits of marijuana consumption for the majority of users who do not suffer from substance-use disorders
- economic opportunity for lawful marijuana vendors
- tax revenue on the one hand versus administrative effort and expense on the other for the state government and local governments.

No one policy choice will be superior on all dimensions. Trade-offs are unavoidable, and inevitable differences of opinion about how much weight to place on the various outcomes will lead to disagreements about which policy to choose.

Throughout the document, we refer to the new regulatory regimes in Colorado and Washington; however, it is simply too early to know how these regimes will fare in the long run. Industry structure and behavior will take years, if not decades, to mature, and consumer responses will develop over similar periods. Furthermore, given data lags, it will take some

Figure S.1
Nearly 40 Times as Many Current Marijuana Consumers Live Within 200 Miles of Vermont's Borders as Live in Vermont



NOTE: These estimates come from self-reports circa 2012; adjusting for underreporting would inflate these numbers by roughly one-quarter. They do not include marijuana users in Canada. For this figure, we are interested primarily in the relative number of users outside versus inside Vermont's borders, not the absolute number, so, to make an apples-to-apples comparison, we compare these figures with the household survey's estimate of the number of past-month users in Vermont *before* that figure is adjusted upward for underreporting, which is 64,000.

additional time before high-quality evaluations are available. The fact that both Colorado and Washington State had fairly open marijuana availability under the medical-marijuana rubric also complicates any sort of outcome measurement. This does not mean that there is nothing to learn from these experiences, but the bulk of the early insights are about regulations and implementation instead of outcomes.

We conducted the analyses presented here for the benefit of Vermont, but the general themes should be useful to any jurisdiction considering alternatives to marijuana prohibition. We hope that analysts examining other states or countries will replicate and extend what we have done in this volume.

Acknowledgments

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Abbreviations

ACLU	American Civil Liberties Union
AIDS	acquired immune deficiency syndrome
AMR	average market rate
APIS	Alcohol Policy Information System
BRFSS	Behavioral Risk Factor Surveillance System
CADUMS	Canadian Alcohol and Drug Use Monitoring Survey
CBD	cannabidiol
CCS	Cannabis Consumption Survey
CDOR	Colorado Department of Revenue
CP	concentrate by potency
CSA	Controlled Substances Act
CW	concentrate by weight
DLC	Vermont Department of Liquor Control
DOJ	U.S. Department of Justice
DSM-IV	<i>Diagnostic and Statistical Manual of Mental Disorders</i> , 4th edition
DUI	driving under the influence
ED	emergency department
FCC	Federal Communications Commission
FY	fiscal year
HIDTA	High Intensity Drug Trafficking Area
HIV	human immunodeficiency virus
ICPSR	Inter-university Consortium for Political and Social Research
IOM	Institute of Medicine

IQ	intelligence quotient
JFO	Vermont Legislative Joint Fiscal Office
LLC	limited-liability company
MED	Marijuana Enforcement Division
MLDA	minimum legal drinking age
MS	multiple sclerosis
NIDA	National Institute on Drug Abuse
NLSY	National Longitudinal Survey of Youth
NSDUH	National Survey on Drug Use and Health
OAS	Organization of American States
ONDCP	Office of National Drug Control Policy
Project SAM	Project Smart Approaches to Marijuana
PUP	purchase, use, and possession
SAMHSA	Substance Abuse and Mental Health Services Administration
SD	standard deviation
t	metric ton
TEDS	Treatment Episode Data Set
THC	tetrahydrocannabinol
UNGASS	UN General Assembly Special Session
VCIC	Vermont Crime Information Center
VEDA	Vermont Economic Development Authority
VSHA	Vermont State Housing Authority
WSLCB	Washington State Liquor Control Board
YMCA	Young Men's Christian Association
YRBS	Youth Risk Behavior Survey

Introduction

Marijuana legalization is a controversial and complex issue. The prohibition of marijuana has been the subject of debate for decades, but now the discussions are moving from dorm rooms and dinner parties to state legislatures and federal hearing rooms. In May 2014, Vermont Governor Peter Shumlin signed a bill into law that required the Secretary of Administration to provide a report about the consequences of legalizing marijuana. We produced this document for the Vermont Secretary of Administration, and it reflects the insights and assessments only of the authors.

The report provides a systematic assessment of various alternatives to marijuana prohibition, with a special focus on supply architectures, taxes, and regulations. It presents new information about the size of the marijuana market and criminal justice costs associated with enforcing marijuana laws in Vermont and provides information that decisionmakers can use to weigh the consequences of various policy options. The report does not make a recommendation about whether Vermont should change its marijuana laws. It addresses the issue in broad terms because there is no single specific legalization proposal on the table in Vermont at this time, and that generality should make the document useful over time and to other states.

Before jumping into the specifics about marijuana in Vermont and details about various marijuana policies, this chapter offers a brief summary of marijuana policies in the United States and abroad, as well as an overview of the report.

A Brief Overview of Marijuana Policy

United States

Marijuana prohibition was universal across the United States through the 1960s, and those convicted of growing, possessing, or selling marijuana could receive sentences of incarceration. Then, in the 1970s, 12 states removed or substantially reduced criminal penalties for possession of small amounts of marijuana.¹ Many observers then believed that it was just a matter of time

¹ The 12 states were Alaska, California, Colorado, Maine, Minnesota, Mississippi, Nebraska, New York, North Carolina, Ohio, Oregon, and South Dakota. There is a lot of debate about what decriminalization actually means (see Pacula, MacCoun, et al., 2005, and MacCoun, Pacula, et al., 2009). For example, California has generally been considered a decriminalization state, but possession of small amounts for personal use was not exclusively a noncriminal offense until January 2011.

until the nation legalized the drug.² Instead, the movement toward liberalization came to a sudden halt in 1978. One state (South Dakota) reversed its decriminalization, and no state initiated decriminalization in the subsequent 20 years. The end of the 1970s liberalization is often associated with the so-called parents' movement, itself a response to the rapid rise in frequent marijuana use among junior and senior high school pupils and the associated harms; in 1979, about one out of every ten high school seniors reported daily use of marijuana.³

In recent years, a handful of states, including California in 2011 and Vermont in 2013, have fully decriminalized possession of small amounts of marijuana. Vermont and more than 20 other states now allow marijuana to be used for medicinal purposes, but there is tremendous variation in how that marijuana is supplied and the uses that are allowed. California and Colorado receive a lot of attention in medical-marijuana debates, but they represent one end of a broad spectrum. They allow brick-and-mortar medical-marijuana stores (called dispensaries) and have very expansive definitions of what conditions justify obtaining a medical recommendation (Pacula, Chriqui, et al., 2002; Pacula, Powell, et al., 2015).⁴ In some other states, including Vermont, the medical-marijuana system is more controlled, serving more as an adjunct to the health system than as a loophole for recreational users. Indeed, 11 (mostly southern) states in 2014 passed even more-restrictive medicinal laws, allowing only high-cannabidiol (CBD) and low-delta-9-tetrahydrocannabinol (THC) marijuana for medicinal purposes (Ingold, 2014c).

The near passage of a ballot initiative in California in 2010 that would have gone beyond legalization of medical marijuana to allow large-scale commercial production for recreational use helped trigger a new round of legal liberalization. That initiative attracted the support of 46.5 percent of the voters, even though it was a midterm election with low turnout among youthful voters, who tend to favor legalization. Encouraged by that result and by public opinion polls showing that a majority of the population nationally now favored legalizing marijuana use, in 2012, Colorado and Washington voters passed legalization initiatives, and Oregon nearly did so. In November 2014, voters in Alaska, Oregon, and Washington, D.C., also passed initiatives to legalize marijuana. We expect other states, including California, to consider legalization in coming years via propositions or legislation. In particular, 2016, a presidential election year, is likely to see more states voting on legalization (Hughes, 2014).

Why the new momentum for legalization? Certainly public sentiment has changed. Gallup has asked the same question about marijuana legalization since 1969: "Do you think the use of marijuana should be legal or not?"⁵ Support rose from 12 percent in 1969 to 28 percent in 1978, decreased to 23 percent in 1985, and then steadily rose; by 2013, 58 percent answered positively. Other polls confirm that the increase in support has been particularly large after 2010 (Galston and Dionne, 2013); however, some 2014 polls show support below 50 percent (see McGraw, 2014). The Gallup figure fell back down sharply to 51 percent in 2014, but it is unclear whether this was all a true decline or whether the 58-percent figure in

² For example, Bonnie and Whitebread (1974) asserted, "The social structure will ultimately adjust to the realities of drug-using behavior. America will become comfortable with marijuana and the [prohibitionist] laws will vanish in practice if not in form" (pp. 298–299).

³ Johnston et al. (2013) provided historical data from Monitoring the Future, which tracks high school drug use annually.

⁴ For an account of the chaotic nature of the California medical-marijuana industry, see Samuels (2008).

⁵ Swift (2013) provided data. Note that the question does not ask about legalizing supply, let alone commercial supply by companies. It asks only about use.

2013 was somehow a fluke (Saad, 2014). However, that simply moves the question one step back: Why has public sentiment changed in the past 30 years?

One factor is generational turnover leading to a rise in the proportion of the adult population who have direct personal experience with marijuana; those who have used previously are more likely than those who have not to support legalization (Caulkins, Coulson, et al., 2012). However, generational turnover is a slow process and does not explain the sharp increase in support around 2010. Other observers believe that the availability of medical marijuana increased national support for legalization. Although no direct evidence supports that belief, one study found that the availability of medical marijuana in Colorado reduced the perceived risk associated with marijuana use, which could presumably reduce opposition to legalizing the drug (Schuermeyer et al., 2014). Certainly, fewer people see the drug as harmful than saw it that way 20 years ago (Johnston et al., 2013).⁶ The fact that the past two presidents are known to have used marijuana and, in the case of President Barack Obama, to have used it frequently in his youth (Hertzberg, 2013), might also exert an influence. In recent years, there has been growing attention to the much higher rate of arrests of blacks for marijuana possession (American Civil Liberties Union [ACLU], 2013). It could also be part of a general growth of antigovernment sentiment; marijuana-possession arrests have affected tens of millions of people, with growing skepticism that there is any good justification in terms of deterrence.

It is important to note that federal law still prohibits the possession, distribution, and production of marijuana. The U.S. Department of Justice (DOJ) has not approved Colorado or Washington's legalization (or the operation of state medical-marijuana systems), but it has issued guidelines in the form of memos to its prosecutors setting out what it views as priorities for the allocation of scarce enforcement resources. The August 2013 memo from Deputy Attorney General James M. Cole (Cole, 2013) suggests that DOJ will tolerate state-legal marijuana activities as long as the states have "strong and effective regulatory and enforcement systems" and avoid infringing on eight federal enforcement priorities:

- preventing the distribution to minors
- preventing enrichment of gangs and criminal enterprises
- preventing diversion to other states
- preventing dealing other drugs
- preventing violence or the use of weapons
- preventing drugged driving and exacerbation of other public health consequences associated with marijuana use
- preventing growing marijuana on federal land or in federal reserves
- preventing possession on federal property.

The Cole memo, the February 2014 memo from the U.S. Department of Treasury Financial Crimes Enforcement Network (Cole, 2014), and the December 2014 DOJ memo about marijuana issues in Indian country (Wilkinson, 2014) can be construed as signaling what the

⁶ The Monitoring the Future annual survey shows that, in 1979, less than 40 percent of high school seniors perceived "great risk" in regular marijuana use. By 1993, this rate had more than doubled to nearly 80 percent but has steadily declined since then, reaching about 40 percent in 2013 (Johnston et al., 2013).

federal government will and will not countenance.⁷ Any administration could withdraw these guidelines at any time. If that were to happen, authorities could arrest and prosecute marijuana industry participants then for the actions they are taking now.

In October 2014, the Assistant Secretary of State for Drugs and Law Enforcement, William R. Brownfield, announced a new approach to addressing the international drug conventions; this new approach includes tolerating countries that legalize marijuana.⁸ The Assistant Secretary asked,

How could I, a representative of the Government of the United States of America, be intolerant of a government that permits any experimentation with legalization of marijuana if two of the 50 states of the United States of America have chosen to walk down that road?

However, as with the federal DOJ memos, this approach could change in future administrations.

Neighboring states might also try to take action against states that legalize marijuana. In December 2014, the attorneys general of Nebraska and Oklahoma filed a lawsuit against Colorado with the U.S. Supreme Court (*Nebraska and Oklahoma v. Colorado*, 2014). The suit claims that,

[i]n passing and enforcing Amendment 64, the State of Colorado has created a dangerous gap in the federal drug control system enacted by the U.S. Congress. Marijuana flows from this gap into neighboring states, undermining Plaintiff States' own marijuana bans, draining their treasuries, and placing stress on their criminal justice systems. (pp. 3–4)

At this point, it is unclear whether the Supreme Court will hear the case (Ingold, 2014d).

Outside the United States

Though various countries have decriminalized possession of marijuana and, in some cases, other drugs as well,⁹ the Netherlands went further by (de facto) legalizing its retail sale (although

⁷ This report does not address industrial hemp because that is a distinct issue from legalizing marijuana for consumption; however, the Cole memo addresses both issues. In response to a question posed by Senator Patrick Leahy about whether the Cole memo applied to state laws regarding the cultivation and processing of industrial hemp, DOJ wrote that,

[t]o the extent marijuana is cultivated, either for consumption or for industrial or other purposes, in violation of federal law, the guidance of the August 29 memorandum would apply to the use of investigative and prosecutorial resources to enforce the relevant provisions of the CSA. (Kadzik, 2014)

⁸ As Brownfield reported,

In my statement, I laid out what we call our four pillars as to how we believe the international community should proceed on drug policy. First, the—respect the integrity of the existing UN Drug Control Conventions. Second, accept flexible interpretation of those conventions. The first of them was drafted and enacted in 1961. Things have changed since 1961. We must have enough flexibility to allow us to incorporate those changes into our policies. Third, to tolerate different national drug policies, to accept the fact that some countries will have very strict drug approaches; other countries will legalize entire categories of drugs. All these countries must work together in the international community. We must have some tolerance for those differing policies. And our fourth pillar is agreement and consensus that whatever our approach and policy may be on legalization, decriminalization, de-penalization, we all agree to combat and resist the criminal organizations—not those who buy, consume, but those who market and traffic the product for economic gain. Respect the conventions; flexible interpretation; tolerance for national [policies]; criminal organizations—that is our mantra. (Brownfield, 2014)

⁹ Italy and Spain removed criminal penalties for possession of any psychoactive drug decades ago; Portugal officially did the same in 2001. More recently, many countries in Latin America have decriminalized possession of small amounts of psychoactive drugs.

not production or the wholesale trade, as is further discussed in Chapter Four). Uruguay's parliament voted for marijuana legalization in 2013, despite substantial popular opposition, and President José Mujica signed it into law in December 2013.¹⁰ As of December 2014, Uruguay was still in the process of implementing the commercial aspect of the law, which will allow marijuana to be sold in pharmacies. Uruguay also allows residents ages 18 and older to grow at home or join a cannabis growers' club (Pardo, 2014), but they can obtain marijuana only from one of these three supply options and must register with the government. In addition, Uruguay's new law bans all marijuana advertising and promotional activities (this is further discussed in Chapter Six).

A small number of foreign jurisdictions (Jamaica, Mexico City ["These Countries Mull over Marijuana Legalization After Uruguay Ruling," 2014]) are considering similar changes. A self-styled Global Commission on Drug Policy, chaired by a highly respected former Brazilian president (Fernando Henrique Cardoso) and including such globally prominent figures as Kofi Annan, Paul A. Volcker, and former Mexican president Ernesto Zedillo, has pushed for investigating alternatives to current drug policy, including experimentation with marijuana legalization.¹¹ Perhaps more surprisingly, the Organization of American States' (OAS's) Secretary General issued a report suggesting study and assessment of marijuana decriminalization and legalization:

Drastic or dramatic changes to domestic law would not appear to be advisable. Nevertheless, it would be worthwhile to assess existing signals and trends that lean toward the decriminalization or legalization of the production, sale, and use of marijuana. Sooner or later decisions in this area will need to be taken. (OAS, 2013, p. 105)

In addition, in 2016, a UN General Assembly Special Session (UNGASS) will focus on the world drug problem. We expect that session participants, as well as participants in UNGASS side events sponsored by nongovernmental organizations on all sides of the debate, will extensively discuss marijuana policy.

Report Overview

This report makes it clear that Vermont and other jurisdictions have many options for dealing with marijuana; the approaches taken in Colorado and Washington are only two examples. Options can range from increasing the intensity of prohibition enforcement to a *laissez-faire* approach, accomplished by simply repealing current state prohibitions. These extremes provide useful anchors for the many other options in between, such as state-operated monopoly distribution or allowing production by co-ops or nonprofits but not by for-profit businesses. The state could also decide to make no change in the laws themselves but change its implementing policies, such as a *de facto* tolerance of limited home growing, in the same way the Netherlands *de facto* allows retail sale without having formally changed its laws.

¹⁰ In one survey in 2013, 62 percent of Uruguayans were against the legalization.

¹¹ A recommendation in one of its most recent reports is to "[a]llow and encourage diverse experiments in legally regulating markets in currently illicit drugs, beginning with but not limited to cannabis, coca leaf and certain novel psychoactive substances" (Global Commission on Drug Policy, 2014).

Although a state that wishes to end its marijuana prohibition has many choices, the available experiences from which to learn are few. It is too early to determine how the policy changes in Colorado, Washington, or Uruguay will play out. There is inevitably considerable uncertainty about the consequences of any particular choice; however, analysis can significantly improve voters' and decisionmakers' understanding about the potential consequences of the options available.

The report contains eight chapters. Chapter Two presents information about the marijuana landscape in Vermont, paying special attention to the amount of marijuana consumed in the state and the criminal justice resources dedicated to enforcing marijuana prohibition. Chapter Three presents what we know about the health and behavioral consequences associated with marijuana consumption and prohibition. Because any policy change's effect on consumption of other substances could heavily influence the public-health consequences of marijuana legalization, Chapter Three also summarizes the literature about whether the use of marijuana influences the consumption of other substances, including tobacco. Subsequent chapters present various policy options available to jurisdictions considering a change in marijuana policy. Chapters Four, Five, and Six highlight the options and trade-offs associated with the decisions about supply architectures, taxes, and regulations, respectively. Chapter Seven makes projections about how legalization in Vermont could influence tax revenue, consumption, and public budgets (including regulatory costs). In addition, it provides an analytic framework that will allow users to substitute their own values for specific parameters and develop their own estimates. Chapter Eight offers closing thoughts. We also provide two appendixes: Appendix A offers additional evidence about marijuana's substitution and complementarity with alcohol, tobacco, opiates, and illegal drugs, and Appendix B describes business deductions under relevant parts of U.S. Code (26 U.S.C. § 280E).

Relative to the rest of the report, Chapters Two and Seven are the most quantitative, relying on secondary data from multiple sources to inform calculations and projection models. Chapter Three relies on a critical assessment of the existing research about the consequences of marijuana use. Chapters Four through Six present an assortment of policy design considerations, most of which have never been implemented for marijuana. When possible, we draw on published research from other fields to provide insights for these three chapters, but, in some cases, we have only our own judgment to hypothesize about the consequences of various choices. Although most of the authors of this report have been researching substance use and public policy for more than 20 years, these assessments are fallible. We have endeavored to think about these issues from multiple perspectives, and we hope that others will build on these assessments.

The principal message of this report is that legalization of marijuana is not simply a binary choice between making the production, sale, and possession of the drug legal on the one hand and continuing existing prohibitions on the other. Legalization encompasses a wide range of possible regimes, distinguished in at least four dimensions: the kinds of organizations allowed to provide the drug, the regulations under which those organizations operate, the nature of the products that they can distribute, and price. These choices could have profound consequences for outcomes in terms of health and social well-being, as well as on job creation and tax revenue.

The Marijuana Landscape in Vermont

Introduction

It is not surprising that marijuana policy is a serious topic of discussion in Vermont. Vermont has one of the highest rates of marijuana use in the nation, particularly among young adults. Household surveys have found that 12 percent of Vermont's population ages 12 and older—and nearly 30 percent of those ages 18 to 25—reported using marijuana in the past month (National Survey on Drug Use and Health [NSDUH], covering 2012–2013; see Substance Abuse and Mental Health Services Administration [SAMHSA], 2014a).

Because misleading or exaggerated numbers sometimes hijack legalization debates, this chapter aims to provide a factual foundation for serious discussion. Great uncertainty surrounds all figures associated with a black market, so ranges of values better represent the actual state of knowledge than point estimates do. Hence, the goal is to replace seemingly precise but potentially inaccurate numbers with reasonable ranges.

“Marijuana Laws in Vermont” sets the stage by summarizing marijuana laws in Vermont and how they have changed in recent years. “Marijuana Prevention and Treatment in Vermont” describes efforts to prevent and treat marijuana problems throughout the state, with a special focus on government-funded programs. “Indicators of Marijuana Use in Vermont” presents data from several sources about the prevalence of marijuana use in Vermont, paying close attention to recent trends. We also describe insights from treatment and hospital admissions. “Estimating the Size of the Marijuana Market in Vermont in 2014” uses this information to estimate the total amount of marijuana consumed and the amount users spend on marijuana in Vermont. “Criminal Justice Costs Associated with Marijuana Prohibition in Vermont” analyzes Vermont's criminal justice data and estimates how much money it currently devotes to enforcing marijuana prohibition in the state. We summarize briefly in “Concluding Thoughts.”

Marijuana Laws in Vermont

The possession, distribution, and production of marijuana for nonmedical purposes are illegal in Vermont. Those who are arrested and convicted of marijuana offenses face fines, community supervision (e.g., probation), and possibly time behind bars, depending on the offense and the amount of marijuana involved. For example, someone convicted of selling “one-half ounce or more of marijuana or 2.5 grams or more of hashish shall be imprisoned not more than five years or fined not more than \$100,000.00, or both” (18 V.S.A. § 4230). Despite the possibility of incarceration, very few Vermonters are behind bars solely for marijuana offenses. In response

to an inquiry made on our behalf, a Vermont Department of Corrections official reported on September 3, 2014, “Today amongst 2045 inmates, there are only three (2 sentenced and 1 detained) who are being held incarcerated with only marijuana charges. That works out to 0.15% of all inmates” (personal communication with a Department of Corrections official).

In July 2013, Vermont reduced the penalty for possessing up to 1 oz. of marijuana or up to 5 g of hash from being a misdemeanor criminal offense to a civil offense punished only with a fine for those 21 and older (up to \$200 for the first offense, up to \$300 for the second offense, and up to \$500 for subsequent offenses).¹ This policy change is referred to as decriminalization, which is very different from legalization. *Decriminalization* typically refers to reducing the penalties for possessing small amounts of marijuana; legalization involves removing the prohibition on production, distribution, and possession and making allowances for legal supply.

Vermont also has a medical-marijuana program that the Department of Public Safety manages. In 2004, the first medical-marijuana bill (Senate Bill 76; State of Vermont General Assembly, 2004) was passed, and the statutes covering this policy area have changed over time. Only Vermonters with debilitating medical conditions are eligible for the program; conditions include

cancer, acquired immune deficiency syndrome (AIDS), positive status for human immunodeficiency virus (HIV), multiple sclerosis (MS), or the treatment of these conditions if the disease or the treatment results in severe, persistent, and intractable symptoms; or a disease, medical condition, or its treatment that is chronic, debilitating and produces severe, persistent, and one or more of the following intractable symptoms: cachexia or wasting syndrome, severe pain or nausea or seizures. (Vermont Crime Information Center [VCIC], undated [b])

Each patient must receive a recommendation from a health care provider and register with the state.²

The original statute limited the number of registered patients to 1,000, but this changed with the passage of S. 247 in May 2014; as of this writing, there are now 1,600 patients on the registry (Wells, 2014). Vermont’s first dispensary opened in June 2013, only four may exist at any one time, and each patient must register with one specific dispensary. Each registered patient or registered caregiver may cultivate indoors “up to two mature marijuana plants, seven immature plants, and [possess] two ounces of usable marijuana” (VCIC, undated [b]).

Marijuana Prevention and Treatment in Vermont

Substance misuse is a significant threat to public health and safety in Vermont. In 2014, Governor Shumlin dedicated his state-of-the-state address to problems with prescription opiates and heroin, noting that, “[i]n every corner of our state, heroin and opiate drug addiction threatens us” (Shumlin, 2014). Alcohol continues to be the most harmful intoxicating drug in Ver-

¹ Those under 21 are diverted to the Youth Substance Abuse Safety Program.

² From VCIC:

The phrase “Bona fide health care provider–patient relationship” means a treating or consulting relationship of not less than six months duration, in the course of which a health [care] provider has completed a full assessment of the registered patient’s medical history and current medical condition, including a personal physical examination. (VCIC, undated [a])

mont; a new Centers for Disease Control and Prevention (CDC) study found that excessive drinking accounts for more than 9 percent of all deaths among working-age adults in Vermont (Stahre et al., 2014).

Marijuana is the most commonly used illegal drug in Vermont (SAMHSA, 2014a), and heavy consumption is strongly correlated with a variety of adverse outcomes, especially for youth (these consequences are discussed in detail in Chapter Three). Indeed, the goal of reducing youth marijuana consumption is one of the few issues on which those on both sides of the legalization debate seem to agree (see, e.g., *Smart Approaches to Marijuana Vermont*, undated, and *Vermont Coalition to Regulate Marijuana*, undated).

For FY 2014, the Vermont Division of Alcohol and Drug Abuse Programs spent on the order of \$2.5 million on all substance use–prevention programs, including grants to schools and community groups.³ A large share of this money came from a federal grant for the Partnership for Success program, which supports regional prevention strategies that include such activities as alcohol compliance checks, community mobilization, media advocacy, electronic screening and brief intervention, and parenting programs (Vermont Department of Health, 2014b). It is critical to note that these are the resources dedicated for all substances, not just marijuana. Indeed officials from the Vermont Department of Health told us that the Partnership for Success grants focus largely on alcohol and prescription drugs and did not have a dedicated marijuana program.

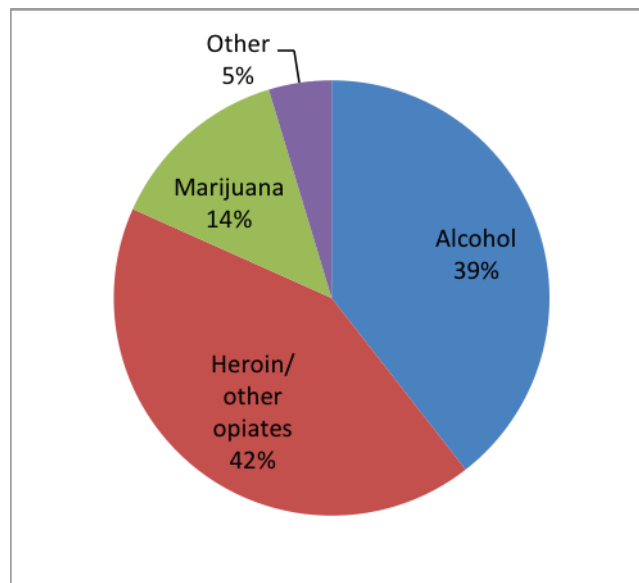
It is unclear whether recent changes in Vermont’s marijuana laws have affected the efficacy of interventions intended to prevent or reduce marijuana use. During our discussions with prevention officials in Vermont in the fall of 2014, some expressed concerns that youth conflated marijuana decriminalization with legalization and assumed that marijuana must be safe if it is legal. It was also noted that some children perceive marijuana as safe because it could be used as a medicine. Disentangling perceived harm and policy changes to predict variation in consumption is a tough empirical task, but these comments highlight the possibility that prevention messaging and programming might have to change if Vermont seeks to further liberalize marijuana laws (this is further discussed in Chapters Six and Seven).

Vermont has a network of treatment facilities and services to help those with substance-use disorders or those who are experiencing problems with their use. Vermont’s Division of Alcohol and Drug Abuse Programs contracts with 22 agencies to provide treatment services and provides funding for 11 recovery centers throughout the state (Vermont Department of Health, 2013).

Figure 2.1 presents the proportion of the 9,570 treatment admissions in Vermont by primary drug of abuse in FY 2013, based on Vermont’s Substance Abuse Treatment Information System (SATIS), which includes only admissions to state-funded treatment facilities. Alcohol is the primary drug reported in 39 percent of the admissions, and combining heroin with opiates accounts for another 42 percent. After alcohol and opiates, marijuana is the next-most commonly listed primary substance at 14 percent (1,305 admissions). The most-recent data from the Vermont Department of Health (undated [a]) suggest that, in FY 2011, treatment for marijuana disorders cost \$2.1 million.

³ The major items in the January 2014 “Prevention Program Overview” from the Vermont Department of Health Division of Alcohol and Drug Abuse Programs (2014b) included \$440,000 to be spent on community-based prevention grants (11 grants at \$40,000 per grantee), \$1.2 million for the Partnership for Success program (a grant from the federal government), and \$800,000 for school-based substance abuse–prevention services.

Figure 2.1
Proportion of Treatment Admissions in Vermont, by
Primary Substance of Abuse, Fiscal Year 2013



SOURCE: Vermont Department of Health, 2014a.

NOTE: This reflects only people receiving treatment at state-funded treatment facilities.

Using federal data on Vermont's marijuana primary treatment admissions for 2012 (most recent year available), we see that the criminal justice system referred 44 percent to treatment, 23 percent were self-referrals, 11 percent were referred by other community referrals, 10 percent by health care providers, 9 percent by schools, and the rest from other sources (online analysis of the Treatment Episode Data Set [TEDS]). Although SATIS and TEDS do not produce identical admissions figures, the distribution of primary drugs is very similar (TEDS, 2012: alcohol, 41 percent; heroin and other opiates, 40 percent; marijuana, 13 percent). Whether marijuana decriminalization in July 2013 has affected admissions or referral sources remains to be seen.

Finally, people entering treatment often have more than one drug of abuse, and the TEDS data report up to three substances for each admission (i.e., primary, secondary, and tertiary substances). For Vermont in 2012, more than twice as many admissions had marijuana as the secondary or tertiary substance as admissions listing it as the primary substance of abuse.

Indicators of Marijuana Use in Vermont

This section presents information from multiple sources about marijuana use in Vermont, with a focus on changes over time. Trend data are important for our market calculations because we must extrapolate data from 2012 or 2013 to generate estimates for 2014.

National Survey on Drug Use and Health

The best source of data on numbers of marijuana users in total and in terms of relative rates across states is the federally funded NSDUH. Each year, nearly 70,000 people participate in the survey, and NSDUH weights their responses to generate national estimates. Because the sample sizes are smaller for individual states (e.g., approximately 900 per year in Vermont), state-level estimates combine data from two adjacent survey years.

The NSDUH sampling frame excludes certain subpopulations (e.g., those who are incarcerated, the homeless not living in shelters, and the military) but covers the great bulk of the population 12 and older. Furthermore, marijuana use is so common that there are simply not enough people in the excluded populations to badly distort estimates. In that sense, marijuana use is much easier to study than, say, heroin use is.

A bigger concern is underreporting by those who do fall within the survey's sampling frame. NSDUH is well run, and the survey goes to great lengths to elicit honest responses (e.g., use of computer-assisted interviews at respondent households), but we know that some respondents misreport their use (Harrison et al., 2007). Adjusting for these limitations is critical for our market calculations, and we address this in "Estimating the Size of the Marijuana Market in Vermont in 2014." For the sake of replicability and comparison with other published reports, the data presented in this section do not make adjustments for underreporting.

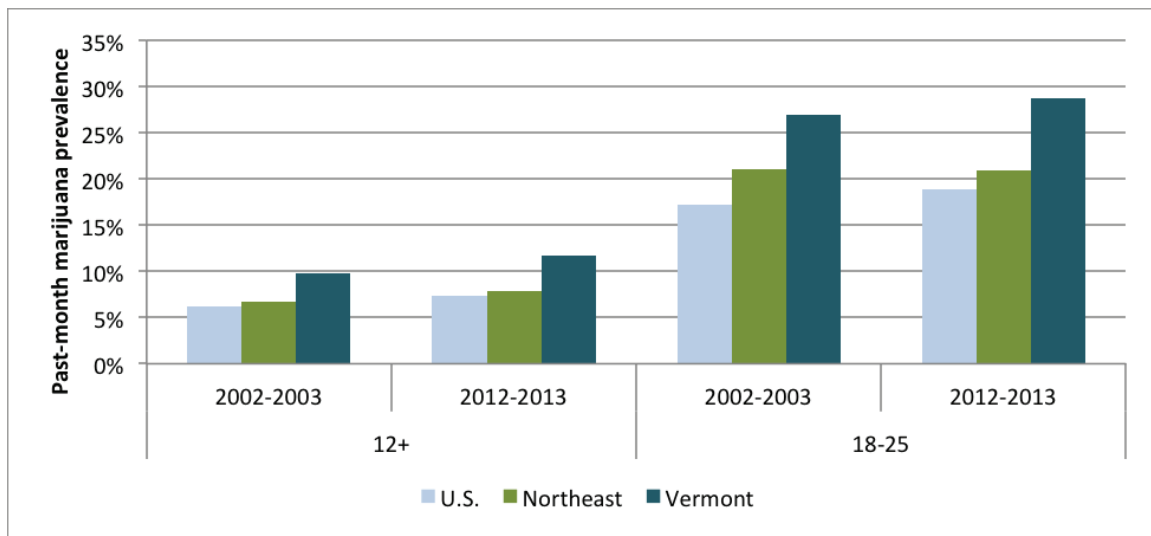
The self-reported prevalence of marijuana use in Vermont has long exceeded that in the nation as a whole, and the gap remained stable as past-month prevalence grew 20 percent both in Vermont and nationally between the 2002–2003 and 2012–2013 survey samples (Figure 2.2). These differences are statistically significant at the 95-percent confidence level. However, the gap among 18- to 25-year-olds in the state and the rest of the nation has narrowed. In Vermont, the rate among that age group grew a non-statistically significant 7 percent in Vermont, compared with a statistically significant 10 percent nationally.

Prevalence—meaning the number of people who used a drug within the previous month or year—is the traditional focus of drug data collection. It is not always, however, the best measure of total consumption or market demand because a relatively small number of frequent users can consume more than a considerably larger number of infrequent users (Kilmer, Everingham, et al., 2014). To estimate consumption, we are more interested in total use-days aggregated across users than in prevalence because shifts in intensity of use can translate to a significant increase in consumption. Indeed, much of the increase in marijuana consumption in the nation since 2006 stems from a sharp increase in the number of people using daily or near daily and not so much from increases in the total number of users (Kilmer, Everingham, et al., 2014). In theory, it would be even better to track grams consumed, not days of use, because people who use frequently also tend to consume more grams of marijuana per day of use, but the current generation of household surveys asks only about days of use, not weight consumed.

Table 2.1 shows data on annual use-days in Vermont and the United States. After an apparent decline between 2002–2003 and 2004–2005, use-days in Vermont grew at an accelerating rate. The range of uncertainty on these estimates is large, so the growth rate could be due only to sampling error; however, such growth could alternatively be indicative of an actual increasing rate in use intensity.

Of the 14 million annual use-days reported in 2010 and 2011 in Vermont, approximately 2.9 million, or 20 percent, are reported by people under the age of 21.

Figure 2.2
The Rate of Past-Month Marijuana Prevalence in Vermont Continues to Outpace That in the Northeast and the Nation, Especially Among 18- to 25-Year-Olds



SOURCES: SAMHSA (2014d); Vermont Department of Health (2014c). We calculated point estimates and confidence intervals as the averages for the two-year survey pair covering each year; point estimates and confidence intervals for 2013 are based on the 2012–2013 data exclusively.

NOTE: We did not adjust the data for underreporting. Because of methodological changes to the BRFSS survey weighting procedures in 2011, the Vermont Department of Health warns against comparing the pre-2011 data with the post-2010 data.

Behavioral Risk Factor Surveillance System

NSDUH is not the only drug-use survey conducted in Vermont. Figure 2.3 displays the rates reported in the state's Behavioral Risk Factor Surveillance System (BRFSS), an annual telephone survey of residents 18 years of age or older. Because of methodological changes to the BRFSS survey weighting procedures in 2011, the Vermont Department of Health warns against comparing the pre-2011 data with the post-2010 data.⁴ Among those 18 years of age and older, data from Vermont's BRFSS (Vermont Department of Health, 2014c) show that 7 percent of respondents reported using marijuana in the past month in 2013. This rate is lower than what NSDUH reports for the same age group and the discrepancy could stem, at least in part, from differences in survey methods (phone versus computer-aided interview); however, both series seem to suggest that self-reported marijuana prevalence probably declined in Vermont from 2011 to 2013.

⁴ The Vermont Department of Health reports,

In 2011, the CDC implemented changes to the BRFSS weighting methodology in order to more accurately represent the adult population. In 2011 and forward, weights are calculated using an iterative proportional fitting (or "raking") methodology. This allows the weights to be calculated using a smaller sample size, adjusts for more demographic variables, and incorporates cell phone interview data into estimates. While these adjustments make the calculations more representative of the population, the changes in methodology also limit the ability to compare results from 2011 forward with those from previous years. The Vermont Department of Health recommends that comparisons between 2011 data and earlier years be made with caution. Statistical differences between data collected in 2011 or later and that from 2010 and earlier may be due to methodological changes, rather than changes in opinion or behavior. (p. 4)

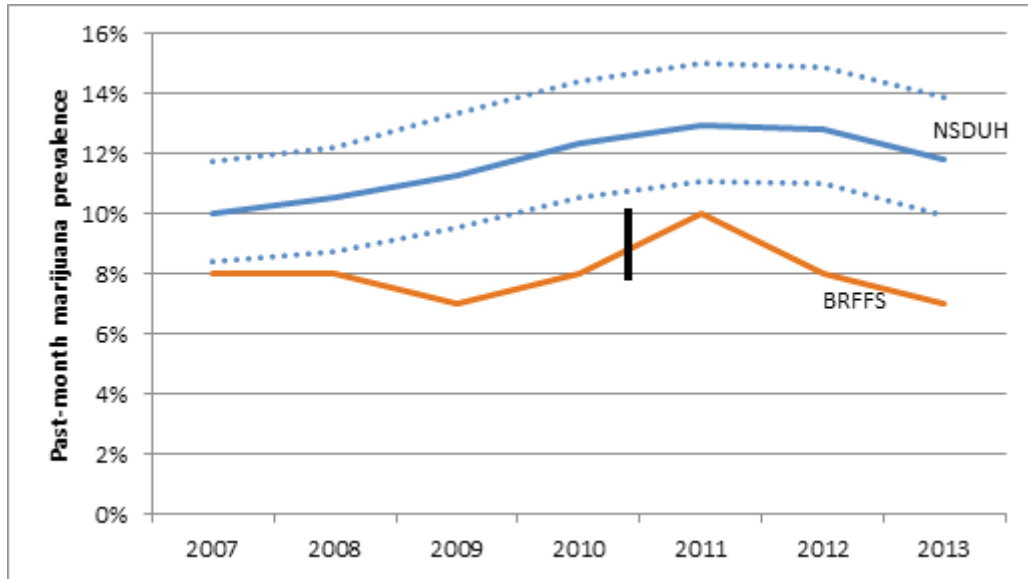
Table 2.1
Estimated Annual Use-Days

Location	Millions of Use-Days					Average Annual Growth from 2002–2003 or 2004–2005 (%)	
	2002–2003	2004–2005	2006–2007	2008–2009	2010–2011	2002–2003	2004–2005
Vermont	9.0	7.2	7.6	8.9	14.0	5.6	11.7
United States	2,119	2,134	2,179	2,436	2,892	4.0	5.2

SOURCE: Authors’ calculations based on SAMHSA (2014c).

NOTE: We did not adjust the data for underreporting.

Figure 2.3
Reported Past-Month Prevalence of Marijuana Use Among Vermont Adults over 18 in the National Survey on Drug Use and Health and Behavioral Risk Factor Surveillance System



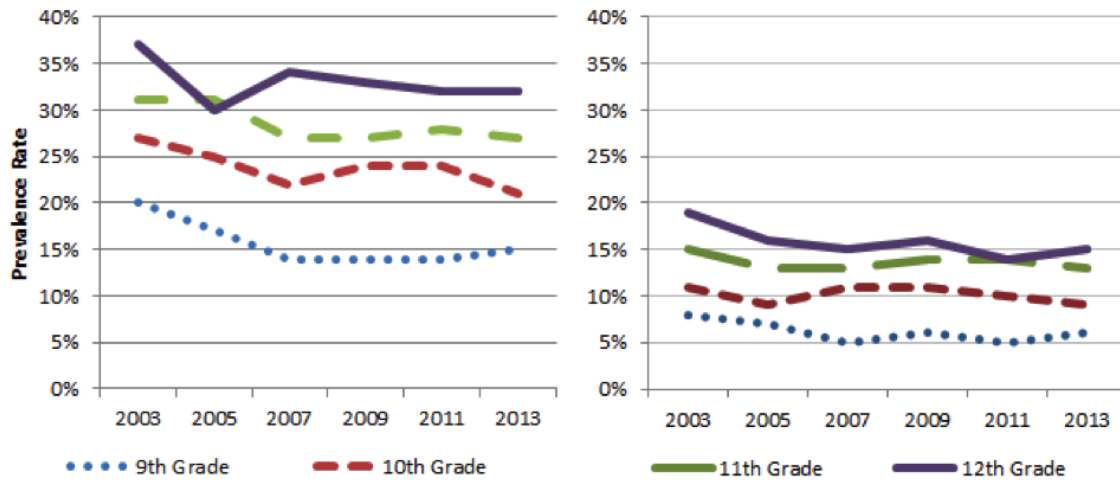
SOURCES: SAMHSA (2014d). We calculated point estimates and confidence intervals as the averages for the two-year survey pair covering each year; confidence intervals for 2012 are based on the 2011–2012 data exclusively (Vermont Department of Health, 2014c).

NOTE: We did not adjust the data for underreporting. Dotted lines represent the 95-percent confidence interval for NSDUH figures; this was not reported for BRFSS. The black line represents a break in the BRFSS series. Because of methodological changes to the BRFSS survey weighting procedures in 2011, the Vermont Department of Health warns against comparing the pre-2011 data with the post-2010 data.

Vermont Youth Risk Behavior Survey

Another survey, the Vermont Youth Risk Behavior Survey (YRBS), estimates use rates among students in ninth, tenth, 11th, and 12th grades every other year (Figure 2.4). The past-month rates for high school seniors for 2011 and 2013 is about one-third, which is 1.5 times the

Figure 2.4
Prevalence of Any Marijuana Use in the Past Month (left panel) and of Marijuana Use on Ten or More Days in the Past Month (right panel) Among High School Students in Vermont



SOURCE: Vermont Department of Health (undated [b]).

NOTE: We did not adjust the data for underreporting.

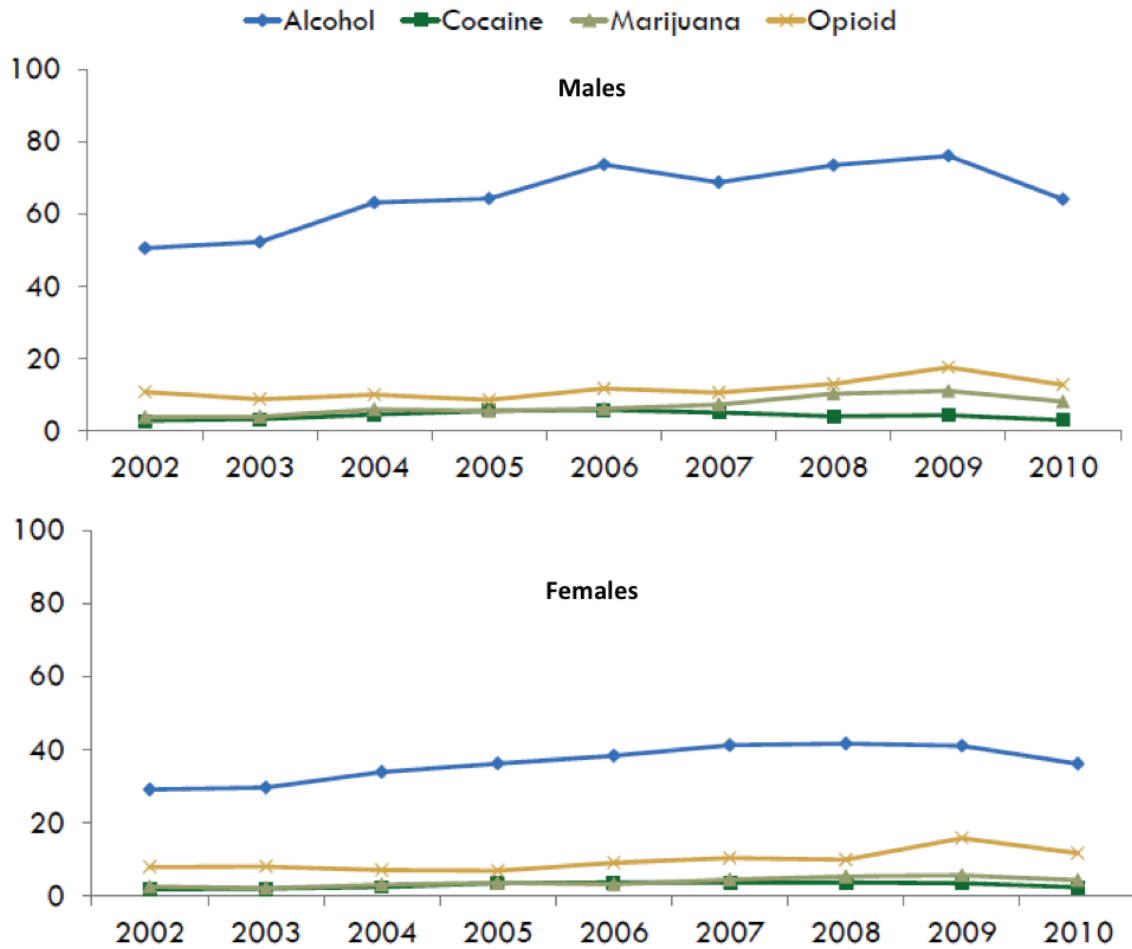
national rate for 12th-graders reported by the Monitoring the Future survey.⁵ For both past-month prevalence and the share of students reporting use on ten or more days in the past month, the rates for 2013 appear to be lower than they were for 2003 for all grades.

Marijuana-Involved Emergency-Department Discharges

Emergency-department (ED) discharge data suggest that marijuana-related visits remain a very small proportion of total events related to substance use, plotted by discharges by primary substance in Figure 2.5. The rates are dwarfed by alcohol, which is the largest driver of substance-related visits for both genders but larger for men, and opiates, which are second but larger for women.

⁵ The Vermont YRBS expanded its sampling frame considerably in 2013 and switched from a school-weighted design employed from 1993 to 2011 to reporting unweighted statistics because weights were no longer necessary. The state received 8,654 responses (96-percent response rate) from ninth- through 12th-graders in 2011 and 21,746 responses in 2013.

Figure 2.5
Emergency-Department Discharges per 10,000 Residents



SOURCE: Vermont Department of Health (2012); Vermont Uniform Hospital Discharge Data Set (UHDDS).

Estimating the Size of the Marijuana Market in Vermont in 2014

Following Kilmer, Caulkins, Midgette, et al. (2013), we estimate the amount that Vermont residents consumed in 2014 using this formula, with Table 2.2 providing the parameters and values used:

metric tons consumed = number of marijuana users in Vermont in 2012–2013
 estimated by NSDUH
 × change in use since 2012–2013
 × average grams consumed per month by those users
 × 12 (to convert monthly consumption to annual)
 × adjustment for survey undercounting and misreporting
 ÷1,000,000 (to convert grams to metric tons).

Table 2.2
Model Parameters and Their Distributions Used to Estimate Consumption in Vermont

Step	Parameter	Low	Medium	High	Distribution
1	Number of past-month marijuana users in Vermont in 2012–2013 NSDUH	54,000	64,000	74,000	Normal (SD = 5,100)
2	Change in past-month use from 2012–2013 to 2014	0.90	0	1.1	Triangle
3	Aggregate NSDUH adjustment		1.22		Normal
4	Average grams per day for daily or near-daily users	1.30	1.60	1.90	Triangle
5	Ratio of grams per day for daily users versus once-per-month users	2		3	Uniform

NOTE: SD = standard deviation.

In step 1, we use the number of past-month users in Vermont published by NSDUH and its 95-percent confidence interval for lower and upper bounds.

In step 2, we multiply by a factor to adjust for growth in use between when those most-recent Vermont-specific NSDUH data were collected, in 2012 and 2013, and the present (2014). There is no single best way to do this; the indicators summarized in Table 2.3 demonstrate a range of possible growth rates. Because some of the indicators suggest no growth, we assume no growth in the number of users in the 1.5 years separating mid-2014 from the middle of 2012–2013 (January 2013), the estimated growth in that interval is 14 percent. The range of growth patterns observed in the other data and the fact that growth rates in the past few years could differ from those in the half-dozen years before that suggest embedding that point estimate within a fairly broad uncertainty range. Plus or minus 10 percentage points allows for changes between a 10-percent decline and a 10-percent increase during this period.

Third, we need to adjust for the limitations of NSDUH. Kilmer, Caulkins, Midgette, et al. (2013) identified four sources of bias:

1. Use by people outside the NSDUH's sampling frame (e.g., homeless who are not in shelters, active members of the military).
2. Use by people who are in the sampling frame but nonetheless are not surveyed (e.g., because they were never home or refused to answer).
3. Misreporting of past-month use by people who are successfully surveyed.
4. Misreporting of quantities consumed (e.g., days used in the past month) even if some use is acknowledged. (p. 13)

Table 2.3
Indicators of Average Annual Rates of Growth in Marijuana Prevalence or Use

Indicator	Most Recent Point Estimate	Year Estimated	Average Annual Change in Prior (%)		
			Three Years	Five Years	Ten Years
Past-month users, 12+ years old, Vermont ^a	64,000	2012–2013	1.0	3.4	2.1
Past-month users, 12+ years old, Northeast ^a	3.7 million	2012–2013	2.0	4.8	2.0
Past-month users, 12+ years old, United States ^a	19 million	2012–2013	4.3	5.5	2.9
Past-month prevalence, 18+ years old, Vermont ^b	7%	2013	4.4 ± 4.2	–2.6 ± 2.6	Not available
Annual use-days, Vermont ^c	14 million	2010–2011	16.3	11.7	Not available
Annual use-days, United States ^c	2.9 billion	2010–2011	7.4	5.2	Not available
Past-month prevalence, 12th-graders, Vermont ^d	32%	2013	–0.8	–1.0	–1.4
Past-month prevalence, 12th-graders, United States ^e	21%	2014	–2.1	0.6	0.6

^a SAMHSA (2014d).

^b BRFSS reports data in whole percentages (e.g., 7 percent rather than 6.5 percent or 7.49 percent). The growth rate of 4.4 from 2008 to 2013 could actually be between 0 and 8.6 percent, depending on rounding, with a central estimate of 4.4 percent.

^c NSDUH two-year data accessed with SAMHSA (2014c); based on two-, four-, and six-year average annual changes because data are reported biennially.

^d “Trends in 30-Day Prevalence of Use of Various Drugs in Grades 8,” 2014.

^e Vermont YRBS; change in prevalence based on two-, four-, six-, and ten-year average annual changes because data are reported biennially. We did not adjust the data for underreporting.

After a review of the literature (Kilmer, Caulkins, Midgette, et al., 2013, appendix), they conclude that NSDUH-reported figures should be adjusted upward by 22 percent to give a better estimate of actual (as opposed to reported) numbers of users but with an uncertainty band around that adjustment factor. We apply the same adjustment.

Fourth, we must multiply by an estimate of the amount (i.e., weight) consumed per day of use. Most surveys do not ask about weight, let alone the type of marijuana that is consumed (i.e., commercial grade or sinsemilla). However, data from a convenience sample of marijuana users in Washington State in 2013 suggest that daily and near-daily users consumed between 1.3 and 1.9 g per use-day, with a best estimate close to 1.6 g (Kilmer, Caulkins, Midgette, et al., 2013). A similar survey conducted for the State of Colorado in 2014 led researchers to conclude that “results confirm that a preliminary estimate of 1.6 grams per day for heavy users is close to the Colorado average as well” (Light et al., 2014, p. 17). Washington and Colorado

are useful benchmarks for these purposes because, like Vermont, they have liberal marijuana policies and high prevalence rates.

Finally, we calculate consumption based on the estimated distribution of days of use per past-month user in Vermont from NSDUH, ranging from one day of use to 30, multiplied by average use per day of use. Even though frequent users dominate total consumption, we still need a corresponding figure for less frequent users. Following Kilmer, Caulkins, Midgette, et al. (2013), we assume that a daily or near-daily user consumes two to three times as much marijuana on a typical use-day as someone who uses only once per month.

We use Monte Carlo simulation to translate the uncertainty in each parameter into a range of estimates of consumption in Vermont. In particular, we independently draw values for each parameter from the ranges defined in Table 2.2 and put them into the equation for weight consumed for 10,000 “trials” and record the resulting distribution of consumption estimates. The mean and median of the resulting distribution is about 20 metric tons (t), with 95 percent of the trials yielding values between 14 t and 27 t. Given the imprecision in the various parameters, we round those figures to a range of 15 t and 25 t. Figure 2.6 shows the full distribution trial outcomes for the amount of marijuana consumed in Vermont in 2014.

An alternative approach would multiply a national consumption estimate by the share of U.S. past-month marijuana users who live in Vermont. Many of the authors of this report were part of a team that produced the national estimates for the White House ONDCP for 2000 through 2010 using a slightly different approach from what is presented here (Kilmer, Everingham, et al., 2014). For 2010, the national estimate was 4,200 t to 8,400 t, with a middle estimate close to 5,700 t. Multiplying these figures by Vermont’s share of past-month marijuana users (0.39 percent)⁶ generates a range from 16.9 t to 32.8 t, with a middle estimate close to 22.2 t, which is consistent with our preferred 15 to 25 t.

To estimate total spending on marijuana, we begin with information about the number of past-month users. According to the Monte Carlo simulation, 95 percent of the trials yield a range between approximately 60,000 and 100,000, with a mean and median close to 80,000 past-month users in 2014.

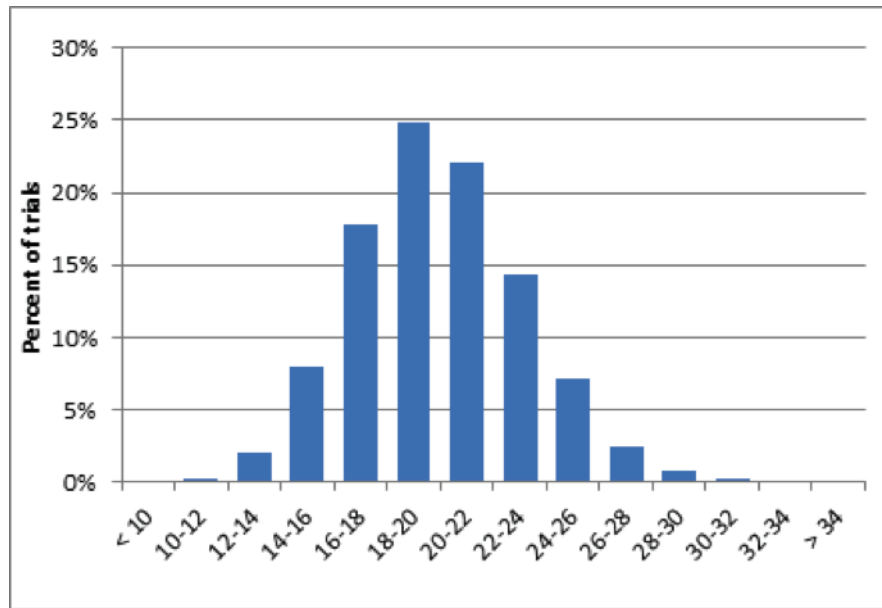
We then consider the average annual spending per past-month user. The most-recent data available are the Kilmer, Everingham, et al. (2014) national estimates that, in 2010, there were 24.5 million past-month users and that users spent \$40.8 billion on marijuana in that year. Dividing and adjusting for inflation suggests average annual spending close to \$1,800 per past-month user in 2014 dollars.

However, prices paid for marijuana in Vermont tend to be a bit higher than what is typically paid nationally, presumably because Vermont is far away from Mexican and West Coast suppliers (Caulkins and Bond, 2012). Higher prices tend to suppress the amount consumed per past-month user, but less than proportionally, so users in states with high prices probably spend more on average than users in states with lower prices do. Vermont’s prices appear to be about

⁶ State estimates are available in two-year intervals. Thus, we need to combine estimates 2009–2010 and 2010–2011 to generate a figure for 2010:

$$0.39\% = \frac{62 + 70}{17,696 + 18,334}.$$

Figure 2.6
Frequency Distribution of Estimated Amount of Marijuana Consumed in Vermont in 2014



15 to 25 percent higher than the national average,⁷ and the conditional elasticity of demand for marijuana could be about -0.24 ,⁸ suggesting that consumption per person is about 5 percent lower and spending per past-month user is about 15 to 20 percent higher in Vermont than in the nation as a whole. Rerunning the Monte Carlo simulation with these per-person spending estimates generates a mean and median market value close to \$165 million, with 95 percent of the trials yielding values between roughly \$122 million and \$213 million. Given the imprecision in the various parameters, we round those figures to a range of \$125 million to \$225 million per year, in 2014 dollars.

Criminal Justice Costs Associated with Marijuana Prohibition in Vermont

There have been important changes to Vermont marijuana laws in the past decade. In addition to implementing a medical-marijuana program, in July 2013, Vermont reduced the penalty

⁷ For example, *Price of Weed* reports, “Your average ounce of weed will cost you \$258.22 for some medium quality weed as of August, 2014” (“How Much Does Weed Cost?” undated). For Vermont, it reports that medium-quality marijuana costs \$309.82 per ounce:

$$\frac{\$309.82 - \$258.22}{\$258.22} = 20\%.$$

Additional sources of price data discussed in Chapter Seven are consistent with that figure, but, to avoid connoting inordinate precision, we consider a range of 15 to 25 percent.

⁸ The literature suggests a point estimate for the total elasticity of demand of -0.54 , divided into a -0.3 participation and a -0.24 conditional elasticity. This is further discussed in Chapter Seven.

for possessing 1 oz. or less from a criminal misdemeanor to a civil offense, which results in a civil fine, like a traffic ticket does (this policy change is referred to as decriminalization, which is a very different policy from legalization). The first offense can be a fine up to \$200; for the second offense, up to \$300; and, for the third and subsequent offenses, up to \$500.

This section presents information about marijuana offenses in Vermont and how they are processed and sanctioned now, after these changes. We then apply cost information to estimate the amount of criminal justice resources currently dedicated to enforcing marijuana prohibition in the state. The final section considers a variety of sensitivity analyses.

Criminal and Civil Cases Involving Marijuana

Natural questions to ask include, “How did decriminalization affect the number of marijuana arrests?” and “How many arrests are still being made, particularly for low-level possession?”⁹ The director of Research and Information Services for the Vermont Judiciary provided data on marijuana cases for FYs 2013 and 2014, which cover the 12 months before and after decriminalization was implemented on July 1, 2013 (Table 2.4).¹⁰ After decriminalization, criminal marijuana cases fell by 80 percent to 306.¹¹ However, the total number of recorded marijuana cases—which includes both criminal arrests and civil infractions—increased by 20 percent. This could reflect increased use or a so-called net-widening effect whereby law enforcement officers punish behavior that they would have previously ignored if the only option had been a criminal arrest. Criminal arrests dropped by 80 percent for young and older defendants, but total offenses fell by 36 percent for those under 21 years old, compared with a 52-percent increase for those 21 and older.

Table 2.5 breaks down the criminal offenses by charge. Although criminal offenses overall fell by 80 percent, those involving possession of less than 2 oz. fell even more—by 89 percent. Sales and trafficking offenses combined remained unchanged at just 31 each year. Arrests for possession of 2 oz. or more increased, and possession for cultivation increased substantially in percentage terms (by 20 percent and 50 percent, respectively), although the total numbers remain small.

Table 2.4
Marijuana Offenses, Before and After Decriminalization

Population	FY 2013 Cases (All Criminal)	FY 2014 Cases			% Change in Total	% Change in Criminal Cases
		Criminal	Civil	Total		
Total cases	1,602	306	1,615	1,921	19.9	-80.9
Age < 21	488	98	213	311	-36.3	-79.9
Age ≥ 21	1,047	195	1,398	1,593	52.1	-81.4
Age unspecified	67	13	4	17	-74.6	-80.6

NOTE: FY = fiscal year.

⁹ The Vermont Department of Public Safety no longer maintains a central all-department database of arrests with marijuana charges because some jurisdictions have adopted idiosyncratic incident-based reporting systems (Aumand, 2014).

¹⁰ Cases covering possession, sale, trafficking, and cultivation are included here. We discuss driving under the influence (DUI) and other vehicular crimes later in this chapter.

¹¹ By way of comparison, in 2012, there were more than 2,500 criminal cases for DUI of alcohol in the state.

Table 2.5
Distribution of Criminal Cases, Before and After Decriminalization

Charge	FY 2013	FY 2014	% Change
Possession <2 oz., infused ^a	1,487	164	-89.0
Possession ≥2 oz.	50	60	20.0
Cultivation	34	51	50.0
Selling	31	29	-6.5
Trafficking	0	2	
Total	1,602	306	-80.9

^a Includes one case with the charge of possession of 1 oz. or more of marijuana in FY 2013 and 42 in FY 2014. Also includes arrests for possession of 2 oz. or less in FY 2013 and between 1 and 2 oz. in FY 2014 because of decriminalization of possession of less than 1 oz.

Finally, note that some cases pertain only to marijuana, whereas, in others, the marijuana offense is combined with other offenses. Table 2.6 suggests that, both before and after legalization, roughly one-third of incidents involving marijuana also involved some other charge.

Adjudication, Fines, and Surcharges Paid

Table 2.7 shows the number and value of fines and associated court surcharges paid in FYs 2013 and 2014. The number of fines associated with criminal charges fell by 80 percent, but the total number of fines paid quadrupled because fines are much more common with civil charges, so much so that total amount of money collected more than doubled (even though the average fine is smaller with civil charges).

Sanctions

Even before decriminalization, marijuana offenders occupied little jail or prison space, and the number of inmates has declined further since then. Table 2.8 shows the admissions to

Table 2.6
Criminal Charges per Case Involving Marijuana, Before and After Decriminalization

Number of Charges	2013		2014	
	Cases	Percentage of Cases	Cases	Percentage of Cases
1	1,035	64.6	187	61.1
2	333	20.8	79	25.8
3	135	8.4	23	7.5
4	48	3.0	6	2.0
≥5	51	3.2	11	3.6
Total	1,602		306	

SOURCE: Analysis of data obtained from the Office of the Court Administrator.

Table 2.7
Fines and Surcharges Paid, by Case Disposition

Disposition	2013		2014	
	Cases	Fines (\$)	Cases	Fines (\$)
Criminal charges				
Dismissed	32	3,645	3	150
Pled or found guilty	190	71,874	38	23,347
Nolo contendere	7	2,541	1	2,000
Civil charges				
Comply			17	6,446
Judgment			847	172,388
Suspended			4	415
Total	229	78,060	910	204,746

NOTE: Includes only cases in which a fine was paid.

Table 2.8
Admissions to Incarceration, Probation, and Intermediate Sanctions

Sanction	FY 2013	FY 2014
Sentenced (to incarceration) for marijuana charge only	8	5
Sentenced (to incarceration) for marijuana charge plus another charge	19	6
Detained (in incarceration) for marijuana charge only	7	3
Detained (in incarceration) for marijuana charge plus another charge	58	16
Put on probation for marijuana charge only	96	60
Put on probation for marijuana charge plus another charge	49	18
Put on intermediate sanctions for marijuana charge only	24	12
Put on intermediate sanctions for marijuana charge plus another charge	19	8

SOURCE: Weeber (2014).

NOTE: The table includes cases in which sale, cultivation, or possession of marijuana was among the three most-serious charges.

incarceration, probation, and intermediate sanctions. We see declines across the board after decriminalization.

Table 2.8 helps us understand the flow of marijuana offenders into each of these sanctions; however, we are also interested in the stock or number under that sanction at any given time. The stock depends on the flow and on the duration of the sanction. Recall from “Marijuana Laws in Vermont” that only three people were behind bars exclusively for marijuana offenses on September 3, 2014.

Estimating the Costs of Enforcing Marijuana Laws in Vermont in Fiscal Year 2014

We estimate the criminal justice costs associated with enforcing marijuana laws in Vermont by multiplying the number of events just described by the cost per event. Some of the cost figures are based on a Vermont Legislative Joint Fiscal Office (JFO) memorandum about the criminal justice costs associated with arresting, booking, jailing, trying, and rehabilitating people arrested for possession of up to 2 oz. of marijuana (Belliveau, 2010). Others are based on marginal cost estimates published in the final report of the Criminal Justice Consensus Cost–Benefit Working Group for drug crimes that are not marijuana-specific (Vermont Center for Justice Research, 2014). We adjust all costs to 2014 dollars based on data from the Bureau of Labor Statistics Consumer Price Index (Bureau of Labor Statistics, undated).

JFO estimated that 801 misdemeanor marijuana-possession charges cost the state \$716,000, with a feasible range between \$573,000 and \$860,000. The hourly wage rate that JFO uses for police is \$24.75 in 2014 dollars. Assuming 15 minutes per citation written, the total cost per civil case processed is

$$\frac{\$24.75}{4} + \frac{\$41.07}{3},$$

or about \$20. That suggests that the cost to the state of the 1,615 civil cases is \$32,000, against \$179,000 in fines and surcharges collected (see Table 2.7).

For the remaining 306 events in FY 2014 that carried a criminal charge, we assume that the costs are equivalent to those for any drug crimes from Vermont Center for Justice Research, 2014. Because some marijuana misdemeanor cases might be less demanding of the criminal justice system than other drug crimes, this estimate could overstate true costs.¹² At \$1,266 per offense, the aggregate marginal cost of the 306 criminal events is just under \$390,000.

The Vermont Center for Justice Research (2014) \$134 cost for a criminal drug arrest is based on cases not involving the Vermont Drug Task Force or serious investigative support. The center estimates that drug cases using this type of support require 186 person-hours, which works out to \$8,400 per arrest in 2014 dollars. Because most of the criminal marijuana offenses are for possession, not selling, we expect that few of these arrests required more than what is required of a typical drug arrest. But if one assumed that 25 percent of the marijuana trafficking and sales offenses required 186 person-hours of investigative support, this would increase the aggregate marginal cost by only slightly less than \$70,000.

We next estimate incarceration costs associated with marijuana crimes. For FY 2013, the Vermont Department of Corrections estimated an average cost of \$159 per day of incarceration in an in-state facility, which is \$60,000 per year in 2014 dollars.¹³ Because this is an average cost of incarceration instead of a marginal cost (which would be lower because it would exclude fixed costs; see Table 2.9), using this number biases our cost estimates upward. Because we take the daily number of people incarcerated in the state for only marijuana charges to be three, this suggests that the in-facility corrections cost of marijuana-related crime could be on the order of \$180,000. (Obviously, when the numbers of people involved are so small, the cost estimates

¹² According to Vermont Center for Justice Research (2014), felony drug crimes require three hours of judge time and five hours of court clerk time on average, whereas misdemeanors require only a half-hour and 2.5 hours, respectively.

¹³ For FY 2014, the Vermont Department of Corrections (2014) estimated an average cost of \$162 per day of incarceration in an in-state facility, which is \$60,000 per year in 2014 dollars.

Table 2.9
Estimated Marginal Cost of Criminal Marijuana
Offenses, in 2014 Dollars

Cost Type	Marginal Cost
Police ^a	134
Court	126
Prosecutors	432
State's attorney and victim advocates	547
Defenders	27
Total	1,266

SOURCE: Marginal cost of drug crimes estimated in Vermont Center for Justice Research (2014); costs are FY 2012–2013 estimates expressed in 2014 dollars.

^a Vermont Center for Justice Research (2014) reports that marginal cost to police from drug crimes is \$0 because it calculates marginal cost savings as averted overtime hours and overtime is not authorized for drug crimes in the state. Rather than limit marginal costs only to overtime labor, we use the center's figure based on the opportunity cost for police to make a drug arrest: \$134 (in 2014 dollars).

are imprecise. If, the day before, an additional person had been incarcerated or released, that would have moved this estimate up or down by one-third.)

We might want to add some fraction of the costs for the 22 people Table 2.8 describes as admitted to incarceration for marijuana plus some other charges. We do not know how many of those 22 were behind bars at any point in time (the 22 figure represents a flow, not a stock). If we guess based on the marijuana-only inmates that three people are detained at any given time for every eight who are admitted at some point in the year and if we attribute all of the resulting costs to marijuana, that works out to an additional cost of about \$500,000. If we attribute only half the cost to the marijuana charge and the other half to the other charge or charges, that figure is halved to \$250,000. Either way, we need to add back the \$180,000 for the marijuana-only offenders, suggesting that incarceration costs might perhaps be approximately \$430,000 to \$680,000, which we prefer to report as \$400,000 to \$700,000, given the many simplifying assumptions made.

As of 2008, 124 people were on field supervision per day for marijuana, at a cost of \$3.33 per day per person (in 2014 dollars). If those unit costs still pertain, the total cost of field supervision is approximately \$150,000.

Courts referred defendants in about one-sixth of the 306 criminal cases in FY 2014 to diversion programs. According to an official in the Office of the Vermont Attorney General, assessing eligibility and making referrals to the nonprofit organization that runs the program in each county costs the state approximately \$200 to \$240 per person, or \$11,000 total assuming a per-person cost of \$220.¹⁴

¹⁴ Diversion participants pay fees directly to the nonprofit organization to offset some of the program costs.

Table 2.10
Cost of Prohibiting Marijuana in Vermont,
in Thousands of Dollars

Cost Area	Cost
Civil cases, n = 1,615	32
Criminal cases, n = 306 (police, defender general, judiciary)	390
Corrections	
In facility	400–700
Field supervision	150
Diversion	11
Gross cost	983–1,283
Fines and surcharges collected	–205
Net cost	778–1,078

Table 2.10 summarizes these estimates of the criminal justice system costs of prohibiting marijuana in 2014. There is uncertainty surrounding these results, so it is better to round these figures than to preserve three digits of (artificial) precision. However, overall, the analysis suggests that, in the year after decriminalizing possession of small amounts of marijuana, the State of Vermont spent between \$1 million and \$1.3 million enforcing its marijuana laws but also collected approximately \$200,000 in marijuana-related fines and surcharges.¹⁵

We derive our estimate from court case information and thus miss any arrest event that does not result in a criminal or civil case. We could not find an estimate of the number of arrests not resulting in a court case or citation; however, a quick calculation suggests that the magnitude of this omission is small. For example, even if only one in ten marijuana stops results in a recorded event—a much lower rate than we would expect, especially given the relative ease of issuing a citation after decriminalization—then we would need to account for approximately 17,000 events. Assuming that each event takes 15 minutes of officer time at \$24.75 per hour, the costs of these events to the state is only about \$100,000.

Finally, because most legalization proposals would still prohibit marijuana for those under 21, we consider the costs of prohibiting marijuana for those 21 and older in FY 2014; this reduces the number of civil cases considered to 1,402 and criminal cases to 208. At \$20 per case, the cost of civil cases is \$28,000. Limited to the 208 criminal cases involving adults, the costs of police, the defender general, and judiciary are approximately \$263,000. Prorating \$400,000 to \$700,000 in correction costs based on the proportion of cases involving arrestees 21 and over (68.0 percent) suggests correction costs of \$272,000 to \$475,000. After account-

¹⁵ Arrests for intoxicated driving are not included in this estimate. We can develop ballpark estimates for the additional cost associated with marijuana-related DUI and other vehicular crimes (e.g., reckless or negligent operation of a motor vehicle) based on the Vermont Center for Justice Research (2014) marginal-cost-per-case estimate of \$645 associated with arrest, adjudication, and victim services and \$4,834 in victim compensation payments for DUI cases (in 2014 dollars). However, these estimates come with the important caveat that we do not know how many of these events are due exclusively to marijuana use, as opposed to marijuana and alcohol. In FY 2014, 196 such cases were recorded, an increase of 20 percent over the prior year. Multiplying by the \$645-per-DUI-case marginal-cost figure, we find DUI costs on the order of \$125,000 net of victim compensation and \$950,000 in victimization compensation, or just under \$1.1 million overall.

ing for the \$178,000 in fines and surcharges collected from offenders 21 and older, this yields a net criminal justice cost estimate between approximately \$546,000 and \$749,000.¹⁶

Summary

We estimate that the State of Vermont spent between \$1 million and \$1.3 million enforcing laws against marijuana in FY 2014 but also collected approximately \$200,000 in marijuana-related fines and surcharges. The estimates nonetheless suggest that, after decriminalization, marijuana charges are now a quite small component of criminal justice costs in Vermont. Although our \$400,000–700,000 estimate for the in-facility costs of incarceration associated with marijuana is the largest component of the total criminal justice cost estimate, it is still a very small fraction of the \$153 million in correctional services costs the state incurred in FY 2014.

Concluding Thoughts

This chapter presents new estimates of marijuana consumption (15 t to 25 t), users' spending on marijuana (\$125 million to \$225 million), and the net cost of enforcing marijuana prohibition (on the order of \$1 million) in Vermont. Great uncertainty surrounds all figures associated with a black market; therefore, ranges of values better represent the current state of knowledge than point estimates do.

¹⁶ We assume that field supervision and diversion expenditures remain unchanged for this calculation.

Consequences of Marijuana Use

Introduction

The debate about marijuana legalization has been ongoing for many decades, and each point of view offers a variety of arguments (see MacCoun and Reuter, 2001; Caulkins, Coulson, et al., 2012). Some of the arguments involve what philosophers call deontological moral concerns—roughly, concerns about the inherent rights and wrongs of using a mind-altering substance (other than under medical direction) on the one hand and concerns about the propriety of paternalistic restrictions on personal liberty on the other. However, much of the debate revolves around what is known and unknown about the practical consequences of marijuana use and about marijuana production and distribution. Although we acknowledge the deontological set of issues, this chapter focuses on these practical consequences.

It is important to distinguish two types of questions, each of which is important for thinking about the effects of marijuana legalization on health and other outcomes:

1. What effects does *marijuana use* have on health and other outcomes?
2. What effects would *a change in marijuana laws* have on patterns of use and, hence, on health and other outcomes?

The effects of marijuana use have been studied extensively, and, because there are several excellent recent reviews of this literature (e.g., Danovitch, 2012; Fischer et al., 2011; Hall, 2014; Hall and Degenhardt, 2009; Volkow et al., 2014; J. Williams and Skeels, 2006), we are selective rather than exhaustive in our coverage. As we explain in the next section, the existence of this research does not mean that the question has been answered; often, there are inherent limits on what can be known or on the types of research that have been used. The question of how changing the laws would affect health and safety has received less attention. Indeed, the debate often fails to recognize that it is a distinct question. But we argue that, even if all the uncertainty about the health and safety consequences of marijuana use were somehow resolved, one would not necessarily then know how marijuana legalization would affect those harms for at least four reasons.

First, the effects of marijuana legalization will depend on whether and how it influences the *prevalence* of use—meaning the total number of users—and the age distribution of those users. For example, is an increase in use by 40- to 44-year-olds as important as a comparable increase in use by 16- to 20-year-olds? The answer is “not likely,” given that the risk of engaging in other risky behaviors is higher for youth and the existence of concerns about marijuana’s effect on brain development. And the composition of any new using population might be important. For example, MacCoun and Reuter (2001) argued that people who would use

under a legalization regime but not a prohibition regime are likely to be more-cautious people, implying that, other things equal, the average user might be a more careful user under legalization. We examine potential changes in the prevalence of marijuana use directly in Chapter Seven (also see MacCoun and Reuter, 2001; Kilmer, Caulkins, Pacula, et al., 2010).

Second, any effects on the *frequency and intensity* of marijuana use are at least as important as effects on the prevalence of use—and probably more important. This issue has received relatively little attention in the marijuana literature, but it is a major focus of theory and research on alcohol policies and outcomes, in which changes in the median of the consumption distribution can have implications that differ from those for changes among heavy users (e.g., Skog, 2006). Marijuana legalization might also influence the length of a using career; however, what little empirical evidence exists on this is mixed. MacCoun (2011b) found evidence against this in the Netherlands; however, van Ours and Williams (2007) used data from Australia to show that lower marijuana prices are statistically associated with earlier ages of initiation and that earlier ages of initiation are associated with longer use careers. Similarly, Jenny Williams and Anne Line Bretteville-Jensen (2014) showed that marijuana decriminalization in Australia led to a shift toward earlier age of first use.

Third, marijuana legalization is likely to change the *modalities* of both use (e.g., smoking, vaping, eating, drinking) and sales (who provides the marijuana and how it is promoted to the customer).¹

Finally, marijuana regulation might change some of the risks associated with marijuana use, via THC potency, quality control, time and place regulations, education opportunities, or differential pricing and taxation. The extent to which these factors will change is unknown because it will depend on the regulations and taxes adopted (see Chapters Five and Six); we simply raise the point here that these sorts of factors could matter when thinking about potential harms associated with use.

All these considerations make the analysis of the public-health and safety impacts of marijuana legalization quite complex. To make decisions about marijuana laws, we would like to know the total net consequences across users, doses, and outcome dimensions (e.g., respiratory health, mental health, road safety). But as MacCoun (1998) and MacCoun and Reuter (2001) argued,

$$\begin{aligned} \text{total harm} &= \text{average harm per dose} \\ &\quad \times \text{number of doses per user} \\ &\quad \times \text{number of users,} \end{aligned}$$

or, more simply, total harm = harmfulness × intensity × prevalence. For any given outcome dimension, marijuana could be a significant source of harm per dose, and yet there might be little aggregate effect of legalization if use did not increase. Alternatively, legalization might significantly reduce average harm on a given outcome dimension yet raise total harm by increasing the amount of marijuana used or the age at which use begins. And total harm might decline along some outcome dimensions but increase along others. Finally, total harm across all citizens might look different from total harm for some subgroups, e.g., teenagers and young

¹ Vaping is inhaling vapor from material that is heated but not burned like it is in conventional cigarettes. The distinction is elaborated in Chapter Four.

adults, people in poorer neighborhoods, polydrug users (that is, users of multiple drugs), people susceptible to mental health problems.

With these complexities and limitations in mind, the rest of this chapter discusses some of the most-relevant public-health and safety issues that Vermont should consider when deciding whether to pursue legalization. We begin with a careful discussion about why, even when there is lots of research showing a strong positive association between marijuana use and some outcome variable (e.g., crime or psychosis), that research might not indicate that we can interpret the association as causal. It also can help policymakers understand why, in some areas of research, the findings from a few methodologically strong studies outweigh the evidence from dozens of other, less rigorous studies. We then discuss in greater detail the general scientific consensus of the literature on the consequences of marijuana use.

Limitations of Existing Studies

There are inherent methodological challenges in studying the consequences of an illicit psychoactive substance. Even for licit psychoactive substances (e.g., alcohol), dose–response effects are usually nonlinear, making extrapolation beyond the dose range in a given study difficult.² And ethical barriers (appropriately) limit the doses and settings that we can study in controlled experiments involving true randomization of people to treatment and control conditions. When human experiments are possible, they are often of questionable generalizability; animal experiments are less restricted but even more limited in their generalizability. When the psychoactive substance is illegal, there are even greater barriers to research—ethical, legal, political, and practical.

Ethical considerations often preclude conducting truly randomized experiments, so scientists must often interpret evidence from purely observational data. Causal inference, however, can only be confidently drawn when the people in the so-called treatment group (in this case, the marijuana users) are similar in all important ways to people who are untreated (the nonusing control group), both in terms of easily observed differences (e.g., educational attainment, gender, prior drug use) and less easily measured differences (e.g., maturity, self-control, susceptibility to mental health problems) before marijuana use begins. This is very difficult to ascertain when making use of real-world observational data because marijuana users differ from nonusers in myriad ways. Thus, the vast majority of studies (regardless of techniques applied) rely on correlational methods because they account for differences only in *observable factors* between users and nonusers that the data capture. Important differences between users and nonusers could exist that are unmeasured in the data but correlated with the decision to use or maintain use of marijuana. Such problems are common in social science and epidemiological research. This is the primary reason correlational methods cannot clearly establish true causal connection.

Statistical techniques have evolved such that stronger statements of associations can be made, or at least *some* of the bias caused by the nonrandom assignment can be identified

² Traditionally, medical researchers have viewed dose–response relationships as a valuable cue for inferring causation in purely correlational designs, but this approach is highly problematic because dosages are often correlated with confounding risk propensities.

and adjusted for. Correlational studies involving individual-level data are stronger than other observational studies when the following are true:

- They study people across both settings and time periods so they can adjust for any stable but unobservable individual differences (so-called fixed-effect methods).
- They include control variables that are likely to be highly correlated with hypothesized important unobservable factors, such as deviance, maturity, and self-control.
- They use matching methods that try to make the user and nonuser groups as similar as possible on all the observable variables before the risk factor (marijuana use) is introduced (so-called propensity-score methods).

But even these sorts of rigorous statistical methods cannot completely eliminate the inherent causal ambiguity caused by nonrandom assignment; at best, such techniques reduce or identify some of the biases that self-selection creates (Manski, 2007).

A persistent inferential problem, even in strong observational studies, involves the classic difficulty of differentiating among three interpretations of any observed association:

- A can cause B (e.g., marijuana use can cause some health outcome).
- B can cause A (e.g., people with the health problem seek out more marijuana, e.g., to self-medicate)
- Some third variable C can cause both A and B (e.g., the children of neglectful parents are more likely both to start using cannabis at younger ages and to do badly in school), making the A–B correlation spurious.

The “B can cause A” account is plausible given that people seek out marijuana as medicine for a variety of conditions, but it is usually at least partially testable by examining whether the condition preceded the marijuana use. The “C can cause A and B” third-variable possibility is much more difficult to rule out. For example, marijuana use is strongly associated with dropping out of high school, but low attachment to conventional norms and roles might cause both marijuana use and dropping out. Multivariate studies can control for situational and personal characteristics that are measured, but it is not possible to rule the effect of unobserved factors in the absence of random assignment. There is very strong evidence for a shared risk propensity for substance use, delinquency, school problems, accidents, and mental health problems (see Elliott, Huizinga, and Menard, 1989; Kessler et al., 2005). So almost certainly some of the observed associations between marijuana use and poor outcomes are not causal. But it is much harder to judge whether that means that 90 percent of the association is causal, or only 10 percent, or even none at all.

To raise these concerns is not to diminish the seriousness of the potential harms associated with marijuana. Readers will differ in their sense of where the burden of proof lies; should we err on the side of assuming that marijuana causes the associations until proven otherwise (a sort of precautionary principle)? Should we assume the opposite? Or should we split the difference and assume expected harms that have been discounted for uncertainty?

In the abstract, the situation is similar to that posed by correlational evidence linking tobacco and cancer. Health experts were willing to act on a causal interpretation (tobacco causes cancer) well before it could be established rigorously—a decision that seems wise and prudent when considered today. But the analogy to the current marijuana debate is prob-

lematic. In the case of tobacco, there were not compelling reasons to believe that cancer (or some genetic propensity to cancer) somehow caused people to smoke tobacco. However, for marijuana, there is a plausible hypothesis that its use is a form of self-medication for people coping with other health and behavioral problems. (As we note below, researchers are beginning to test this hypothesis; so far, it does not appear to be a major part of the associations, but more research is needed.) More important is the fact that the tobacco industry's accounts of how smoking and cancer might both be attributable to various third variables were not scientifically persuasive (see Michaels and Monforton, 2005). In contrast, there are very strong reasons to believe that marijuana use and various health and behavioral problems might share common causal antecedents—personality traits, emotional problems, poor coping and self-control mechanisms, bad peer influences, and disordered families and neighborhoods.

But observing that the evidence is not as strong as it was for tobacco is not, in some sense, terribly reassuring; tobacco use was killing hundreds of thousands of people per year. Harms can reach a threshold for alarm far before reaching that level.

Consequences of Marijuana Consumption on Health

Several recent comprehensive reviews have assessed the current scientific evidence regarding the acute and chronic health effects associated with marijuana use (Hall, 2014; Volkow et al., 2014; Gordon, Conley, and Gordon, 2013; Hall and Degenhardt, 2009). The upshot of these reviews is that persistent, frequent use is unhealthy, mostly because of modest elevation in the risk of a diffuse range of adverse outcomes, but also because of a risk of marijuana dependence that is much greater (at least one in nine users) than most risk levels reported in the health and safety literature.

The literature focuses primarily on traditional use modalities (mainly smoking) so does not necessarily address the full range of marijuana products that are becoming increasingly popular. Furthermore, very few and only the more-recent studies provide explicit information regarding the specific doses of cannabinoids (in particular, THC and CBD) consumed.³ Because we expect that legal markets will shift the types of products, the average potency, and the ratios of specific cannabinoids contained within the products consumed, the relationships identified from these studies might no longer hold. The relationships could get stronger or weaker, depending on how the presence or absence of particular cannabinoids contributes to the relationship. Indeed, evidence suggests that the average potency of seized marijuana has been increasing in states that provide explicit legal protection for marijuana dispensaries (Sevigny, Pacula, and Heaton, 2014). If this trend continues with legalization, insights from the previous health literature could understate future health impacts. Similarly, to the extent that contaminants (mold, bacteria, pesticides, or other additives) contribute to some of the observed health effects associated with marijuana use, government product testing and labeling rules could reduce some of the health hazards (see Daley, Lampach, and Sguerra, 2013).

³ Ironically, even if outcomes became more severe, the correlation between dose and outcome could get weaker. Rather than rising linearly, dose–response relationships tend to be S-shaped, jumping up at a threshold-like inflection point and then leveling off. Thus, if the number of observations drops at the low end of the potency range, correlations between dose and various outcomes might actually become hard to detect.

The remainder of this section addresses some of the acute and chronic health risks associated with marijuana, as well as the medical benefits.

Acute Health Risks

Fatal Overdose

Unlike many other psychoactive substances, marijuana does not pose any serious risk of a fatal overdose. Hall (2014) noted that the dose range that is fatal in animal studies is “far greater . . . than even a very heavy cannabis user could use in a day” and that there are “no reports of fatal overdoses in the epidemiological literature.” Hall (2014) categorized descriptions that Hartung et al. (2014) gave of the deaths of two young men that were plausibly attributable to “acute cardiovascular complications evoked by smoking cannabis” separately as cardiovascular events, not overdoses. But even under a broader notion of fatal overdose that includes such cardiovascular events, given the vast number of incidents of consumption in recent decades, the risk of acute death is extremely low.

Accidental Poisoning

As noted in Chapter Two, some marijuana users in Vermont do end up in EDs and being admitted to the hospital because of marijuana. Twenty years ago, one might have assumed that ED mentions of marijuana were ancillary; the patient went to the ED because of the effects of some other drug but just happened to also be using marijuana. However, ED mentions of marijuana have grown enormously since the early 1990s, including episodes in which marijuana is the only drug mentioned (SAMHSA, 2002, 2013a). So it is of interest to ask how legalization might affect those trends.

ED episodes involving children are a particular concern. Colorado has experienced an increase in young children admitted to EDs because of accidental ingestion of marijuana-infused edibles (e.g., Ingold, 2014b; Wang, Roosevelt, and Heard, 2013). According to an article in *The Denver Post* published in May 2014, nine children went to just one hospital ED (Children’s Hospital Colorado) between January and May 2014, which was more than it saw the entire year before. Seven of the nine were admitted to the hospital’s intensive care unit to be watched due to extreme sedation and agitation, and one required a respirator. A more formal analysis focused on medical marijuana published in *The Journal of the American Medical Association* found a “new appearance of unintentional marijuana ingestions by young children after modification of drug enforcement laws for marijuana possession in Colorado” in 2009 (Wang, Roosevelt, and Heard, 2013). It is important to be careful about drawing conclusions from simple pre–post analyses without adequate control variables. For example, any increase in reported pediatric incidents might be at least partially attributable to rising levels of THC potency, which could increase the likelihood that parents seek medical help. But it seems clear that brightly packaged edibles, designed to mimic regular sweets, pose a very plausible risk of accidental ingestion.

The Rocky Mountain High Intensity Drug Trafficking Area (HIDTA) reports that ED visits related to marijuana (for those of any age) increased in Colorado by 29 percent in the first year after legalization of personal possession and use (12,888 in 2013 versus 9,982 in 2012), and that was before stores selling recreational marijuana opened.

Anxiety

An important acute health risk of using marijuana is anxiety. In 2011, marijuana accounted for 38 percent of ED visits in which illicit drugs were mentioned (about 450,000 visits, or one for every 40 past-month marijuana users; SAMHSA, 2013a, Table 4); this is a 62-percent increase since 2004 (SAMHSA, 2013a, Table 9). The most common stated reason for these visits is “unexpected reaction” (Kissin and Ball, 2003), which is usually a transient panic attack brought on by extreme intoxication.

Cognitive Impairment

The acute (short-term) cognitive effects of marijuana intoxication are easier to establish than the long-term effects. Studies show that being under the influence of marijuana can impair short-term memory, attention, reaction time, and psychomotor performance (Hall and Pacula, 2003). Attempting to estimate the aggregate costs associated with such performance losses is tricky; one would need to separate the direct effects of the substance from personality traits and other factors that are correlated with the decision to use in these settings and that might themselves be causes of poor performance. But given the sheer number of aggregate hours of intoxication (surely in the billions nationally), the costs could be considerable. Next, we take up two closely related questions—marijuana’s effects on accident risks and the possible chronic effects of heavy marijuana use.

Accident Risks

Another important health concern associated with marijuana consumption is the risk of accidents (e.g., falls, motor-vehicle accidents, and workplace accidents). There is clear evidence from strictly controlled laboratory trials that marijuana use reduces psychomotor performance in ways that increase overall risk of accidents and, in particular, impairs driving (Ramaekers, Berghaus, et al., 2004; Ramaekers, Moeller et al., 2006). Of course, not unlike with alcohol, the degree of impairment is a function of the dose, as well as individual-level factors, including age, body mass, and length of time using the drug (Degenhardt, Hall, and Lynskey, 2001; Ramaekers, Berghaus, et al., 2004). Although early evidence from simulator and epidemiological studies was far less conclusive (see Ramaekers, Berghaus, et al., 2004; Blows et al., 2005), Room et al. (2010) argued that the more-recent better-controlled epidemiological studies do, in fact, provide credible evidence that marijuana users who drive while intoxicated are at greater risk of motor-vehicle crashes. Meta-analyses conducted since Room et al.’s evaluation, accounting for differences in study design and use of case controls, conclude that recent marijuana use (indicated by THC in blood or self-reported use near the time of the accident) more than doubles the risk of a car crash (Asbridge, Hayden, and Cartwright, 2012; Li et al., 2012).

There is understandably a strong desire to have quantitative metrics that would allow one to conclude that some particular concentration of THC or its metabolites produced an increase in risk equivalent to that of some familiar measure of alcohol intoxication. For example, after a review of the evidence on the impairment of driving-related skills by alcohol or cannabis, one international group of experts concluded that a THC concentration of 7–10 nanograms (ng) per milliliter in serum is sufficient to produce impairment equivalent to 0.05-percent blood alcohol content (Grotenhermen et al., 2007). Some argue that the pharmacokinetics of THC suggest that any serum concentration of THC could be indicative of intoxication sufficient to impair driving, because THC concentrations are measurable in blood only within the first two hours of smoking marijuana while the psychomotor effects can last for eight hours or more

(Asbridge, Hayden, and Cartwright, 2012; Neavyn et al., 2014). Thus, considerable debate continues about the ideal (from a policy perspective) blood or serum levels to indicate marijuana intoxication while driving. We view this quest as being as of yet unfulfilled, though innovations are in development in various jurisdictions in the United States and abroad, including defined per se levels for impaired driving and saliva testing.

This measurement issue also has serious implications for assessing the public-health and safety consequences of marijuana legalization. If legalization increases marijuana use, holding everything else constant, we would expect to see an increase in the share of people whom police test for DUI who test positive for THC; however, that does not necessarily mean that legalization will lead to a net reduction in traffic safety. Much will depend on how legalization influences the use of other substances, especially alcohol (further discussed in “Substitution and Complementarity with Other Substances”). Thus, those trying to evaluate how legalization influences traffic safety should focus on the overall accident or fatality rate, not just the number of cases involving marijuana or other substances.

Chronic Health Risks

Dependence

The 2001–2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) (National Institute on Alcohol Abuse and Alcoholism, 2002; see also Compton, Thomas, et al., 2007, Table 1) found that about 2.6 percent of adults would meet *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV) (American Psychiatric Association, 1994) criteria for cannabis dependence in their lifetimes. About one in ten lifetime users will, at some point, meet the dependence criteria: one in six for those who started using in adolescence and about half of all daily users (Hall, 2014). The probability of remission from dependence is 97 percent—66 percent within a decade and half within six years (Lopez-Quintero et al., 2011)—but the impact on the user’s life can be significant. Drug-dependence diagnoses are made using a checklist of criteria that allows people with different configurations of symptoms to receive the same diagnosis, and those symptoms might not match popular stereotypes of what an addict is like.

The diagnostic criteria for the marijuana-dependence diagnosis have been controversial (see MacCoun, 2013b), in part because some of the symptoms are arguably due to drug laws and social context in addition to any purely psychopharmacological properties of the drug. But there is fairly compelling evidence that heavy marijuana use can produce many of the hallmarks we associate with addiction. For example, evidence for both marijuana tolerance and a marijuana-withdrawal syndrome continues to accumulate and is clearer now than in the late 20th century (Hall, 2014). Perhaps the most-important evidence that marijuana dependence is a serious problem is that nearly one in six past-year users report that they are trying to quit using the drug (Compton, Dawson, et al., 2013). About half of marijuana treatment admissions in the United States are due to criminal justice system referrals, but the other half are not, and marijuana accounts for a large and growing treatment population in the Netherlands, where criminal justice referrals are much less common (MacCoun, 2011b). Rising treatment rates in the Netherlands coincide with increases in marijuana potency (MacCoun, 2011b; Hall, 2014), an issue to which we return in Chapter Six.

Respiratory Health, Cardiovascular Health, and Cancer

There are plausible reasons that marijuana smoking might increase risk for respiratory diseases. For example, marijuana smoke contains many of the same carcinogens as tobacco smoke (Moir et al., 2008). But the epidemiological evidence has been inconsistent and difficult to interpret because so many users also smoke tobacco (Hall, 2014). The most-comprehensive research to date suggests that chronic marijuana smoking is significantly less risky than tobacco smoking. Marijuana smoking probably creates greater pulmonary harm at high doses, but heavy users are less common in epidemiological studies, making inferences more difficult. Marijuana's chronic effects on cardiovascular functioning are similarly inconsistent across studies, but, as noted earlier, there is some evidence that serious acute effects are possible. Hall (2014) reviewed several lines of suggestive evidence for a possible association of chronic marijuana smoking and male testicular and prostate cancers. Although more research is needed, the available evidence suggests that long-term marijuana smoking is less risky than long-term tobacco smoking, in part because a typical marijuana smoker will ingest far less than a typical tobacco smoker and is far less likely to use on a daily basis.⁴

Brain Development

Volkow et al. (2014) reviewed the emerging body of evidence on possible adverse effects of marijuana on brain development. Although the studies on humans are strictly correlational, controlled experiments on animals suggest that a causal role for marijuana in these associations is plausible. But because several different factors influence brain development, the question remains: If marijuana changes human brain development, does this lead to long-term negative consequences?

A recent neurological study comparing recreational users and nonusers found significant differences in gray-matter density in several brain regions involved in reward processing (Gilman et al., 2014), and these varied with frequency of use. As the authors recognize, these associations might not be caused by marijuana use and might even cause marijuana use, and their user and nonuser samples were matched on only a very limited set of variables. Still, the results are very troubling, and longitudinal brain-imaging studies might resolve some of the uncertainty.

Long-Term Cognitive Impairment

Scientists and activists alike vigorously debate the claim that marijuana use produces cognitive impairment, much like earlier arguments about an amotivational syndrome. Even if one is convinced about the acute effects, establishing that there are chronic, cumulative effects—possibly even irreversible effects—is much more challenging. Science is working hard to try to answer this question but cannot definitively answer it at this time. Even if any impairment is limited to the period of heaviest use (usually late adolescence), however, there might be long-term consequences due to processes that are social or developmental rather than neurological. For example, even a few years of poor academic performance during high school can have cascading effects on college and career prospects.

Meta-analyses of the literature suggest that associations between marijuana use and cognitive functioning are fairly weak and somewhat inconsistent (Grant, Gonzalez, et al., 2003;

⁴ We remind readers that (1) smoking is only one way to consume marijuana and (2) marijuana is also used to address some physical ailments (further discussed in “Consequences of Marijuana Consumption on Health”).

Schreiner and Dunn, 2012), and they appear to be limited to a subset of very heavy users who began using very early. But the tremendous heterogeneity of types and measures of cognitive functioning, study populations, and available control variables plague these meta-analyses. Further, much of the literature was developed when average age at first use was higher and average potency was lower.

Perhaps the most rigorous and ambitious study of chronic effects is the 38-year Dunedin Multidisciplinary Health and Development Study analysis of 1,038 New Zealand residents born in 1972 and 1973 (Meier et al., 2012). We focus on this study more than some others in this chapter given its prominence in current legalization debates and because it nicely illustrates the complexity involved in drawing causal conclusions from nonexperimental data.

Meier et al. (2012) reported significant declines in neuropsychological functioning and intelligence quotient (IQ) among persistent daily or near-daily users who began using in adolescence. The study has many important methodological strengths, including its longitudinal design and sophisticated statistical methods. For example, the study includes IQ measurements from before any cannabis use had occurred, allowing the researchers to control for the possibility that lower IQ is a cause of the decision to use cannabis. Still, the authors could not rule out the role of unobserved confounding variables (especially time-varying ones) that might influence both marijuana use and cognitive functioning. For example, Rogeberg (2013) presented a simulation study showing that the Dunedin results are consistent with a model in which differences are due to time-varying socioeconomic confounders rather than any direct effects of marijuana. Daly (2013) presented a hierarchical regression analysis of another longitudinal data set to show that the Dunedin results are potentially attributable to the lack of controls for stable personality traits that correlate with both marijuana use and cognitive functioning.

Meier and colleagues (Moffitt et al., 2013) responded to these criticisms. In response to Rogeberg (2013), they directly showed that socioeconomic status did not account for their results, while conceding Rogeberg's broader point that, because of unobserved time-varying factors, their observational design could not conclusively establish causation or rule out spurious associations. In response to Daly, they show that controlling for a measure of self-control did not significantly alter their findings. But although self-control is similar to conscientiousness, one of the five main personality factors that Daly did mention, it is not the same, and, at any rate, Daly's demonstration involved openness to experience—a completely different big-five factor.⁵

We hope that readers now understand why findings like this are not as straightforward as often discussed, not because of any failings by the researchers but because of the inherent ambiguity that accompanies nonexperimental findings on complex human phenomena involving many potential causal pathways. It is premature to argue that long-term cognitive impairment has been clearly established, but just as premature to argue that the risks are nonexistent.

The National Institute on Drug Abuse (NIDA) is planning a decade-long longitudinal study of 10,000 teens (Reardon, 2014), which will feature periodic brain imaging, but even that approach cannot solve the problem of unobserved confounders. This will complement the Dunedin design and surely enhance our understanding of the neuropsychology of marijuana users. But the only really decisive way to rule out confounding effects is by using a controlled experiment, which is ethically precluded. Thus, we believe that the balance of the evidence is

⁵ For a brief summary of the big five personality factors, see Barrick and Mount (1991).

consistent with the proposition that persistent regular cannabis use is associated with small but meaningful long-term impairments in cognitive functioning, but the possibility remains that the associations are partly or wholly spurious.

Mental Illness

Many of the potential health risks of marijuana have been studied and debated for more than four decades. But perhaps the most serious concern to have emerged in recent years involves a growing body of evidence linking marijuana use to psychotic symptoms and possibly even schizophrenia. There are several interrelated claims about this link, and some are better established than others.

First, is there a statistical association between marijuana and experiencing psychotic symptoms? Yes, and it has been replicated many times in many different populations, using many different ways of operationalizing both drug use and mental illness (see Donoghue et al., 2014; Hall, 2006, 2014; Large et al., 2011; McLaren et al., 2010; Proal et al., 2014; Radhakrishnan, Wilkinson, and D'Souza, 2014).

Second, in numerous longitudinal studies, the temporal pattern of the association is usually more consistent with the marijuana-use-leads-to-mental-illness model than with a self-medication (i.e., mental illness leads to marijuana use) account (see Hall, 2006, 2014).

Third, experimental studies using double-blind methods establish that controlled exposure to marijuana increases the likelihood of measures of negative affect, dissociation, and disordered thought during intoxication that are common symptoms of psychosis (see Radhakrishnan, Wilkinson, and D'Souza, 2014). We have to interpret these findings with some care because the fact that these are symptoms observed in schizophrenia does not necessarily imply that their occurrence in the experiments is evidence of psychosis. The ability to experience some of these psychotomimetic symptoms in a voluntary and time-limited fashion is, for some people, part of the attraction of the recreational use of the drug.

Fourth, despite considerable effort, researchers have been unable to rule out the possibility that the association between marijuana use and psychotic symptoms is due to some common risk factor. In some studies, controlling for plausible common risk factors eliminates the association between marijuana and psychosis, and, in other studies, these control variables weaken but do not eliminate the association (see Hall, 2006, 2014; McLaren et al., 2010; Proal et al., 2014; van Ours and Williams, 2012). Lewis, Heron, and Zammit (2013) observed that “[t]hose investigators who adjusted more comprehensively for confounders also found that the association was reduced somewhat more,” raising the possibility that additional control variables, if assessed, might further attenuate the association.

Fifth, if cannabis use does have a causal impact on psychosis, it appears to be highly contingent on the timing and intensity of cannabis use and possibly on a genetic propensity or other existing personal and environmental risk factors (Hall, 2006, 2014; Proal et al., 2014). Hall (2006) noted that these contingencies might explain

first, why the risk of psychosis in cannabis users is only increased 2–3 times; second, why there have not been large increases in the incidence of psychoses in line with the rise in rates of cannabis use in young adults in recent decades; and third, why the age of onset of schizophreniform disorders might be earlier in cannabis users. (p. 194)

Finally, the best available evidence is that any population effects of marijuana on the psychoses are likely to be small (Hall, 2014). Hickman and colleagues (2009) estimated that

if cannabis is related causally then the risk of schizophrenia in 1997–99 for men aged 20–24 was approximately 1 in 1500 for heavy cannabis users and 1 in 2400 for light users. For women aged 20–24 the risk of schizophrenia was 1 in 4000 for heavy cannabis users and 1 in 6600 for light cannabis users. (p. 1858)

This implies that thousands of users would have to be prevented from use for a year to prevent one case of schizophrenia. Still, this does not mean that the risk is inconsequential. That legalization could increase the number of frequent marijuana users in a jurisdiction by many thousands is not at all implausible. And even if marijuana simply accelerated the onset of schizophrenia, rather than causing it, an increase in person-years of psychosis can be enormously costly for patients, families, and taxpayers.

Medical Benefits

Different cultures have used marijuana for therapeutic purposes for thousands of years for various ailments (O’Shaughnessy, 1843; Grinspoon and Bakalar, 1993; Robson, 2014). As described in Chapter Two, Vermont allows physicians to recommend marijuana for debilitating medical conditions, where *debilitating* includes

Cancer, acquired immune deficiency syndrome (AIDS), positive status for human immunodeficiency virus (HIV), multiple sclerosis (MS), or the treatment of these conditions if the disease or the treatment results in severe, persistent, and intractable symptoms; or a disease, medical condition, or its treatment that is chronic, debilitating and produces severe, persistent, and one or more of the following intractable symptoms: cachexia or wasting syndrome, severe pain or nausea or seizures. (VCIC, undated [b])

There is a growing scientific literature documenting the medical benefits of THC and increasing interest in assessing the efficacy of CBD and other constituents of the cannabis plant (e.g., terpenes). In 1999, the Institute of Medicine (IOM) assessed the scientific literature on medical marijuana and concluded,

Scientific data indicate the potential therapeutic value of cannabinoid drugs, primarily THC, for pain relief, control of nausea and vomiting, and appetite stimulation; smoked marijuana, however, is a crude THC delivery system that also delivers harmful substances. (Joy, Watson, and Benson, 1999, p. 4)

The IOM noted that five other reviews of the medical-marijuana literature were published between 1996 and 1999 and all but one concluded that “marijuana can be moderately effective in treating a variety of symptoms”; however, they all raised similar concerns about the “uncertain composition of plant material” and called for more research (Joy, Watson, and Benson, 1999, p. 180).

Since 1999, dozens of human clinical trials involving cannabinoids have been conducted.⁶ Some involved cannabinoid extracts produced by pharmaceutical companies, while others

⁶ Hundreds—if not thousands—of cannabis studies involving lab experiments with animals and petri dishes have also been published since 1999. The lab studies examining the antitumor effects of some cannabinoids are especially promising

have involved raw cannabis material that is either smoked (combusted) or vaporized. Sativex® is a plant-derived oral spray that is roughly 50 percent THC and 50 percent CBD. It is used to treat spasticity from MS in 11 countries, and some studies support the producer's claim that

Exploratory trials in several hundred [MS] patients consistently showed significant advantages for Sativex® over placebo in the relief of spasticity, chronic pain, muscle spasms, bladder-related problems and sleep quality which appeared to be maintained over long-term treatment, and the medicine was generally well tolerated. (Robson, 2014, p. 26)

Randomized, double-blind trials with non-MS populations suggest that Sativex could reduce unilateral peripheral neuropathic pain and allodynia (Nurmikko et al., 2007) and inflammatory pain (Blake et al., 2006).⁷

Although medical-marijuana dispensaries sell tinctures, extracts, and nonpsychoactive topical preparations with varying levels of THC, CBD, and other cannabinoids, these particular products have not been the subject of clinical trials. However, the anecdotal evidence about high-CBD extracts reducing seizures—especially among children—has been convincing and likely explains why more than ten states enacted CBD laws in 2014 (Ingold, 2014c).⁸ Clinical trials of a plant-derived CBD spray (Epidiolex) to treat children suffering from severe seizures started in the United States in early 2014 (Bunim, 2014).

The systematic reviews of the Cochrane Collaboration provide what are arguably the most-rigorous assessments of the evidence for medical applications of marijuana and the chemicals it contains. Cochrane reviews examining the medical benefits of cannabis for epilepsy (Gloss and Vickrey, 2014), HIV or AIDS symptoms (Lutge, Gray, and Siegfried, 2013), dementia (Krishnan, Cairns, and Howard, 2009), and schizophrenia (McLoughlin et al., 2014) found that few available trials meet their methodological standards for inclusion and that the available evidence is insufficient to establish medical benefits. No doubt, this paucity of strong studies partly reflects the enormous obstacles of doing marijuana research. Given the tremendous proliferation of medical-marijuana systems in the United States, more and better clinical trials are clearly needed.

(National Cancer Institute, 2014). Although clinical trials of antitumor effects have not been conducted on humans, the National Cancer Institute notes that “a single, small study of intratumoral injection of delta-9-THC in patients with recurrent glioblastoma multiforme reported potential antitumoral activity” (see Guzmán et al., 2006, and Velasco, Sánchez, and Guzmán, 2012).

⁷ As this document was going to press, a clinical trial of Sativex for cancer pain was reported to yield “no statistically significant difference between subjects using [Sativex] and those given a placebo” (Hirschler, 2015). Results from two other phase III trials are expected in 2015. (A phase III trial is one in which the “drug or treatment is given to large groups to confirm its effectiveness, monitor side effects, compare it to commonly used treatments, and collect information that will allow the drug or treatment to be used safely” [U.S. National Library of Medicine, 2008]).

⁸ One might refer to this as the Gupta effect because the CNN documentary *Weed: Sanjay Gupta Reports* that first aired in August 2013 spurred much of the discussion about CBD. Among others, it featured a three-year-old girl with severe myoclonic epilepsy of infancy (also known as Dravet syndrome) who suffered from nearly 300 grand mal seizures per *week*. After twice-daily use of a high-CBD, low-THC extract produced by farmers in Colorado, she reportedly experienced only two to three seizures per *month*, typically in her sleep. For more on this story, see Young (2013).

Consequences of Marijuana Consumption on Other Outcomes

Like being under the influence of alcohol, being under the influence of marijuana at school or work can impede development for some people by making it harder to learn and concentrate. And if intoxication leads users to skip school or work, or, in the case of school, not complete their homework, this could have a negative effect on future performance. Because THC is fat-soluble and can stay in the system long after a use episode, there is concern about the residual effects of marijuana on cognitive functioning.

The challenge for researchers is trying to figure out whether regular or heavy marijuana use has any lasting effects on education or employment outcomes, or what economists often refer to as human capital development. There are strong correlations between frequency of marijuana use and many education and employment outcomes, but here we run into the same selection issues that we have mentioned throughout this chapter. Here we highlight three outcomes that have received a relatively large amount of attention in the marijuana research literature: dropping out of high school, labor outcomes, and criminal activity.

Deciding to Drop Out of High School

The correlation between marijuana use and dropping out of high school is positive, but it is unclear whether the relationship can be attributable to cognitive effects, peer effects, both, neither, or some other factors. Largely based on a series of longitudinal studies, the Hall (2014) review of the research concludes that “[r]egular adolescent cannabis users have lower educational attainment than non-using peers”; however, his review raises important questions about how much of the relationship is causal. For example, the review highlights a recent Australian twin study that attributes the association to genetic and environmental risk factors instead of cannabis (Verweij et al., 2013) and suggests that this is consistent with two other U.S. twin studies. The review also notes that “the adverse effects of cannabis use on educational outcomes may be amplified by school policies that exclude students who are caught using cannabis from secondary school.”

A recent article that combined samples from three longitudinal studies in Australia and New Zealand found that those who used marijuana daily before age 17 had significantly lower odds of completing high school and earning a college degree (Silins et al., 2014). Although the study found a statistically significant dose–response relationship, this is neither necessary nor sufficient for causation. The authors argue that the relationship between marijuana use and completing high school “probably does not arise from a reverse causal association,” but they note that “this possibility remains plausible” (p. 291).

Another longitudinal study based in the United States by McCaffrey et al. (2010) found that the apparent effect of marijuana use on dropping out of high school disappeared once they controlled for cigarette use. This led the authors to conclude that the effect of marijuana use on decisions to drop out was not attributable to a reduction in cognition (because cigarette smoking does not seriously impair cognition). Additional analyses revealed that parental and peer influences could explain the marijuana–dropout relationship.

Labor Outcomes

We previously noted the acute effects that marijuana use can have on cognitive skills and psychomotor performance. With respect to the research about the effect of illegal drug use on employment and worker productivity, the results are all over the place. Kilmer and Pacula

(2010) reviewed the econometric literature of the topic and concluded that the evidence is mixed, attributing the variation to three factors:

- These studies often assess earning labor-market outcomes for populations of varying ages.
- There is “inconsistent treatment of indirect mechanisms through which substance abuse could impact earnings, for example through educational attainment, health, fertility and occupational choice.”
- Studies often use different definitions of *substance use* (e.g., past year, past month, daily).

Criminal Activity

There is a long-established positive correlation between marijuana and crime (Dembo et al., 1987; Dawkins, 1997; Baker, 1998). People who commit criminal acts are more likely than those who do not to use marijuana (Taylor and Bennett, 1999; Makkai and Fitzgerald, 2000), and people who use more marijuana commit more criminal acts than those who use less marijuana (McRostie, Castle, and Marshall, 2001). Still, most experts believe that the correlation could be due to common risk-seeking or delinquency factors that generate a spurious association between marijuana use and crime.

Although there have been numerous studies that have attempted to examine the contemporaneous relationship between marijuana use and violent or property crime, rigorous examinations using techniques that enable causal interpretation of results are rare (Pacula, Lundberg, et al., 2013). Instrumental-variable approaches and longitudinal analyses of prospective cohorts provide the clearest evidence (Arseneault et al., 2000; Markowitz, 2005). However, even when a statistically significant association remains in these studies, the studies have never been able to demonstrate that the people being studied were actually under the influence of marijuana at the time of the offense (suggesting that intoxication was a direct cause). Thus, they never completely eliminate the possibility that a third unobserved factor is causing the statistical association.

For example, a paper by Green et al. (2010) identified a link between marijuana use and property crime by applying propensity-score matching to a longitudinal community cohort of blacks in Chicago. Heavy adolescent marijuana users (defined as those who had used 20 or more times in their lifetimes) were matched with nonheavy marijuana users based on variables that would confound the relationship between drugs and crime. After matching, the two groups were similar in important observable characteristics (measured from the survey), including personality traits (such as aggression), family situation (such as mother’s use of discipline), and elementary school adaption and achievement (such as teacher’s rating of conduct problems). Using these matched groups, heavy marijuana use in adolescence was associated with crime generally, but, when the authors decomposed their findings by different types of crimes, they found that the association held for drug-related crime and property crime, not violent crime. The association with drug-related crime is not surprising but is more a reflection of marijuana being illegal than of any psychopharmacological effects on criminality. The odds ratio associated with property crime based on heavy marijuana use was 1.5:1.

Although the Green et al. study is clearly suggestive, it cannot rule out that marijuana use is simply a correlate of a long-term trajectory of criminality because use is not measured in close temporal proximity to engagement in crime (which is needed to conclude that the substance itself has a criminogenic effect). Indeed, in supplemental analyses that attempted to explore the extent to which marijuana use was the true cause, the authors found that dropping out of high

school was a key mediating pathway through which heavy adolescent marijuana use negatively influenced crime over the life course. Other social scientists have also found evidence suggesting that marijuana use is simply a mediating influence of a delinquent life course (Pedersen and Skardhamar, 2010; J. Ford, 2005; Windle and Wiesner, 2004; Fergusson, Horwood, and Swain-Campbell, 2002).

The crime rate in Colorado has been a topic of discussion postlegalization, with advocates on all sides of the debate arguing that the evidence does not support their opponents' positions. For example, comparing Denver crime data from the first six months of 2013 and those from the first six months of 2014, *The Huffington Post* noted that rates of property crime, as well as homicide, sexual assault, and robbery, were all down; only aggravated assault was up (by 2.2 percent). The author noted,

Correlation does not imply causation, regardless of which way the crime data move, and after just six months, it may be too early to identify any strong social trends. But evidence of a crime wave simply has not materialized—despite numerous dire warnings prior to legalization. (Ferner, 2014)

Similarly, a *Washington Post* blog post argued, “So perhaps we should hold off on the panicky stories about pot-fueled crime waves for a bit—especially since the early data show that crime has actually dropped” (Balko, 2014).

On the other side, opponents of legalization argued that evidence of a crime drop in Colorado comes from those who wanted to “cook up numbers they wished to see” (Sabet, 2014). They cite sources suggesting that total crime in Denver actually went up 7 percent in the first six months of 2014 from rates in 2013 (see, e.g., Thurstone, 2014). The story depends on what offenses are being considered, what data sources are used, and whether crime reports are being combined with arrest statistics. After commissioning a similar study of crime in Denver, the head of the National Association of Drug Court Professionals noted that “we are promoting the position that the question remains open, and at best we can say there is contradictory evidence when trying to draw conclusions about the effect marijuana legalization has had on crime” (as quoted in Thurstone, 2014).

To make any sense of crime statistics in Colorado or Washington State, a more comprehensive multivariate analysis is needed, including crime trend data from nonlegalization states. The implementation of legalization in Alaska, Oregon, and Washington, D.C., will provide additional evidence. Unfortunately, a convincing study will require a longer postchange period, so we might not know more for several years.

Consequences of Marijuana Prohibition

Enforcement of laws against marijuana use and distribution imposes costs. It not only requires public expenditures as discussed in Chapter Two; it can also reduce the well-being of people and neighborhoods in a variety of ways. Having an arrest record—let alone being incarcerated, even briefly in jail—can disrupt legitimate careers and impair future job prospects (Raphael, 2014). Fines can also be significant: For someone who works close to the minimum wage in Vermont, paying \$200 for possessing less than 1 oz. could consume the take-home pay from the better part of a full week of work.

Collateral consequences associated with drug convictions can negatively affect users and their families. For example, depending on the state of residence and level of offense, a drug conviction can entail loss of food assistance, access to public housing, and federal financial aid for postsecondary education (*Federal Statutes Imposing Collateral Consequences upon Conviction*, undated; Mauer and McCalmont, 2013). On the other hand, according to a report funded by the Marijuana Policy Project, Vermont is already one of the ten states with the least severe collateral sanctions for marijuana offenses (Boire, undated).

Marijuana enforcement in the United States disproportionately affects blacks (ACLU, 2013; Glaser, 2015). Especially in the context of stop and frisk, these police encounters are correlated with self-reported trauma, anxiety, and other mental health problems (Geller et al., 2014). In addition, enforcing laws that have limited popular support can erode the legitimacy of authorities and might reduce compliance with the law (Nadler, 2005; Tyler, 1990) and cooperation with the police (Tyler and Fagan, 2008).

As mentioned in Chapter Two, legalizing marijuana will not eliminate the costs associated with marijuana prohibition. If a minimum legal purchase age is imposed, there will be penalties for underage possession and those who supply minors. There may also be penalties for public consumption, which could especially affect out-of-state visitors who might not be allowed to consume in their hotel rooms.

Substitution for or Complementarity with Other Substances

The previous sections identified various marijuana-related outcomes and reviewed literature on their magnitudes. However, even if such a catalog of direct effects were both exact and exhaustive, it could still be a terribly incomplete and misleading basis for a benefit–cost analysis because legalization’s indirect effects, via changes in the use of other substances, could well outweigh the importance of the marijuana-related outcomes themselves (at least as they are currently understood today). Unfortunately, the uncertainty about these indirect effects is, in many instances, even greater than the uncertainty about legalization’s effect on marijuana-related outcomes. This inconvenient ambiguity places severe limits on the confidence anyone should have in prior predictions about whether legalization will be a net win or a net loss for society.

This story of indirect effects mediated through other substances is easiest to tell, and most often raised, in terms of alcohol. Suppose that legalization led to a doubling of marijuana consumption of all sorts, including not only a doubling of controlled recreational use but also a doubling of compulsive abuse and dependence. One might well view this as a net bad because of all of the marijuana-related harms discussed above.

However, the total social cost associated with alcohol abuse is very much larger than all costs and outcomes related directly to marijuana use. So if the doubling of marijuana use came about because all these new marijuana users switched from drinking alcohol, that could be a net win from a public-health perspective, particularly if these people would otherwise have been binge drinking (Caulkins, Hawken, Kilmer, and Kleiman, 2012). Indeed, Caulkins,

Hawken, Kilmer, and Kleiman (2012) found that even a 10-percent reduction in alcohol abuse accompanying the doubling in marijuana use could be a net win for society.⁹

Alas, that story of increased marijuana use being a *substitute* for alcohol use is not the only possibility. It is also possible for two consumer goods to be *complements*, such that, when market conditions change in ways that promote greater use (and abuse) of one, that might lead to greater—not lesser—use (and abuse) of the other.

If marijuana and alcohol proved to be complements, and legalization led to any sizable increase in alcohol use and abuse, then legalization would be a net loss. Even if all marijuana-related costs magically disappeared, that could not offset the harm caused by a 10-percent increase in alcohol-related problems.

Not surprisingly, this prospect of marijuana legalization affecting alcohol-related problems becomes something of a Rorschach test for an observer's position concerning legalization. When interaction with alcohol use is raised, those who favor legalizing marijuana are often certain that any increase in marijuana use would replace and so reduce alcohol use; after all, the two substances are alternative ways of achieving intoxication. Conversely, opponents of legalization are often just as certain that greater marijuana use will bring greater alcohol use; after all, polydrug abuse is the norm (Mohler-Kuo, Lee, and Wechsler, 2003).

The descriptive statistics concerning overlap in use are clear. Marijuana users are much more likely than are nonusers to drink and to abuse alcohol. For example, current marijuana users are five times as likely as nonusers to meet DSM-IV criteria for alcohol abuse or dependence (26 percent versus 5 percent); that is, one in four current marijuana users is a problem drinker (calculated using 2012 NSDUH data using the SAMHSA online tool).

Indeed, simultaneous use is common. The national household survey asks people what, if any, other substances they used the last time they drank alcohol.¹⁰ Among the 15.4 million people who used both alcohol and marijuana at some time in the past 30 days, 54 percent reported using marijuana along with alcohol the last time they drank, a proportion that rises to 83 percent among daily or near-daily marijuana users.

As was discussed earlier in this chapter, correlation need not, however, imply causality. Alcohol use might cause marijuana use, not the other way round. Or there could be third variables—such as coming from a broken home or having a risk-taking personality—that lead people to consume more intoxicants generally, including both alcohol and marijuana. As we discuss in Appendix A, some scientific literature makes a serious attempt to tease out these complicated overlapping causal pathways, but, unfortunately, that literature is inconclusive.

Nor is alcohol the only substance with which there could be important interactions. Consider the one substance that could cause even greater social harms than alcohol—namely, tobacco. The overlap between marijuana and tobacco use is at least as strong as the overlap between marijuana and alcohol use. Past-month marijuana users are three times as likely as

⁹ Doubling of marijuana use would not lead to even a halving of all drinkers, because there are nearly ten times more drinkers than people who use marijuana. According to the 2013 NSDUH, there were 136.9 million past-month alcohol users and only 19.8 million past-month marijuana users (unadjusted for underreporting). Indeed, there were three times more binge drinkers in 2013 (60.1 million) than there were marijuana users. So a doubling of marijuana users—even if all the new users had been binge drinkers and became teetotalers—would reduce the social cost of binge drinking by only about one-third.

¹⁰ The question's wording: "Think again about this last time you drank any alcoholic beverages, when you had [number] [drink/drinks]. Did you also use [drug] while you were drinking or within a couple of hours of drinking?" and "What other drug or drugs did you use while you were drinking or within a couple of hours of drinking?"

nonusers to smoke cigarettes (59 percent versus 19 percent), a ratio that rises to 6:1 for those under the age of 21 (53 percent to 9 percent). Ninety-five percent of marijuana users report using tobacco at some point in their lives.¹¹ And again, concurrent use is common. More than half of marijuana users under the age of 35 report smoking a blunt (a hollowed-out cigar filled with marijuana) within the past 30 days (more than three-quarters among blacks). In Europe, mixing tobacco with marijuana or hashish in the same cigarette or joint has long been the norm (Leggett, 2006); it is not hard to imagine tobacco companies wanting to promote that practice in the United States after legalization.

Suppose that legalizing marijuana caused even a 1-percent increase in tobacco smoking. Because tobacco kills well over 400,000 people in the United States every year, then, in that hypothetical, legalizing marijuana might—in the long run—cause 4,000 additional premature deaths per year, an outcome that could outweigh any plausible benefits of marijuana legalization.

On the other hand, legalizing marijuana could shift marijuana consumption away from combusting plant material (as in smoking a standard joint) and toward heating and vaporizing extracts in vaping pens. The latter has become increasingly popular in places that have eased their marijuana prohibitions and is akin to using e-cigarettes to consume nicotine. Suppose this spilled over to make vaporization the norm among nicotine users (i.e., converted cigarette smokers into e-cigarette users). Some argue that that could be a public-health win if the health harm per person-year of nicotine dependence turns out to be lower when nicotine is delivered via e-cigarettes than with smoking traditional cigarettes (Cahn and Siegel, 2011).

Or it could be a public-health disaster; some in the tobacco-control community worry that e-cigarettes will prove to be not so much a substitute for traditional cigarettes as a pathway or stepping stone through which nonsmokers could get pulled into smoking (Grana, Benowitz, and Glantz, 2014). E-cigarette cartridges (like marijuana vaping-pen cartridges) come in all sorts of child-friendly fruit flavors, and, even if e-cigarettes create no risk of lung cancer directly, they do unambiguously deliver nicotine, which is highly dependence-inducing. So if the tobacco-control community's fears prove true, then a legalization-induced bump in vaping of all kinds, including e-cigarettes, might end up increasing, rather than reducing, the amount of tobacco smoking and all its many attendant harms.

At this point, even though the literature reviewed in Appendix A suggests that marijuana and tobacco are complements today, no empirical evidence can truly assess the likelihood of these very different future scenarios concerning the impact marijuana legalization might have on tobacco smoking.

Legalization could also affect the use and abuse of other illegal drugs. Long ago, there was great concern that trying marijuana could be a gateway that caused users to go seek stronger and stronger highs. Those fears arose from the combination of conditional probabilities (children who use marijuana are much more likely to progress to harder drugs) and sequential order (marijuana usually predates use of harder drugs). But those facts together do not imply causality. Various observers (e.g., Morral, McCaffrey, and Paddock, 2002) have shown that the same patterns could emerge if third variables (e.g., broken homes, risk-seeking personalities)

¹¹ Oddly, most of the remaining 5 percent report consuming marijuana in the form of blunts (cigars stuffed with marijuana), which they apparently do not view as using tobacco products even though the shell of a cigar is made of tobacco leaves.

cause use of both marijuana and hard drugs, and marijuana gets used first simply because it becomes available to children first.

But showing that the data do not imply that a causal version of the gateway hypothesis holds is not the same as showing that there is no causal effect. Third variables could account for some but not all of the correlation. Furthermore, the connection need not be purely biochemical. For example, use of marijuana could lead teens to spend more time with others who use marijuana (birds of feather flock together or, more formally, homophily), and those marijuana-using peers might have more-positive attitudes toward use of other drugs or know how to obtain those other drugs. Likewise, marijuana use might lead the individual to self-identify and to be identified by others (labeling) as being the sort of person who uses drugs of all kinds. And so on. So there could be a causal path from greater marijuana use to use of hard drugs that is social or psychological, even if there is no biochemical link. Hence, although confidence in the old-fashioned version of the gateway hypothesis went beyond the empirical evidence, confidence in the irrelevance of the gateway hypothesis might be equally naïve.

Marijuana could also be both a complement and a substitute for other drugs but on different time scales—e.g., they might be substitutes in the short run and complements in the long run. Or marijuana might also be a complement for some drugs but a substitute for others.

And even if marijuana were a complement to other illegal drugs under today's circumstances, that does not mean that legalizing marijuana would necessarily increase use of hard drugs. One of the primary motivations for the Netherlands' de facto legalization of retail cannabis sales was the desire to separate the soft- and hard-drug markets, so people could obtain cannabis without coming into contact with sellers of hard drugs, and there is some evidence of success in that regard (MacCoun, 2011b).

It is also worth noting that the vast majority of initiation into the use of any of these drugs, including marijuana but also other illegal drugs, alcohol, and tobacco, occurs before the age of 21, so the legal status of most potential initiates would not change. What would change is the supply, variety, price, and availability of marijuana products.

One goal of the either-or discussion in the preceding paragraphs is to shake readers from any strong prior convictions that they can just know that legalizing marijuana will increase or that it will decrease use or abuse of this or that other substance. It is easy to assemble deductive arguments in either direction, as advocates on both sides of the marijuana-legalization debate routinely do.

An honest analysis should view the issue as an empirical question to be resolved by looking at evidence from well-run studies. Hence, Appendix A briefly reviews empirical evidence from the scientific literature concerning whether and under what circumstances marijuana appears to be a substitute or a complement for use of other drugs.

Unfortunately, the punch line remains enormous uncertainty; the nature and size of the totality of legalization's indirect effects mediated through changes in the use of all other substances—legal and illegal—remains a huge unknown.

One can be slightly more definitive when considering each substance or category of substances one at a time. Table 3.1 captures the gist of this complicated literature in the simplest possible terms, distinguishing along just two dimensions: (1) size of the literature underpinning the estimates and (2) degree of consensus among those studies.

For alcohol and for the other illegal drugs, the existing literature is ambiguous, with some studies pointing in one direction and others pointing in the opposite direction. For opioids, there is consistency, but perhaps only because there are so few studies. The one substance for

Table 3.1
Summary of Literature on the Extent to Which Marijuana Is a
Substitute for or Complement with Other Drugs

Substance	Studies	Agreement Among Studies	Finding
Alcohol	Many	No consensus	Unknown
Tobacco	Many	High consensus	Complementarity
Prescription opioids	Few	Consensus	Substitution
Illegal drugs	Few	No consensus	Unknown

which the literature provides clearer indication is the interaction with tobacco use, for which there is considerable evidence and it tilts strongly toward complementarity (i.e., greater marijuana use would be expected to lead to greater tobacco use). Complementarity can arise with respect to initiation (marijuana initiation often predates tobacco initiation, creating the possibility of a reverse gateway), concurrent use (some users think that nicotine enhances the marijuana high), or cessation (marijuana use predicts lower success rates when trying to quit tobacco use).

Note that, even if the literature assessing historical patterns were unanimous, though, none of it speaks directly to Vermont's situation. Legalization is new; before 2012, no major modern jurisdiction had ever legalized commercial production of marijuana, and it is only in 2014 that stores have opened in the two early-adopting jurisdictions (Colorado and Washington State). So all of the historical evidence comes from changes in the price, availability, or sanctions for marijuana under regimes that prohibited production and commercial distribution of marijuana (or from changes in supply of the other drug on use of marijuana). Drawing inferences from that backward-looking literature about what would happen if Vermont legalized involves substantial extrapolation beyond the support of the data. So the literature can, at best, be suggestive; it is in no way definitive.

Concluding Thoughts

We began this chapter by asking two very basic questions: (1) What effect does marijuana use have on health and safety? and (2) What effects would a change in marijuana laws have on patterns of use and, hence, health and safety? By this time, the reader is keenly aware that what the literature has found about the effects of marijuana use in the past might not be the effects of marijuana use in the future because the findings to date have been based largely on observational data that reflect use of a substance containing largely unmeasured amounts of cannabinoids that can differentially influence marijuana's impact on health and safety. We also do not know precisely what will happen to marijuana use with legalization or, specifically, the extent to which heavy or harmful use will rise, which is directly relevant for understanding the public-health and safety consequences. Nor do we know how the product might change (e.g., potency, mode of use) or how these changes might differentially influence relationships identified here. Thus, it is difficult to say with any certainty whether the associations identified in the past will be maintained in the future.

With those caveats in mind, the current status of the literature does identify some clear acute and chronic health effects, especially of frequent, high-dose marijuana use. Acute risks include accidents and impaired cognitive functioning while intoxicated, as well as anxiety, dysphoria, and panic. Longer-term risks of persistent heavy use include dependence and bronchitis. There is some suggestive evidence of other serious risks for heavy marijuana users, including psychotic symptoms (which is different from being diagnosed with schizophrenia), cardiovascular disease, and testicular cancers. More research is needed before firm conclusions can be drawn. Although the literature showing a relationship between marijuana use and crime is extensive, there is little evidence that use itself increases criminal behavior, so one would not expect legalization to have important effects on nondrug crime, either favorably or unfavorably. Finally, the literature that persistently identifies a negative association between marijuana use and school attendance and achievement has not definitively determined whether the association is causal or not.

So, perhaps some of the greatest health and safety consequences of marijuana use reside in the implications of its use in lieu of or in addition to other intoxicating substances. There the clearest evidence pertains to interactions with tobacco, and it suggests that greater marijuana use would be expected to also lead to greater tobacco use.

It is important to emphasize that we have not attempted to offer a cost–benefit analysis. We have reviewed evidence for the health and safety consequences associated with marijuana but not its nonmedical or aesthetic benefits. We believe that such benefits are real and that they should matter, but they are far more difficult to quantify, and they have received far less research attention than the harms of marijuana use (see Caulkins, Hawken, Kilmer, and Kleiman, 2012, Chapter Six).

Indeed, if Vermont consumes 20 t of marijuana each year and each gram produces four hours of intoxication, this means that marijuana produces about 80 million hours of intoxication in Vermont each year. If legalization increases intoxication by 50 percent, which is not an unreasonable projection under certain assumptions (see Chapter Seven), those 40 million hours could figure prominently in a benefit–cost analysis—but it is entirely unclear how they should be scored. As Caulkins, Hawken, Kilmer, and Kleiman (2012) noted, “some of those hours are intensely pleasurable and cause no harm to the user or anyone else; others contribute to dysfunction and personal failure” (p. 181).

We emphasize that the relevant policy question is not whether marijuana’s current harms outweigh its benefits but whether and how legalization might *change* those harms and benefits and in which direction. At least at present, answering that question is more a matter of judgment than of calculation, and different readers will reach different conclusions.

Supply Architectures

Introduction

One of the key elements of a plan for implementing legalization is determining how marijuana will be supplied. Specifically, what kinds of organizations will be allowed to produce and distribute marijuana? Historically, the answer under prohibition has been “none.” Now some states that allow the use of marijuana under medical recommendation allow production and sale for that purpose, while others allow production only for personal use. In November 2012, Colorado and Washington State made a dramatic break with past practice by voting to allow a for-profit commercial marijuana industry that is licensed and regulated somewhat like the alcohol industry.

But there is a lot of policy space between traditional prohibition and such commercial legalization (see MacCoun, 2013a). Figure 4.1 presents 12 alternatives regarding who is allowed to supply marijuana, arrayed from most to least restrictive.¹ Voters in Colorado and Washington skipped over many intermediate options, such as barring for-profit corporations but allowing co-ops or nonprofits whose boards include public-health and child-welfare advocates.

Each of these supply strategies is really a broad category of options encompassing considerable scope for fine-tuning. And a bad implementation of a good strategy might underperform relative to a wise implementation of an inferior one. Therefore, picking a strategy is more the beginning of a discussion and design process than an answer to the question of what should be done. However, some consequences inevitably flow from selecting who is allowed to produce and supply marijuana that no amount of fine-tuning can overcome.

The chapter describes 12 approaches, breaking them down into three groups:

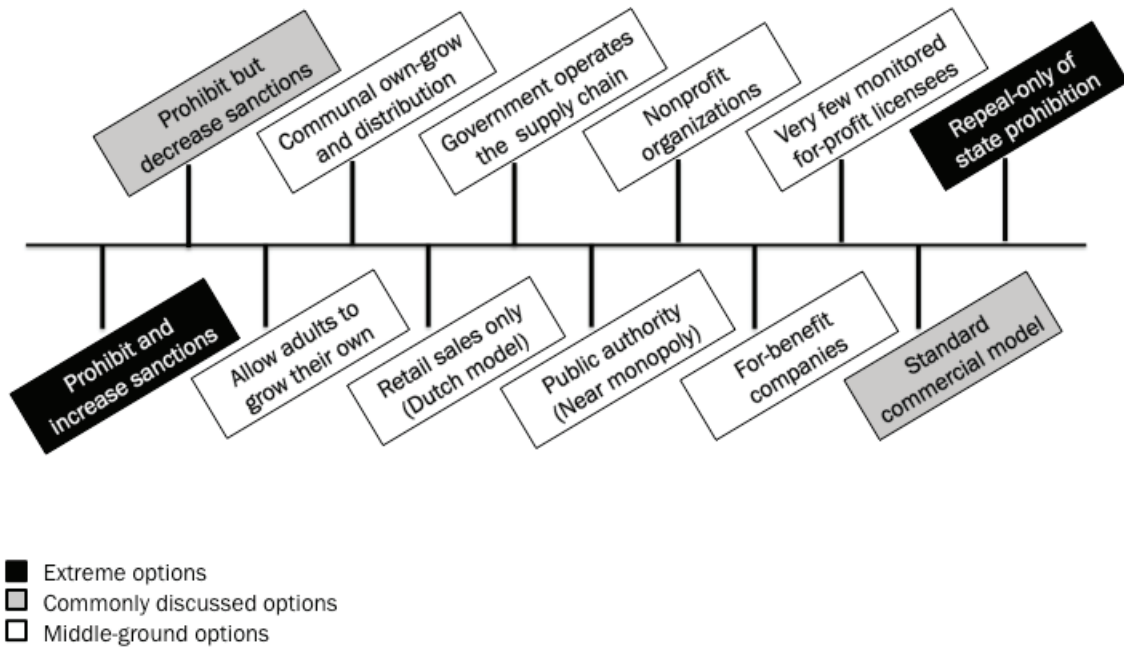
- the two options most commonly discussed in the United States
 - Retain prohibition but decrease sanctions.
 - Implement an alcohol-style commercial model
- eight options that find a middle ground between those commonly discussed
 - Allow adults to grow their own.
 - Allow distribution only within small co-ops or buyers’ clubs.
 - Permit locally controlled retail sales (the Dutch coffee-shop model).
 - Have the government operate the supply chain (government monopoly).
 - Have a public authority operate the supply chain.

¹ There could be exceptions to this general ordering. For example, it is possible to conceive of a highly taxed and tightly regulated private market that was actually more restrictive than a state monopoly with low prices and aggressive marketing along the lines of many state lotteries.

- Permit only nonprofit organizations to sell.
- Permit only for-benefit companies to sell.
- Have very few closely monitored for-profit licensees.
- two extreme options
 - Increase sanctions.
 - Repeal the state’s prohibition without creating any new, product-specific regulations.

We then compare these strategies across a series of criteria likely to be important to policy-makers and voters, such as production costs, product quality assurance, government ability to restrain suppliers’ promotion of harmful use, cost of government control efforts, ability to generate state revenue, and conflict with the Controlled Substances Act (CSA) (Pub. L. 91-513, 1970, Title II).

Figure 4.1
Twelve Supply Alternatives to Status Quo Prohibition



The Commonly Discussed Options

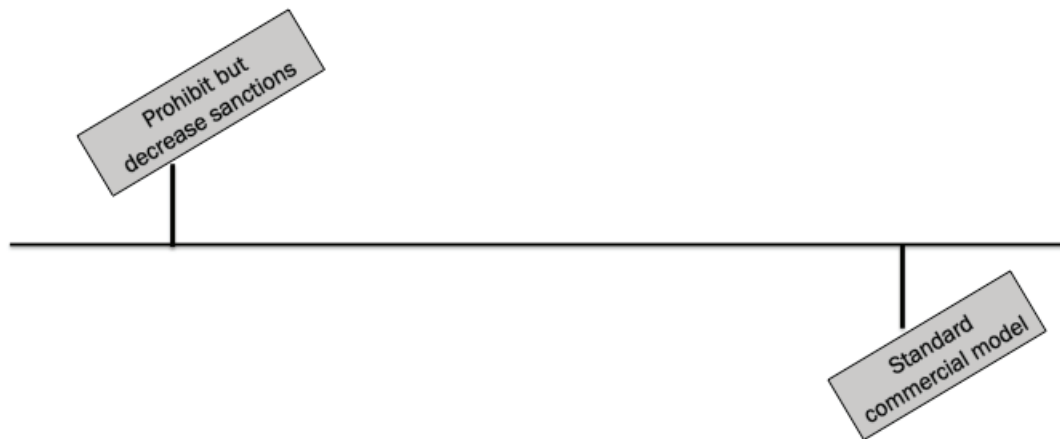
This section describes two commonly discussed supply options (also illustrated in Figure 4.2).

Retain Prohibition but Decrease Sanctions (Mend It; Don't End It)

Many people support legalizing marijuana not so much because they want access to a broader range of higher-quality and lower-priced marijuana products as because they dislike marijuana prohibition (Galston and Dionne, 2013). They are troubled by the large number of marijuana arrests and their racially disparate character (Nguyen and Reuter, 2012) or by how damaging a youthful indiscretion with marijuana can be to access to student loans, public housing, and jobs (Blumstein and Beck, 2005; University of California Los Angeles Integrated Substance Abuse Programs, 2007; Raphael and Stoll, 2009). See Chapter Three for additional discussion.

For those who dislike the excesses of prohibition, one option is simply to eliminate those excesses or, to borrow President Bill Clinton's slogan for welfare reform, to "mend prohibition but not end it." Vermont has already taken two substantial steps toward liberalizing its prohibition by decriminalizing possession of up to 1 oz., reducing the sanction to just a \$200 fine (maximum) and \$147 in surcharges for the first offense (effective July 2013), and providing access to medical marijuana for those with serious debilitating medical conditions (see Chapter Two).

Figure 4.2
The Commonly Discussed Options



Additional steps in this direction that Vermont could take include the following:

- further reducing the fines for possession, e.g., to the \$25 level established for Washington, D.C., or fully legalizing possession for personal use but not sales
- reducing the number of investigations and prosecutions of marijuana-market offenses or reducing sentence lengths for those convicted of producing or distributing marijuana
- eliminating incarceration for those convicted of producing or distributing marijuana
- expunging criminal records of those who have been convicted of minor marijuana violations
- after a certain lag, expunging criminal records of those convicted of distribution offenses.

(Vermont does not have mandatory minimum sentences for marijuana-distribution offenses, so eliminating them is not a relevant option. See 18 V.S.A. 4230.)

The level of enforcement effort deserves more attention than it usually receives. Existence of prohibition does not imply any necessity to enforce the prohibition aggressively. Many jurisdictions traditionally put little energy into enforcing prohibitions against prostitution and gambling. Indeed, a number of U.S. cities have adopted local policies making marijuana enforcement the lowest law enforcement priority (e.g., Berkeley, San Francisco, and Seattle). On the other hand, enforcement and prosecution are primarily local decisions, harder to influence at the state level.²

Implement an Alcohol-Style Commercial Model (Regulate Like Alcohol)

When people use the term *legalize* without further elaboration, they might often have in mind what might be called the standard commercial model, leaving production, distribution, and sale to the competitive private market, subject both to the standard laws and regulations that apply to all economic activity and to some additional rules specific to that product. For marijuana, these additional rules mostly pertain to the following:

- who can use (e.g., anyone over 21)
- quality control (e.g., testing requirements)
- packaging (e.g., requiring certain labeling)
- industry structure (e.g., requiring or banning vertical integration between producers, distributors, and retailers)
- product selection (e.g., whether to allow the sale of concentrates and edibles, whether to restrict potency)
- retail operations (e.g., rules that keep a minimum distance between stores and sensitive locations, such as schools; require vendor training; ban special sales and volume discounts; limit amount either per transaction or per user per day or month).

² People commonly opine that the United States should be more like European nations on drug policy (e.g., Steves, undated). What such observers might have in mind is that the United States avoid excessive enforcement or expand funding for treatment, prevention, and harm reduction. In 2010, the United States had a somewhat higher marijuana arrest rate per capita than the average for 24 European countries: 275 versus 177 per 100,000 (authors' calculations). But U.S. prevalence is also higher: The number of marijuana arrests per past-month user was actually higher in those European countries than in the United States (6.6 versus 4.9 per 100 past-month users). Likewise, the marijuana arrest rates in Canada in 2010 were about 221 per 100,000 people and 4.5 per 100 past-month users, only 10 to 20 percent lower than in the United States.

To reduce the risk of exports to other states, Washington State has also sought to limit the amount produced to that needed to serve its own domestic market.

In other states, this approach is referred to as “regulate like alcohol.” But Vermont and the other so-called control states take a more restrictive approach to distilled spirits. We describe those systems, with their direct state involvement in one or more tiers of the distribution system (e.g., with state-controlled package or alcoholic beverage control [ABC] stores), under the heading “Have the Government Operate the Supply Chain.” Rather, “regulate like alcohol” for most of the country means just requiring market operators to obtain a license and follow a larger-than-usual set of product-specific regulations.³

Washington State and Colorado (and soon Oregon and Alaska) limit marijuana sales to dedicated stores, as opposed to allowing other retail stores to stock marijuana products alongside other items. That helps keep minors away from retail selling and renders impractical some cross-price subsidization tactics. (If convenience stores could sell marijuana, one might expect them to use marijuana as a loss leader, selling below cost in order to increase customer volumes and recoup forgone marijuana revenue through greater sales of other items.) It also keeps marijuana sales separate from alcohol and tobacco sales.

The guiding spirit of this approach is to let the market evolve to maximize the efficiency of production, the appeal of products to consumers, and the size, scale, and scope of the market—subject only to remaining within the regulatory parameters. This spirit is reflected in which types of agencies are charged with implementing the rules: a revenue-raising agency in Colorado and the Liquor Control Board in Washington, rather than a public-health agency. A public-health agency might instead view the problem as one of killing off the black market while suffering the smallest possible increase in use. However, creating a public-health agency with the requisite capacity to issue licenses, monitor production, issue and enforce regulations, and collect taxes would constitute a challenge, while those activities are among the core competencies of revenue departments and liquor boards.

No one knows how a dynamic competitive market in marijuana would evolve,⁴ but we think that some plausible conjectures include the following:

- Production costs of usable marijuana will be much lower at production scales above 10,000 to 100,000 sq. ft. than they have been in traditional (indoor) operations that were smaller than a few thousand square feet, so average firm size will grow.
- Production will shift from indoors to greenhouses (greenhouses are cheaper, artificial lighting is expensive, and densely packed plants are more prone to pests and disease) and possibly to outdoor production (cheaper still but subject to some caveats explored below).
- The marijuana industry will want to shift consumption patterns away from traditional loose marijuana (for pipes and roll-your-own joints) that could require labor-intensive hand trimming via some combination of the following:

³ Further confusing matters is the fact that Colorado’s legalization explicitly made reference to “regulate like alcohol.” It now allows vertical integration between producers and retailers even though the central purpose of the “three-tier system” of postprohibition alcohol regulation in the United States is preventing such vertical integration and associated practices, such as producers selling directly to or otherwise controlling the retailers.

⁴ Indeed, this description ducks some important issues, such as the evolution of typical potencies, however *typical* gets defined, and whether additional cannabinoids beyond THC and CBD will rise to prominence.

- mechanization of trimming (viewed skeptically by many in the industry⁵)
- production and sale of extract-based products
- sale of rolled joints (akin to conventional manufactured versus roll-your-own tobacco cigarettes).
- Declining costs of production per unit of intoxicant will shift profit opportunities toward
 - firms that promote brand identification via mass marketing
 - boutique brands for affluent consumers
 - on-premise consumption (compare cost of a muffin at a café with that of one from a grocery store)
 - high-touch retailers
 - bundling (marijuana in candy bars might yield higher margins than just marijuana)
 - cross-subsidization (e.g., promoting ski vacations with complimentary marijuana).

The great unknown is the direction of product innovation:

- toward (or away from?) very-high-potency products
- toward (but how far toward?) concentrates and edibles
- the biggest wild card of all: the potential development of new products based on systematic extraction and blending of the hundreds of possibly psychoactive chemicals in the cannabis plant, of which today only two (THC and CBD) have reasonably well-characterized activity.

The contrast between extracts and conventional usable marijuana is important, so it bears elaboration—albeit with a reemphasis on the caveat that these projections are all speculative. *These considerations are also not necessarily germane only to a commercial market model.* A government monopoly could promote the production and sale of extracts despite the associated public-health concerns, just as government monopolies promote lotteries despite various concerns they raise. However, as Rolles and Murkin (2013) observed, profit-oriented companies might be expected to behave that way, whereas regimes that balance profit with broader public interest might wish to restrict legalization to usable marijuana, at least initially. And, more generally, one might expect the industry to be more innovative under a (regulated) free-market model than with some of the other options, particularly, say, if production were limited to small noncommercial co-ops.

Usable marijuana generally refers to the flowering tops of cannabis plants and sometimes the leaves, suitably prepared.⁶ The flowering tops have the highest concentrations of THC but constitute only a modest proportion of the plant's weight. So a considerable proportion of the THC produced by the plant resides in leaves and trim, material that, in the past, has often been discarded because machines that can efficiently extract that THC were too expensive

⁵ The majority view is that mechanized trimming destroys the aesthetics of the product. Another view is that some varieties are already amenable to mechanized trimming because of the shape of their buds and leaves, and growers could selectively breed this desirable trait into other strains.

⁶ Washington State's Initiative Measure 502 (I-502) restricts the definition to flowering tops; by contrast, 18 V.S.A. Chapter 86 Subchapter 2 governing Vermont's medical-marijuana program defines usable marijuana as "the dried leaves and flowers of marijuana, and any mixture or preparation thereof, and does not include the seeds, stalks, and roots of the plant."

and bulky to maintain while evading police detection.⁷ After legalization, one would expect this THC to be extracted for sale as cooking oils, edibles, wax for dabbing, and oils to be used in vaporizers (which release THC by heating but not combusting, akin to e-cigarettes versus conventional cigarettes). So whereas with traditional patterns of production the market equilibrium had the bulk of marijuana being consumed in raw form, after legalization, extracted THC might be produced in volumes that will induce industry to promote a shift toward greater consumption of extract-based products.⁸

If demand for extract-based products takes off (e.g., because e-cigarettes displace combustion as the principal route of inhalation) and marijuana is legalized nationally, not just at the state level, there could be a further radical shift away from labor-intensive cultivation for flowering tops and toward outdoor mechanized farming. Production costs per acre are very low when cannabis plants are grown for seed or fiber and harvested with tractors and combines. By design, cannabis varieties grown for hemp have near-zero THC content, but THC-bearing strains can be farmed in the same way. They likely would not approach the THC content achieved with intensive indoor cultivation, but industrial farming would more than make up for lower potency through much lower costs per pound of material harvested. If the extraction process can be scaled up to deal with larger volumes of lower-THC material, this might radically reduce the cost structure for producing extract and, hence, extract-based products, such as hash oils. This might also push the efficient operating scale for marijuana firms up again, beyond the 10,000- to 100,000-square-foot range, to farm-sized operations. At that point, the production sector might be commoditized; all of the THC consumed in the entire country could be grown on a dozen or so modest farms of 1,000 acres, a common size in the Midwest (Caulkins, Hawken, Kilmer, and Kleiman, 2012).

If the industry goes down this path, then market power and profits could shift to firms with the marketing expertise to develop and promote brands that consumers recognize and for which they are willing to pay more. That is, the industry could shift from being product- or production process-dominated to one in which producers achieve dominance through marketing. Arguably, that is the situation today with cigarettes and mass-market (as opposed to craft) beer.

It is hard to predict whether consumers will accept an overall shift from combustion to vaporization. On the one hand, it is already taking place to some extent in states with wide-open medical dispensaries, such as California, and in Colorado and Washington. Also, by (largely) eliminating the odor, vaporizing makes it much easier to use marijuana discreetly, without being detected by disapproving friends, parents, teachers, or co-workers, and, as Chapter Three explained, vaporization avoids the carcinogens and irritants in conventional marijuana smoke. Nevertheless, the tradition of smoking marijuana—and hence of inhaling combustion by-products—is very well-entrenched.

⁷ A typical machine today might cost \$50,000 to \$100,000 and fill the better part of a small room. It is unclear to us at present whether extraction will enjoy additional scale economies that will push the extraction market toward even larger operations or whether techniques will be developed allowing efficient extraction at small (perhaps even household) scale.

⁸ Again, such innovation is not literally possible only under the commercial model, but the commercial option will presumably encourage innovation; the state-store option could embrace it or avoid it; while the grow-your-own or grow-and-give model would not support extraction operations unless someone invents technologies that are cheaper and easier to use at small scale. Likewise, commercial outfits might have much more incentive than co-ops or not-for-profits to engage in product-innovation research and development (R&D), especially around systematic extraction and blending of specific molecules, which is likely to be both investment-intensive up front and technically demanding in production.

Another possible product shift that might prompt a transition from greenhouse-based production to outdoor industrial farming would be a shift from roll-your-own to rolled joints if—and this remains unclear—lower-THC material could be fortified with additional THC from extracts. Large-scale farming might not match either the potency or the aesthetic (e.g., appearance, smell) of the artisanally grown usable marijuana that dominates the high-end market today. But if THC levels could be pumped up by supplementing the basic organic material with additional THC, large-scale manufacturing might offer rolled marijuana cigarettes at far lower prices than is possible with current production methods. That would mirror the way in which the introduction of manufactured, rolled cigarettes in the 1880s revolutionized patterns of tobacco consumption in the United States and eventually the world.

It is entirely unclear how long it will take the industry to evolve. Where growing is legal or quasi-legal, some of the more-successful firms have been teaming a skilled grower with someone with a good head for business (sometimes literally a master's in business administration, or MBA) in order to expand production volume and leverage the (high-salaried) marijuana expert with larger numbers of lower-skilled workers. As those operations grow a bit more, one might expect them to begin to hire other specialists, such as industrial engineers and professional agronomists, and perhaps professionals with expertise in marketing and brand management.

The specific trajectory just outlined is far from certain. Nevertheless, one would expect there to be, in some form, considerable product innovation, declining production costs, increasing firm sizes, and greater marketing. A regulated-like-alcohol industry can present consumers with a tantalizing array of high-quality products at prices well below what they are today; that is a service at which free markets excel.

One should also expect the industry to maintain a lobbying presence in state capitols; indeed, a trade group, the National Cannabis Industry Association, already does so in some states. But whether a mature marijuana industry looks more like that for tobacco or beer, with a few giant corporations dominating, or whether it looks more like the wine industry, is hard to predict.

The prediction challenge is amplified because much depends on policy. Legalizing only usable marijuana and not extract-based products (something advocated by Rolles and Murkin, 2013) would slow the evolution of the industry. Banning or taxing outdoor and greenhouse-based production would help keep production costs high.⁹ Instituting minimum pricing would thwart sharp price declines, as would production quotas set below the amount demanded at market prices, with or without a quota auction to capture the increase in price as revenue for the state, further discussed in Chapters Five and Six.

It is not clear, though, whether such regulatory constraints are viable in the long run for a single state, as opposed to a nation. If one state bans extract-based products but its neighbor allows them, then availability might be nearly as high as if the first state had allowed the extract-based products.¹⁰ Because Vermont could be the first state in the Northeast to go down this path, competition from neighboring legal markets might not be an issue initially, but product-category bans would leave a market niche for strictly illicit activity.

⁹ However, forcing production indoors with artificial lights greatly increases electricity consumption and the industry's carbon footprint; see O'Hare, Sanchez, and Alstone (2013).

¹⁰ Marijuana has a much higher ratio of value to weight and volume than most consumer goods do. Unlike usable marijuana, some extract-based products, such as some unwrapped edibles, appear innocuous to the naked eye. Detection techniques, such as chemical analysis or trained sniffing dogs, would be required even to identify this kind of contraband.

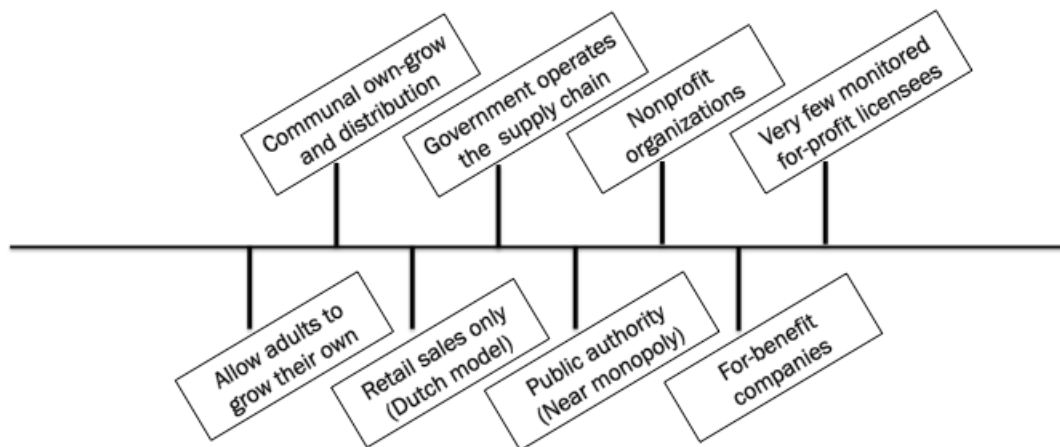
The Middle-Ground Options

This section describes eight commonly discussed supply options (also illustrated in Figure 4.3).

Allow Adults to Grow Their Own

In 1975, Alaska's Supreme Court ruled that the privacy rights granted by its state constitution cover possession of marijuana in the home, a right later quantified as possession of up to 4 oz. or 25 plants. (The right was challenged by a 1990 voter proposition that passed but reaffirmed in a 2003 court case.) South Australia has a roughly similar policy (punished by a fine), as do various other U.S. states for medical marijuana, sometimes coupled with quite liberal rules over what conditions constitute legitimate need for medical marijuana. Likewise, Washington, D.C., voted this fall to pass ballot Initiative 71, which allows people to grow up to six plants (three mature) in their principal residences, with up to two people per residence exercising this right (i.e., up to 12 plants per residence).¹¹

Figure 4.3
The Middle-Ground Options



¹¹ The initiative, whose full text is available at DC Cannabis Campaign (undated), is named the "Legalization of Possession of Minimal Amounts of Marijuana for Personal Use Act." This is somewhat confusing considering that it does more than just legalize possession of minimal amounts for personal use.

So there is considerable experience with allowing users to grow their own marijuana, and overall the effects of doing so seem not to be very dramatic. MacCoun (2013a) reviewed the scarce and conflicting evidence concerning Alaska's home-growing policy changes and concluded that there was no compelling evidence that they affected use appreciably. Alaska has one of the nation's highest rates of marijuana use, but it is not clear that permission for home growing increased that rate.

NSDUH asks respondents how they obtained the marijuana they used most recently, with one of the four response options being "grew it yourself." The number of respondents checking this option hovered somewhat above 200,000 from 2002 through 2007 but has since risen sharply to nearly 500,000 in 2012. One grower could supply several friends, and own-growers tend to be heavier-than-average users, but those are still modest numbers compared with 25 million past-month users. Although home growing could help siphon some demand away from the black market, it might not ever win a large market share.¹² Black-market marijuana could be just too cheap and available for the opportunity to grow one's own to appeal to many customers.

Grow-your-own plus sharing (also known as grow and give) offers little opportunity for the government to generate revenue and provides less scope for enforcing product quality and labeling standards; however, regulations are indeed a possibility (see Chapter Six for further discussion).

There is also some risk of enabling illegal commercial production, particularly if the limits on home production are set too high. Enterprising entrepreneurs could distribute production across friends' houses, with each house staying below the threshold limit, and aggregate the production into (illegal) wholesale quantities only when it was time to harvest the marijuana and ship it to market.

This distributed production strategy, akin to the putting-out system of early textile manufacturing, is viable because it is possible to grow very large plants with yields of approximately 1 lb. per plant. That is not the usual practice when the constrained factor is area (as when trying to avoid police detection), but, if the limit is set only in terms of number of plants, growers can achieve very high yields per plant. Legislators seeking to allow limited home-grow without creating such a loophole might opt to restrict not only the number of plants but also their area and perhaps the wattage of lights used to grow them (Caulkins, Cohen, and Zamarrá, 2013).

Of course, from the perspective of someone who favors outright legalization, this loophole could be seen as a feature rather than a bug, and one could make that loophole larger by setting generous limits on the number of plants or, as in the Washington, D.C., Initiative 71, allowing multiple adults within a single residence to each have a set of plants.

Whether to allow home growing remains a question even if a state permits large-scale commercial growing. Colorado allows unlicensed home growing; Washington State does not allow home growing for recreational marijuana. The preferred option might depend on a state's aspiration for taxation. High tax rates provide an incentive to grow one's own, thereby placing some limits on potential tax revenue.

As a final note, there is a matter of principle; allowing own-growing provides a mechanism through which someone who cared enough about avoiding illegal activity could do so and still enjoy using marijuana. That principle could be important to some people, even if, in

¹² One would also expect home growers to produce primarily traditional usable marijuana (plant material) and fewer of the "exotic" products, such as fruit-flavored extracts for vaping pens, whose production benefits from economies of scale.

practice, allowing home growing would not change the behavior of most market participants, either users or producers.

Allow Distribution Only Within Small Co-Ops or Buyers' Clubs (The Co-Op or Buyers' Club Model)

One limitation of grow-your-own is that it suffers from the “zucchini problem” of feast-or-famine production. If you are going to grow any at all, it is hard not to grow too much for one person. An experienced grower can produce 300 to 400 g from one large plant, which is a year’s supply for even many daily users. Also, there are many varieties of cannabis plants, varying in potency, ratio of THC to CBD, and other ways, which exacerbates the problem. Growing one of each type of plant risks an even greater surfeit.

Some Spanish jurisdictions have addressed this issue by allowing so-called cannabis clubs, which amount to grow-your-own plus sharing with others within the club (or grow-your-own plus selling at cost, depending on the club). Because no one in the club sells for profit, these clubs appear to have managed to stay (ever so slightly) within the international treaty regime, which bans drug production and trafficking.¹³

The Spanish model is not perfect. It falls into a legal gray area, and some strictly illegal producers feign being cannabis clubs in order to provide cover for their black-market activities. Uruguay is currently in the process of implementing and regulating collectives, and time will tell whether they can prevent diversion.

Nevertheless, unlike a strict version of own-growing, the cannabis-club model appears to have the potential to undercut a meaningful segment of the illegal market while nonetheless confining the industry to traditional craft or artisanal production methods that avert the sort of price collapse that could accompany legalization of large-scale commercial production. Likewise, if clubs confine distribution to members, the clubs have little incentive to advertise their product to the public generally.

Finally, relative to simple home growing and small clubs, larger clubs would operate at a scale that facilitates production of concentrates and edibles. Thus, those seeking to reduce the availability of concentrates and edibles would want to ban production (further discussed in Chapter Six) and limit the size of these collectives.

Permit Locally Controlled Retail Sales (Dutch Coffee-Shop Model)

A common misconception is that the Netherlands has legalized marijuana production and sale. That is incorrect. Laws against production and wholesale distribution remain on the books and are enforced with considerable energy. Rather, starting in the 1970s, the Netherlands established de facto (though not de jure) legalization of possession, use, and retail sale via an explicit and formal policy of nonenforcement against sale of small amounts. (The quantity threshold was originally set at 30 g—roughly 1 oz.—but, in response to problems with drug tourism, was subsequently dropped to 5 g.)

The result was the famous Dutch coffee-shop system in which adults can buy (and use) cannabis with no risk of arrest, but proprietors may not sell alcohol or hard drugs or sell to minors. At one time, there were more than 1,000 coffee shops, but the number has fallen sharply as measures were taken to limit sales to drug tourists coming from other countries,

¹³ Some clubs set prices above the cost of production and use the net revenues for club activities but do not, or at least claim not to, allow the growers to retain profits for private use (Caulkins, Hawken, Kilmer, and Kleiman, 2012).

and additional local regulations were enforced, such as keeping shops at least 250 m from the nearest school. At present, there are several hundred coffee shops scattered among about one-quarter of the Netherlands' municipalities. (See MacCoun, 2011b, for a detailed examination of the Dutch system.)

Eliminating arrests for possession and retail sale is no mere half-measure. The great majority of marijuana arrests in the United States are for possession, many of which are for possession of small amounts (see Chapter Two for Vermont-specific numbers). So for a typical state, legalizing retail sale, possession, and use might eliminate a large proportion of the criminal sanctioning. However, Vermont has already decriminalized possession of small quantities, so the incremental reduction in arrests of following the Dutch model would be smaller for Vermont than in some other states (see Chapter Two).

The Dutch choice of nonenforcement against retail selling is restricted to shops that meet certain well-established criteria, such as the limit on amounts sold and a prohibition on most forms of traditional advertising. This provides levers for controlling the nature and behavior of the industry, but the Dutch system is nonetheless probably not best thought of as a national regulatory model. The Dutch national government does not, for example, collect special taxes on cannabis sales or mandate testing or labeling standards. Rather, regulatory control over coffee shops is mostly devolved to local governments.

The Dutch system is widely praised in the academic literature and by marijuana advocates (MacCoun and Reuter, 2001). In particular, it is credited with substantially achieving its original policy objective, which was to separate the soft-drug (cannabis) and hard-drug (e.g., heroin) markets by allowing people to obtain cannabis without coming into contact with people selling hard drugs.

The policy also continues to enjoy support from the Dutch public ("Cannabis Opinion Polls in the Netherlands," 2013), although there is some lingering dissatisfaction, in no small part because of the inherent tension that what the shops legally sell to retail customers out the front door is illegal when it enters through the back door in wholesale amounts.

Also, over the years, the Netherlands has grappled with drug tourism, meaning people coming to the Netherlands from other countries to purchase marijuana and other drugs. As Chapter Seven discusses at greater length, given Vermont's proximity to nearby population centers, Vermont should expect that any form of legalization, even just legalization of retail sales, will likely trigger substantial marijuana tourism until the neighboring states also legalize. Marijuana tourism is not all bad; it would generate revenues for hoteliers and restaurateurs just as fall leaves and ski slopes do. But with tourism comes traffic, congestion, and—for marijuana tourism—some risk of drivers who are impaired on their return journey. That could lead—as it has in a few Dutch towns—to problems with disorder.

Have the Government Operate the Supply Chain (Government Monopoly)

Throughout history, governments have maintained monopoly control over the supply of certain intoxicants, including British control of the opium trade between India and China (through the East India Company), national monopolies on tobacco production in various European countries in the post-World War II era, and various levels of the alcohol supply chain at various times in the United States and elsewhere.

Indeed, after repeal of federal alcohol prohibition in 1933, some states chose to move beyond mere licensing and regulation to directly own and operate parts of the supply chain in order to limit the influence of for-profit businesses (Aaron and Musto, 1981; Cook, 2007). It

was a partial—not a pure—government monopoly because none of the states produced its own alcohol, but, in many places, the state was the only wholesale distributor or the retail shops were state-run (Gruenewald, 2011). Deregulation of these markets occurred over time, really accelerating after 1980 (Gruenewald, 2011). As of January 2013, only 17 states retained state-run wholesale liquor-distribution systems—including Vermont (Alcohol Policy Information System, undated).¹⁴

Given the wealth of research suggesting that alcohol monopolies are better for public health than less regulated options (see reviews in Room, 1987, and Pacula, Kilmer, et al., 2014), we focus special attention on this particular supply alternative. However, we want to stress at the outset that direct state participation in the supply chain could cause the state to violate federal law (Mikos, 2013). Such a violation would seem to exist unless and until the CSA is amended or an equivalent suitable workaround is implemented.¹⁵ We say “seem” because legal considerations concerning federalism are complicated, and courts can surprise. For example, the CSA applies only to persons. Construing unrelated statutes, courts have sometimes found that the term *person* does not extend to the states as sovereign entities (Schwartz, 2013, p. 640), so it is conceivable that a court might rule that they are exempt from the CSA. However, it might be that the option described in this section is not in fact available at this time.

Direct government control of the supply chain would offer at least four categories of potentially beneficial effects. The first two are straightforward; the last two represent double-edged swords and so require longer descriptions.

Potential Benefit 1: Control of Diversion

If the state itself operates the production and distribution chain, limiting diversion could become somewhat easier. It could transform diversion from a regulatory violation by an independent private company to theft or unlawful sale by a supervised government employee. Also, unless the regulatory system is extremely efficient, distributing licenses for legal production to private entities might help provide cover for illegal production, in somewhat the way owning a cash-based business can provide cover for a money-laundering operation. Minimizing diversion from private production is possible, but it could require more effort, partially offsetting legalization’s anticipated benefit of eliminating the government’s costs of enforcing a prohibition.

Potential Benefit 2: Reversibility

If monopoly proves the best method of legalization, it will be easy to retain monopoly if Vermont adopts that method from the beginning. If Colorado- and Washington-style commercial legalization proves to be a better choice for Vermont, it will be relatively easy to switch from monopoly to private commerce. But, if Vermont adopts commercial legalization from the beginning and later realizes that it prefers another supply architecture, change might be more difficult. Commercial interests, at that point vested, would presumably oppose any proposal to take away their profits. Because it is more readily reversible in light of information yet to be obtained, monopoly is a more adaptable method of legalizing than private commerce.

¹⁴ Of the 17 states, 11 are completely state-run, four are mixed with no overlapping (i.e., some beverage types are sold in state-run stores and others in licensee stores, but no beverage type is sold in both kinds of stores), and two are mixed with overlapping (i.e., some beverage types are sold in state-run stores, some in licensee stores, and some in both kinds of stores). For more information, see Alcohol Policy Information System (undated).

¹⁵ One of us (Kleiman, 2013) has described a waiver strategy that might allow a presidential administration to bypass the CSA without actually requiring Congress to amend it.

Potential Benefit 3: Avoiding Advertising and Product Innovation

Private companies in the United States can advertise; their First Amendment protections of commercial free speech are very strong. Most of the limits on alcohol and tobacco advertising have come from voluntary agreements and court settlements, not legislation. However, if a government monopoly controlled supply, firms would have no incentive to spend their money promoting consumption of the government's product, even if they technically retained that right. So placing the entire distribution system in the government's hands sidesteps concerns about commercial advertising.

Government monopoly of just the retail stores would achieve a bit of this benefit; the government could directly control signage and point-of-sale displays, as opposed to merely issuing constitutionally questionable regulations of those practices. However, if the government stores sold name-brand merchandise produced by private companies, then those companies would continue to have an interest in promoting their brands.

The government could also outsource production but sell only a generic commodity with no branding or other labeling that identified the producer. In theory, that might limit producers' incentive to advertise as much as government operation of production would.¹⁶

Limiting advertising is a mixed blessing. Advertising that promotes underage use (e.g., the infamous Joe Camel campaign) is highly undesirable in the eyes of most public-health advocates. But advertising can also provide consumers with information that makes the markets operate more efficiently by reducing search time, facilitating comparison-shopping, and generally balancing the information asymmetry between suppliers and consumers. Losing those functions represents a real loss to society, although the loss could be partially offset by peer-to-peer sharing of user-generated information, which has long been prominent for marijuana, perhaps because of the scarcity of traditional advertising.

Potential Benefit 4: Preventing a Price Collapse

We expect that in the medium to long run, a free-market industry would innovate in ways that drive down production costs, and competitive pressures would force companies to pass along those savings to consumers in the form of lower prices. For most consumer goods, lower prices are a cause for celebration, but, if consumers are vulnerable to overindulging, low prices might be problematic. For example, some view innovation that has led to very low prices for soda pop, junk food, and candy to be a curse, not a blessing, for the American public.

The typical response of economists is that low production costs remain a blessing even if one prefers moderately high prices because one can always use taxes to prop prices up to whatever level is deemed socially optimal. Indeed, public-health advocates frequently suggest higher taxes for tobacco and alcohol; environmentalists do the same for gasoline.

Propping up prices with high taxes always works in the classroom, and usually works in the real world, but there are two caveats. The first is that, if the industry gets too powerful, it could lobby successfully for lower taxes. Arguably, that applies to alcohol, federal taxes for which have not been adjusted for inflation since 1991 and so have fallen enormously in real terms. The second catch is that, if taxes are too high, they invite evasion.

¹⁶ The efficacy of this strategy could depend on the producers' market share. If the government outsourced production to a monopolist, then the monopolist would have an incentive to pump up total consumption because that would increase its own sales by the same amount. If the government outsourced to three equal-sized firms, then when one company spent its own money to promote total consumption, it would reap only one-third of the benefit. If the government outsourced to ten firms, each would only derive one-tenth of the benefit, and so on.

A government monopoly will not solve this problem completely. If the prices are too high either in government stores or in private stores subject to large taxes, then that might induce black-market production. However, a government monopoly might be able to sustain a higher retail price because it would be easier to detect and suppress illegal activity if legitimate production were a government monopoly. Then any production outside of the identified government facilities would necessarily be illegal, whereas, if tax-evading activity could hide amid legal private production, it might be hard for enforcement agents to ascertain quickly whether a particular production site or a particular shipment in transit is legal or illegal.

Potential Cost and Its Possible Irrelevance

One of the usual arguments against government monopolies is that they are inefficient and unimaginative. Oddly, inefficiency might not be a serious problem with regard to marijuana production. Freed from the obligation to produce discreetly, marijuana-production costs might be quite low in the long run. So if the government wastefully produces at double the cost of an efficient free-market enterprise, that deadweight loss to society might not be all that large in absolute terms.

This point is perhaps best made by reference to some specific numbers. A typical daily user can be supplied by 2 to 3 sq. ft. of indoor growing area, or perhaps 3 to 6 sq. ft. of greenhouse space.¹⁷ Professional farmers' costs are typically \$5 to \$20 per square foot per year, suggesting production costs of approximately \$0.15 per day of heavy use. If the inefficiency of a government monopoly drove production cost up by an additional \$0.15 per day of use, that is not a large cost in absolute terms.

Waste and inefficiency are never good, but it is important to keep a sense of perspective. Economizing on production cost is not necessarily the most important consideration when selecting an architecture governing who gets to supply marijuana. If there are other compelling reasons for preferring a government monopoly, the problem of inefficient production costs might not be severe enough to warrant abandoning that approach.

Have a Public Authority Operate the Supply Chain (Near Monopoly)

Another option would obtain many, but not all, of the advantages of monopoly without having the state itself directly violate federal laws against possession or sale of marijuana. Legislation, rather than limiting commerce to licensed sellers, could create a single, special-purpose entity, call it a public authority, that would be the sole supplier and distributor of marijuana.

Under a public-authority model, the state would not itself possess or distribute marijuana. Rather, the public authority, like for-profit businesses in Colorado and Washington, would be the one violating any federal law. The state would appoint members of the public authority and set policy (for instance, to control diversion, control interactions with consumers, restrict sale to particular types of products, avoid advertising and product innovation, and prevent a price collapse). The hope is that those actions, in substance, might prove no more offensive to federal interests than a state's actions in a for-profit commercial model of hiring regulators and tax collectors, issuing licenses, writing regulatory and tax law, and collecting taxes.

There is a tension in the decision about how much independence to grant the authority. The more the state puts the authority at arm's length, the better the case for the authority being

¹⁷ Vermont's weather makes greenhouse operation impractical in winter. It is not clear whether greenhouses would manage two or three crops per year.

equivalent to a private business, so its position vis-à-vis the CSA would rise and fall with the Colorado and Washington models. For example, the state could *authorize* the authority to do various things but not require it and, hence, would not require the authority to violate federal law. Indeed because, like a public monopoly, a public authority could pursue policies that serve the public, not just a profit interest, a rational and selective federal government might well let the public authority proceed, even if more-provocative for-profit commercial sales in other states came under federal attack.

On the other hand, if the authority is entirely separate from the state in form and substance, the state loses control, and the authority could disregard the state's preferences.

Creating a public authority would be within the tradition of existing authorities in Vermont.¹⁸ The Vermont Economic Development Authority (VEDA) (10 V.S.A. § 213) and the Vermont State Housing Authority (VSHA) (24 V.S.A. § 4005), for instance, engage in business transactions and perform work the state wants done, without involving the state itself in commercial transactions.

A public authority would require a board (or perhaps a commissioner) to implement legalization: to set prices that consumers pay, to hire employees, to provide for retail outlets, and so on. Although the board of VEDA includes government officials by statute, the board of VSHA includes no *ex officio* members and need not include any government official.¹⁹ To the extent that legislators worry about the appearance of state involvement, they could minimize or even prohibit the participation of state officials on an authority's board.

One disadvantage of the public authority is that it would pay federal income tax on its perhaps-significant profits. VEDA and VSHA are exempt from federal income taxation only because they are "engaged in the exercise of [an] essential governmental function" under Internal Revenue Code Section 115 (26 U.S.C. § 115). Federal tax law treats this kind of authority differently from the way it treats the state itself. Any profits the state itself earns directly, such as profits from a state liquor monopoly, are automatically tax-exempt (see Internal Revenue Service [IRS], 1971a, 1971b). The Vermont Department of Liquor Control (DLC) is a department, not an authority. It might be hard to argue that selling marijuana is the "exercise of [an] essential governmental function," so income of any public authority, unlike income of a state monopoly, would bear federal income tax, including the burden of 26 U.S.C. § 280E (further discussed in Appendix B).²⁰

Although the profits would bear federal tax, changes in the makeup of the final consumer price could reduce that burden. Vermont could combine a public authority with excise taxes. (Most of Vermont's revenue from liquor sales comes from excise taxes; only a small percentage comes from monopoly profits. See DLC, 2014.) To the extent that the state imposes excise tax, the consumer pays more, and the public authority earns a lower taxable profit and pays less federal income tax. The consumer should be indifferent to this shift and might not notice it. But tax-driven maneuvering risks missing the point of a public authority model. Excise tax rates are relatively hard to change; nimble pricing is a key advantage of a public authority.

¹⁸ Such authorities are common in other states as well. The Port Authority of New York and New Jersey is a prominent example.

¹⁹ The VEDA board consists of 15 members with six-year terms. That of VSHA consists of seven members with five-year terms.

²⁰ Whether a public authority should bear state income tax is a question of state budget accounting.

Permit Only Nonprofit Organizations to Sell

Those who fear that the public interest could lose if the government or a public authority does not supply marijuana might wish to stack the deck by granting licenses only to organizations that are chartered to operate in the public interest (e.g., nonprofits). By design, nonprofits operate to serve the public interest, not to maximize shareholders' profit (although boards of nonprofits might nevertheless seek profits, whether to advance the mission of the group or to extend their personal influence).

One could go a step further and place specific requirements on the types of nonprofit organizations that are eligible. For example, one could require licensees to be nonprofits whose boards include members who are chosen by child-welfare and public-health groups, whose charters include language about operating only to meet existing demand rather than promoting greater use, or that pledge to donate any excess operating revenue to drug treatment and use-prevention organizations.

Note that this strategy is not so much an alternative to regulation as it is a supplement. Any of these restrictions on who is eligible to obtain a license could be overlaid on top of any other regulatory rules and strategies. So, for example, if Colorado had wished to follow this path, it would merely have needed to add a clause requiring licensees to be nonprofits. All of the other regulations and conditions governing licensee behavior could be retained, including tax revenue. *Nonprofit* should not be conflated with *nonrevenue*.

Of course, limiting participation in the marijuana market to nonprofits does not guarantee that the industry will not attempt to exert political influence or try to increase revenues. Although nonprofits should, in theory, not be inherently interested in expanding sales or streamlining production, nonprofit hospitals and universities compete aggressively. Board members might have a tendency to see growth as a sign of success. Term limits for board members of the nonprofit could be considered, along with other mechanisms to deter empire building.

Restricting the industry to nonprofits would also likely slow its growth—for better and for worse. Raising capital has been challenging for nonprofit medical-marijuana producers because they cannot sell equity shares in future profit streams the way for-profit companies can. Their capital comes primarily from loans.²¹ Furthermore, under federal prohibition, banks might be reluctant to make commercial loans, so the loans might come from private individuals.²²

Permit Only For-Benefit Companies to Sell (Sustainable Businesses)

Another supply option serves as a hybrid between the nonprofit and commercial options: Permit only for-benefit companies to sell. This structure would limit participation in the marijuana industry to companies that are concerned with improving environmental and social conditions in addition to making a profit. Although most companies have a fiduciary responsibility only to maximize profits for shareholders, for-benefit companies incorporate social goals into their governing documents.

²¹ In addition, nonprofits can have difficulties obtaining bank loans because lenders see them as a bigger financial risk than other organizations, especially for-profit companies.

²² Some medical industry participants make a similar point concerning employee stock options. If Vermont's industry were restricted to nonprofits but another state allowed for-profit companies, those out-of-state enterprises might lure skilled workers away from the Vermont-based nonprofits with offers of stock options (as well as higher salaries).

This could be a particularly attractive option for Vermont, which is one of 27 states that allows new companies to incorporate as benefit corporations or amend their articles of incorporation to become benefit corporations (Surowiecki, 2014). In Vermont, these companies must create “a material positive impact on society and the environment, as measured by a third-party standard, through activities that promote some combination of specific public benefits,” such as improving the environment or human health.²³ In addition, a benefit corporation’s board of directors must have at least one member designated as the benefit officer. Among other responsibilities, the benefit officer is charged with preparing the annual benefit report, which includes his or her statement about whether the “benefit corporation acted in accordance with its general public benefit purpose and any specific public benefit purpose in all material respects during the period covered by the report.” The company must make this report available to the public.²⁴

Of course, not every marijuana business will have a board of directors. In these cases, the state²⁵ could require businesses (e.g., sole proprietorships, limited-liability companies [LLCs]) wanting to participate in the marijuana market to be certified as a B Corp by a nationally respected nonprofit called B Lab (B Lab, undated [a]). This third-party certification requires applicants “to meet rigorous standards of social and environmental performance, accountability, and transparency.” *Inc.* referred to the B Corp label as “the highest standard for socially responsible businesses” (“How a Business Can Change the World,” 2011). To make sure a B Corp stays true to its stated mission, it must be recertified every two years by B Lab (undated [b]).

If a state is pondering whether to create a for-profit marijuana industry, it will be useful to step back and ask, “What kinds of organizations do we want selling these intoxicants? Those concerned only with profit, or those with a greater goal of producing social benefit or minimizing social harm?” If the monopoly, public-authority, or nonprofit model is infeasible, a jurisdiction could—at a minimum—explore the for-benefit option.

Have Very Few Closely Monitored For-Profit Licensees (Structured Oligopoly)

If a commercial free market would not serve the social interest and the other middle-ground options are not politically viable, it is natural to ask whether there is some way to get for-profit businesses to behave in the public interest. The answer is “Perhaps.”

The challenge is to figure out how to insulate the regulatory agencies from industry influence, empower regulators with big sticks, structure incentives so that companies prefer complying with regulations voluntarily to breaking the rules and taking the chance of getting hit

²³ According to the law, these specific public benefits include

Providing low income or underserved individuals or communities with beneficial products or services; promoting economic opportunity for individuals or communities beyond the creation of jobs in the normal course of business; preserving or improving the environment; improving human health; promoting the arts or sciences or the advancement of knowledge; increasing the flow of capital to entities with a public benefit purpose; and the accomplishment of any other identifiable benefit for society or the environment. (11A V.S.A. Chapter 21)

²⁴ From the Vermont Benefit Corporations Act (General Assembly of the State of Vermont, 2010):

A benefit corporation shall post its most recent benefit report endorsed by its shareholders on the public portion of its website, if any, except that the compensation paid to directors and any financial or proprietary information included in the benefit report may be omitted from the benefit report as posted. If a benefit corporation does not have a public website, it shall deliver a copy of its most recent benefit report on demand and without charge to any person who requests a copy.

²⁵ States that do not allow benefit corporations could follow this approach.

by that stick, and get regulators to see their task as promoting public health rather than simply keeping the industry lawful.

One key might be restricting licensing to the appropriate number of firms that are of appropriate size. Colorado makes no effort to limit the number of licenses. Applicants have to meet certain criteria, but the state awards licenses to all who meet the criteria, depending on market competition to balance supply and demand. Economists would predict that, in such circumstances, competition would drive the value of a license down to zero. If obtaining a license were a ticket to easy profits, then more firms would join the market until those potential rents were bid away.

States might prefer instead to offer only a limited number of licenses, creating artificial scarcity that makes the licenses valuable—valuable enough that firms will have a strong incentive to cooperate with regulators rather than risk revocation. Requiring the payment of license fees on an annual basis, rather than issuing permanent licenses, could also help nudge prices in a useful direction.

Limiting the number of licensees also makes monitoring their behavior easier. A rogue company could more easily break the rules if it were one of 1,000 licensees than if it were one of just ten. Vermont might have had this in mind when it restricted the number of medical-marijuana dispensaries to four.

So a structured-oligopoly strategy might involve licensing a limited number of firms, monitoring them closely, and not being shy about rescinding a firm's license if it behaves in ways contrary to the public interest.

The Extreme Options

We conclude by mentioning the two most-extreme options (also illustrated in Figure 4.4). At one end of the spectrum, Vermont could not only maintain prohibition but also increase sanctions (e.g., increase arrests or sentence lengths). At the other, Vermont could simply remove all of the state's marijuana laws from the books and leave in place only the regulations that apply to any article of commerce. We do not spend time on the former because Vermont has been moving away from that position, e.g., with its decriminalization. Even the antilegalization group Smart Approaches to Marijuana (SAM) supports decriminalizing possession and eliminating mandatory minimum sentences for those convicted of sales offenses (SAM, undated).²⁶

The other extreme, which could be titled the repeal-without-regulation scenario, has received increasing attention in marijuana debates. In 2012, the Committee for a Safer Michigan tried to place on the ballot an initiative to eliminate Michigan's prohibition without creating any regulatory structure to take its place. They failed, gathering only about 50,000 of the 322,609 signatures needed to garner a spot on the ballot (Sands, 2012). The effort, though, illustrates interest in this option. The full text of the proposed amendment to Michigan's constitution was just 88 words:

²⁶ With respect to decriminalization, Project SAM argues

[t]hat possession or use of a small amount of marijuana be a civil offense subject to a mandatory health screening and marijuana-education program as appropriate. Referrals to treatment and/or social-support services should be made if needed. The individual could even be monitored for 6–12 months in a probation program designed to prevent further drug use. (SAM, undated)

Figure 4.4
The Extreme Options



For persons who are at least 21 years of age who are not incarcerated, marihuana acquisition, cultivation, manufacture, sale, delivery, transfer, transportation, possession, ingestion, presence in or on the body, religious, medical, industrial, agricultural, commercial or personal use, or possession or use of paraphernalia shall not be prohibited, abridged or penalized in any manner, nor subject to civil forfeiture; provided that no person shall be permitted to operate an aircraft, motor vehicle, motorboat, ORV, snowmobile, train, or other heavy or dangerous equipment or machinery while impaired by marihuana. (Altieri, 2012)

There are two noteworthy differences between this strategy and that pursued in Colorado and Washington. First, there is no conflict with the CSA because the repeal creates no positive action. To simplify, federal laws preempt state laws when there is a positive conflict making it impossible for someone to comply with both. But states are under no obligation to actively participate in prohibition. Second, the amendment creates no marijuana-specific regulations, taxes, or licensing. Presumably, a business that sought to sell marijuana would have to follow the common rules and regulations that pertain to all businesses, but no provisions mandate testing, labeling, packaging in child-safe containers, and so on.

Although no jurisdiction has yet pursued this strategy for marijuana,²⁷ it has a major precedent during the era of alcohol prohibition. The (federal) Volstead Act (Pub. L. 66-66, 1919) took effect in January 1920. A year and a half later, New York State followed with its own prohibition bills, collectively known as the Mullan-Gage Act. The act required state and local police to enforce federal prohibition, but New York State's prohibition was very brief. By 1923, after Al Smith was elected governor, New York State repealed its participation in enforcement of alcohol prohibition.²⁸

New York's 1920s experience with alcohol illustrates two points. First, a repeal-only strategy could be implemented, at least back then. Second, the results might not be all good. Some combination of the absence of state regulation and the continued threat of occasional federal enforcement produced a disorderly and, at times, crime-infested alcohol market in New York during the 1920s. The outcome might be better in the 2010s with marijuana because marijuana use is less associated with crime and violence than prohibited alcohol was then (Pacula, Lundberg, et al., 2013). However, state silence on an intoxicant's legality shifts decisionmaking authority over interventions to federal officials, who might or might not exercise that discretion to the best advantage of the state.

Concluding Thoughts

This chapter discussed many options from many perspectives; the sheer volume of information can be overwhelming. Table 4.1 provides a one-page summary of some of the key ideas to help the reader organize all of that information into a coherent framework.

The first four columns name the strategy, its popular name, and precedents. The remaining columns rate the strategies with respect to various attributes. We use color codes to flag drawbacks that could be of particular concern. Red indicates that a strategy is among the worst or riskiest options with respect to that criterion; orange indicates that the strategy is bad but not the worst. We do not color-code strengths (e.g., green for good) because the table's goal is just to help organize information for the reader, not to point the way to summary judgments about what row or option is "best."

Column 5 considers production cost. Generally speaking, as one moves down the table to increasingly liberal policies, production cost goes down, but we do not identify any option as having the worst cost. As discussed above, minimizing production cost is, at best, a second-order consideration, and it is not even altogether clear that lower is always better.

Column 6 considers product quality. The options that still prohibit marijuana, as well as grow your own, would all make it virtually impossible to ensure product quality via testing and labeling.

Columns 7 through 9 focus on various aspects of promotion. Column 7 considers whether the strategy incentivizes firms to promote use that could be harmful to public health; column 8 considers the government's ability to constrain advertising; and column 9 synthesizes columns 7 and 8 into a judgment about whether the strategy will actually lead to promotion of harmful use. The basic logic is that aggressive promotion will occur only if both pro-

²⁷ However, New Hampshire House Bill 337 (New Hampshire General Court, 2013) might have had this character and received about one-third support (being voted down 112 to 239) in 2013 (Gacek, 2013).

²⁸ The situation in Maryland was similar, where a state-level prohibition never passed in the first place.

Table 4.1
Key Insights Concerning Supply Alternatives to Status Quo Prohibition

1	2	3	4	5	6	7	8	9	10	11	12	
Strategy	Alternative	Popular Name	Jurisdictions Pursuing This for Marijuana	Examples for Other Products	Production Cost Without Taxes, or Regulations and Labeling	Product Quality Assurance and Labeling	Incentive for Legal Suppliers to Promote Use of Harmful Health	Government Ability to Restrain Suppliers' Promotion of Harmful Use	Likelihood to Promote Harmful Use	Cost or Effort of Government Control Efforts	Ability to Generate State Revenue	Conflict with CSA
1	Increase sanctions	Incarcerate our way out of the problem	Recent proposal for selling heroin in Ky.	Highest	Bad	Status quo	Debated but probably high	None	Highest	Very low; depends on seizures and fines	None	
2	Retain prohibition but decrease the expected sanction	Mend it; don't end it	Medical marijuana in Calif.	Highest	Bad	Status quo	Debated but probably high	None	High	Very low; depends on seizures and fines	None	
3	Allow adults to grow their own	Grow your own	Alaska	Highest	Bad	Status quo	Not applicable	None	High on the rest of the market	Very low; depends on seizures and fines	Effectively none	
4	Allow distribution only within small co-ops or buyers' clubs	Co-op or buyer's-club model	Spain, Uruguay	Highest	Okay	None	Low or not applicable	None	High on remaining market	Very low; depends on seizures and fines	Little	
5	Permit locally controlled retail sales	Dutch coffee-shop model	Netherlands	Fairly high	Fair	Mixed	Low	Low	High on wholesale market	Low	Medium	
6	Have the government operate the supply chain	Government monopoly	Lotteries; liquor wholesale in 11 states	Low or medium	Very good	Low	Best	Low or medium (see lotteries)	High	Best	Highest	

Table 4.1—Continued

1	2	3	4	5	6	7	8	9	10	11	12
Strategy	Alternative	Popular Name	Jurisdictions Pursuing This for Marijuana	Examples for Other Products	Production Cost Without Fees, Taxes, or Regulations and Labeling	Incentive for Legal Suppliers to Promote Use Harmful to Public Health	Government Ability to Restrain Suppliers' Promotion of Harmful Use	Likelihood to Promote Harmful Use	Cost or Effort of Government Control	Ability to Generate State Revenue	Conflict with CSA
7	Have a public authority operate the supply chain	Near monopoly		VEDA	Low or medium	Low	High	Low	Low to medium	Good	High
8	Permit only nonprofit organizations to sell	Nonprofits		Blood banks, YMCA clubs	Low	Low	Low	Low	Low to medium	Fair to good	High
9	Permit only for-profit companies to sell	Sustainable businesses		Ben and Jerry's; Seventh Generation	Low	Low	Low	Low	Low to medium	Fair to good	High
10	Have very few closely monitored for-profit licensees	Structured oligopoly	Medical marijuana in the Netherlands	Opium processing in Tasmania	Low	Very high	High	Low	Medium	Good	High
11	Implement an alcohol-style commercial model	Regulate like alcohol	Colo.; Wash.	Alcohol and tobacco in most of the United States	Very low	Very high	Low	Very high	Low	Fair	High
12	Repeal the state's prohibition without creating any new, product-specific regulations	N.Y. State alcohol policy in the 1920s	Alcohol in N.Y. State in the 1920s		Lowest	Extreme	None	Extreme	Zero	Zero	Effectively none

NOTE: Red indicates that a strategy is among the worst or riskiest options with respect to that criterion. Orange indicates that a strategy is bad but not the worst. YMCA = Young Men's Christian Association.

ducers have an incentive to promote and the government lacks the capacity to stop it. Hence, the only rows that merit a red code with respect to column 9 are the two that are red in both columns 7 and 8 (namely, the standard commercial model and repeal-only).

Columns 10 and 11 examine the burden on the government and the potential benefit in terms of state revenue, respectively. Prohibition requires significant enforcement resources and presents few opportunities for government revenue other than via seizures, asset forfeiture, and fines. At the other extreme, the repeal-without-regulation scenario would generate no enforcement costs, but it also would not generate revenue for the state. Most of the middle options, as well as standard commercial regulation, have the ability to generate revenue, but much depends on the level of resources dedicated to enforcing regulations and pursuing illegal producers. The costs of regulation are further discussed in Chapter Seven.

Decisionmakers in Vermont might want to pay particular attention to column 12, which considers the extent to which these strategies conflict with the CSA. For now, the Obama administration has decided to allow states to experiment with legalization without federal interference as long as they have “strong enforcement and regulatory systems” in place (Cole, 2013). Because that policy was created with a memo, it could be reversed with a memo. At this point, no one knows who will be president in 2017, let alone what his or her position will ultimately be with respect to marijuana legalization.

A state marijuana monopoly is the worst option with respect to compliance with the CSA.²⁹ This raises a point we call the American federalism dilemma. Federal agents could enter state monopoly stores and arrest state employees carrying out the option that has—arguably—the best chance to protect public health and reduce harms associated with prohibition (state monopoly). However, current federal law cannot prevent states from choosing the supply strategy that could create the most damage to public health (repeal state prohibition with no regulation).

Of course, the federal government could also attempt to influence state policies and practices by making certain federal funds conditional on compliance. For example, the federal government did not mandate that every state raise its legal minimum age to purchase alcohol to 21; it threatened to withhold a share of federal highway funds to states that did not implement this threshold. Every state has complied.

It might seem puzzling that a state allowing an anarchic free market could be consistent with federal prohibition, but states are under no obligation to prohibit drugs that the federal government bans. Indeed, at any given time, the federal government has placed minor drugs on its list of controlled substances but one or more states have not yet gotten around to adding to their own lists of banned substances.

Conflicts with the CSA can arise, however, when a regulated industry tries to operate openly in the face of a continued federal ban. That is clear with respect to a state-store system; if a state itself tried to sell something banned by the CSA and the federal government sued, that state’s enabling legislation could be preempted by the CSA and could be rendered inoperative because it could be impossible to comply with both the federal and the state law.

²⁹ The most-prominent examples of state violation of federal law involve violation of strong federal policy as well. These include the discredited doctrines of interposition and nullification. A more recent example involves states issuing drivers’ licenses to undocumented people in defiance of federal law (see, e.g., Railey, 2014). None of these examples involves the situation facing Vermont, in which technical state violation of federal law would not violate announced federal policy. But that federal policy could change from one moment to the next.

The issue is less clear with respect to a state merely licensing and regulating production and distribution activities undertaken by commercial enterprises or other private parties. There is, by now, considerable history, extending over more than a decade, of states doing just that with respect to medical marijuana, and some observers are optimistic that regulatory schemes, such as those in Colorado and Washington, would survive a court challenge. However, the issue has not been adjudicated in federal court, and other observers predict that the CSA will preempt state regulated schemes.

Hence, of strategies 6 through 11, we consider the first (state monopoly) the least plausible option at this point and caveat the other five pending a definitive ruling on the matter by the federal courts.³⁰ This uncertainty makes it prudent for a state adopting one of those strategies to prepare for a possible federal crackdown, which could bring the legalization plan to a halt. A tightening of federal law or policy, perhaps upon a change in presidential administrations in 2017, could stop state taxation and licensing (not to mention state sales in a monopoly model). In such a case, the question becomes what the law is then. Would a governor be authorized to suspend the law upon a discretionary determination that resisting federal efforts was pointless and that the law had failed?³¹ And what would replace the suspended law? Would legislation provide for reversion to the status quo ex ante? Would the legislature draft and enact a less objectionable backup system, such as noncommercial decriminalization or grow your own, waiting in limbo, with its fate dependent on that of the suddenly inoperative commercial law? Or, in an effort to induce federal cooperation, would legislation instead provide for a poison pill in the form of a planned reversion to a repeal-without-regulation scenario, leaving the federal government to enforce all marijuana laws on its own?

Even if the CSA is ruled not to preempt state regulation of a private marijuana industry, gray areas would remain, such as whether the federal government would seize taxes³² that states collected on marijuana sales as proceeds of an illegal conspiracy under money-laundering statutes, whether state employees violate federal law if they possess marijuana during inspection or testing, and whether a state can ban the import or sale of marijuana produced in another state.

Beyond federal action to shut down a monopoly, private individuals might seek injunctive relief to halt the state plan. For instance, under a monopoly model, state employees could, as part of their duties, be required to violate federal law.³³ They might sue the state to seek relief

³⁰ The possibility that federal courts might yet rule that the CSA preempts state regulatory regimes makes a nuance in wording potentially important. Colorado and Washington stipulate that certain acts (e.g., selling marijuana) shall not be illegal if a licensed operator performs them. If the CSA preempts those laws, there will be no properly licensed operators and so no production or distribution that is legal with respect to state law. By contrast, if a state law separately repealed its past laws and created new provisions requiring those selling marijuana to obtain a license, the CSA could be judged to preempt the licensing requirements but not the repeal, defaulting the state into strategy 11 (unregulated free market) rather than back to the status quo ex ante (prohibition). We are not offering any suggestions about how to handle matters of preemption but do flag the need to attend to them carefully.

³¹ New York's new medical-marijuana law allows the governor, upon a recommendation by the health commissioner or the police superintendent that there is a risk to public safety, to suspend the program at any time (New York Public Health Law § 3369-c).

³² Another challenge to taxation is possible. Taxpayers in Colorado argue that the state excise tax there is invalid because filing state returns requires them to incriminate themselves under federal law.

³³ Violation of any law by state employees in their capacity as such, even one they are not specifically sworn to uphold, is not just a matter of legal exposure but a matter of political concern. Still, although officials in most states take an oath of office that refers to the federal government, that is not the case in Vermont, where officials swear or affirm to be "true and faithful to the State of Vermont" (Vt. Const. § 56).

from this requirement. To be sure, by the time courts reached a final determination about any private litigation against the state, Congress might have stepped up to change the laws the state is violating, or federal policy might have changed to enforce the law in a different way. Indeed, enforcement policy could change to be calibrated to protect public health and reduce harms, so that a state monopoly could survive, while profit-seeking commercial models would not. But adoption of a monopoly raises the clear and dangerous prospect that litigants could find a court that would issue declaratory injunctive relief in a private cause of action even as the federal government itself retains a hands-off position. That scenario leads to an uncertain and tumultuous path through the appellate judicial process.

Taxation and Other Sources of Revenue

Introduction

A state that legalizes marijuana by allowing limited private sales creates a privilege to sell it. That privilege is worth money, maybe lots of money. This chapter considers cases in which some of that money goes to private interests but looks at ways the state might keep some of it.

Taxes and fees are often thought of primarily as revenue-raising devices, but, in the case of marijuana, the collateral consequences, for good and ill—reduced heavy use and use by minors and reduced risks of export on the one hand and increased risk of in-state black-market activity on the other—could outweigh revenue in importance. Both revenue and collateral consequences will depend on setting of tax levels, a task complicated by the possibility that increasing firm size and technological innovation will drive pretax production costs for basic product forms down dramatically over time. The mix of product types could also evolve in ways that are difficult to foresee, e.g., with vaping gaining market share at the expense of traditional joints and bongs or the industry promoting products that contain both nicotine (tobacco) and THC (marijuana).

High taxes would work against some undesirable side effects. For instance, high taxes would tend to limit consumption and reduce a specific kind of black-market problem about which the federal government has warned: leakage to other states. Low taxes would tend to allow a nascent market to compete with local black and gray markets; to provide a low-cost product to consumers; to limit regressivity; and to increase compliance with tax laws, thus reducing enforcement and collection costs. But low taxes and low prices can increase underage use, substance-use disorders, and exports to other states substantially, while benefiting casual users only trivially—because, by definition, those casual users are not spending that much on marijuana anyway.

Taxes might aim to offset marijuana's negative externalities, its harm to nonusers, but those externalities are hard to measure (see Chapter Three and Gravelle and Lowry, 2014). The critical goal of curbing alcohol abuse and abuse of heroin and other opioids would be served by high taxes if marijuana and those drugs are complements and by low taxes if they are substitutes. The goal of nudging users away from risky and unhealthy products and practices might be served by high taxes on some marijuana products and lower taxes on others.

Vermont's constitution states that,

[p]revious to any law being made to raise a tax, the purpose for which it is to be raised ought to appear evident to the Legislature to be of more service to community than the money would be if not collected. (Vt. Const. ch. I, art. 9)

Tax and other revenues could first pay for legalization (administratively and in terms of enforcing agreed-upon regulations). Then they could go into the general fund or instead be dedicated to particular uses. For example, certain Vermont taxes on energy are dedicated to Vermont's Weatherization Program for low-income households. Alcohol taxes are used to fund DLC. Alternatively, or in addition, some marijuana revenues could be shared with localities, as they are in Colorado.¹

Jurisdictions considering legalization must not only choose taxation levels and goals; they must also navigate the largely uncharted waters about *how* to tax marijuana. Both Colorado and Washington have adopted ad valorem (percentage of sales price) taxes, but it is unclear whether other jurisdictions should use this approach.

This chapter aims to help decisionmakers in Vermont and elsewhere understand various approaches for taxing marijuana and generating revenue from a legal market.² “Bases for Taxing Marijuana” provides details about several bases—measuring sticks—for taxing marijuana, highlighting some intended and unintended consequences of these choices. “Collection Point” walks through issues surrounding where to collect these taxes, and “Mechanisms for Changing the Tax Burden” describes mechanisms for changing tax rates and the tax burden in anticipation of huge and unknowable transformations in the market. “Fees and Auctions” addresses fees, which can serve as an adjunct to taxes, and considers the use of auctions to raise revenue. “Other Revenue Considerations” looks at how legal marijuana could generate other sources of revenue for Vermont, and “Concluding Thoughts” concludes.

Bases for Taxing Marijuana

Before deciding who pays tax, or how much, the state might start by identifying something—or some things—it can measure accurately enough to tax. This section describes eight bases for marijuana excise taxes,³ ranging from price to weight to features of the product (e.g., THC content) to how it is produced. For each base, we describe precedents and then discuss the potential consequences of this tax choice. “Collection Point” discusses issues surrounding who pays—where in the supply chain tax is collected.

In evaluating tax bases, we look at a range of criteria. The first criterion is prevention of after-tax price collapse. Given the likelihood that a maturing industry will achieve innovations and economies of scale that sharply reduce the price per hour of intoxication offered by basic or generic products (as opposed to name-brand or boutique versions), a revenue structure that provides after-tax price stability might seem advisable. The second criterion is swiftness of initial tax assessment: Will the taxpayer be able to file a return promptly? Although analytically useful, this criterion fits into the category of nice to have, and it deserves little weight. Third, we look at potential for gaming: whether the tax gives taxpayers an opportunity to find loopholes or to cheat outright. Fourth, we consider simplicity: Is the tax easy to calculate? Often, though not always, a tax that is not simple has large potential for gaming. For instance, we

¹ In Colorado, localities allowing marijuana sales get 15 percent of a 10-percent retail tax (Colorado Revised Statutes § 39-28.8-203, 2014).

² Although this chapter provides a comprehensive assessment of many critical issues associated with taxation and revenue generation, it is not exhaustive. Those with a particular interest in this area should also consult Oglesby (2015).

³ Excises, whether based on price, weight, or something else, are taxes imposed on only *particular* products or services.

can imagine an eventual potency base that is as difficult to game as alcohol content is as a federal tax base for spirits, but the chemical analyses that it requires remove it from the simple category. The fifth and sixth criteria deal with administrative costs—whether a tax is costly to set up initially, and then whether it requires substantial ongoing costs. The seventh criterion is whether a base allows for revenue maximization as the industry evolves. We anticipate that the industry would tend to gravitate toward products that are relatively low-taxed; some tax bases are particularly vulnerable to foreseeable industry responses. The final criterion considers whether the revenue scheme would provoke a conflict with the federal government.

We begin with the three bases that receive the most attention: weight, price, and potency (i.e., THC). We then focus on three mixed bases that serve as rough proxies for taxing by potency: taxing bud more than trim, by weight; taxing raw usable marijuana and concentrates differently; and a claimed-THC alternative minimum tax (that is, a potency tax assessed according to the THC content that the seller claimed was present in the product). Note that these taxes can be applied at various points in the production and distribution processes. We conclude with a brief discussion of two tax bases that are specific to producers: square footage and an indoor electricity add-on base.

Simple Weight Base

Vermont and the federal government tax cigarettes and many other tobacco products by weight, and S. 306 (Vermont State Legislature, 2014a), introduced in 2014, would have taxed marijuana at \$50 per ounce. The federal government taxes beer and gasoline by volume, which is like taxing solids by weight.

A weight base is easier to set up and to administer than a potency base but harder than a price base, especially because moisture must be accounted for. It also provides more stable revenue than a price base. However, taxing based on weight creates an incentive to pack the most intoxicating material into each gram, which could be dangerous. Only an extremely low rate, like the low federal per-gallon tax on beer, tames the incentive, but that also reduces revenue potential. A weight base, incidentally, pushes industry away from mass production, toward organic, artisanal, and other high-value-added products. That is because luxurious or fancy products do not bear more tax.

Price (Ad Valorem) Base

Vermont taxes chewing tobacco and certain other noncigarette tobacco products ad valorem, literally, according to value, at 92 percent of wholesale price. Vermont taxes liquor with an ad valorem retail excise tax; that is in addition to a 6-percent sales tax and monopoly profits.

In Colorado, voters approved two ad valorem taxes on marijuana (“Colorado Proposition AA,” undated): A 10-percent tax on retailers is being collected; a 15-percent tax on producers has been de facto converted to a weight-based tax, as we explain later in this section, to avoid phony transfer pricing. Washington State enacted three 25-percent taxes (RCW 69.50.535), on retailers, processors, and producers, but companies that are both processors and producers pay only one tax. That drives processors and producers to combine, so most marijuana commerce in Washington pays just two levels of 25-percent taxes. Across the nation, many localities have enacted price-based taxes on medical marijuana.⁴

⁴ A price-based excise tax might bear another name. Vermont taxes the gross receipts of retail sellers of heating oil, propane, natural gas, electricity, and coal at a 0.5-percent rate (33 V.S.A. § 2503). Berkeley, California, imposes gross-receipt

If consumers pay more for powerful products, taxing price is a little like taxing potency. But high price might not always mean high potency. Price could also be high because consumers like the blend of cannabinoids or the look, smell, feel, and taste of the product; because of marketing factors, such as branding, and convenience and ambience of retail location; or for other reasons.

A price-based tax has some advantages. First, an ad valorem base is simple; it does not require indexing or equipment. Weight or potency bases would take more time to set up. Second, a price base tempers regressivity. Taxes on prices of products other than luxuries tend to be regressive: They take a higher percentage of income from poor people than from rich people.⁵ Price-based taxes tend to favor low-priced products and could therefore benefit scrimping purchasers, who might tend to be relatively poor.

But an ad valorem tax has disadvantages. The most serious one is that an ad valorem tax base amplifies changes in pretax prices automatically. Here is why that is a problem: At first, as the legal industry struggles to gear up, supply cannot meet demand, so pretax prices could be abnormally high early on. (That is what happened in Colorado and Washington.) A price-based tax amplifies those high pretax prices and makes early after-tax prices much too *high*. So bootleggers benefit. That is, the black market and fake medical market retain market share.

But as time goes on, as legal operators learn and become efficient, and as they expand and achieve economies of scale, their costs can drop dramatically. If they pass cost savings on to consumers, pretax prices decline, and a price-based tax *automatically* declines with them. As after-tax prices drop, the dangers of youth use, abuse, and leakage to other states grow. So a price base then can lead to taxes that are too *low*, which could be a problem for a maturing marijuana industry.

Another problem with a price base is that taxpayers might manipulate or game it. Two ploys available with a price base are bundling marijuana with other products and related-party (and intracompany) transfers.⁶

Bundled sales charge one (undifferentiated) price for two items with different tax rates. The tax problem arises if taxable marijuana is given away, or bundled, with excise-tax-free purchases. So where the consumer buys an untaxed pipe or pays an untaxed cover charge and

business-license taxes per \$1,000 of gross receipts. These vary by type of business. The standard rate is \$1.20, but rates are \$25 for medical-marijuana businesses and \$150 for disfavored gun shops (City of Berkeley, 2014b). In case California legalizes recreational marijuana, Berkeley has a \$100-per-\$1,000 rate on its books already.

As early as 2010, several California localities had enacted laws taxing medical marijuana. A list appears in Oglesby (2011, Table 1). Several Colorado localities tax recreational marijuana as well.

⁵ For example, with a price base, two products with identical weight and potency could bear two different taxes. For example, assume that the pretax price of premium beer is \$2 per bottle, and that of standard beer is \$1 per bottle. Both have identical alcohol content. A tax of \$0.40 per bottle would tax premium like standard, with resulting prices of \$2.40 and \$1.40. A tax of 25 percent would tax premium more than standard, with resulting after-tax prices of \$2.50 and \$1.25. A price base tends to shift the tax burden to branded, luxury goods and perhaps to consumers most able to pay. It tends to push the industry toward mass production. But “[s]urprisingly, the progressivity of a tax system’s rate structure is negatively correlated with the reduction in inequality a country achieves” (Kleinbard, 2014, p. 362). Value-added taxes are Kleinbard’s focus there. He argues that a fiscal system should be judged as a whole, not piece by piece. And although one might isolate the tax feature of a legalization plan and label it regressive, the plan *as a whole* would not be regressive if postlegalization taxed marijuana prices were lower than prelegalization untaxed prices.

⁶ Related parties for this purpose are individuals or entities that might be expected to share economic interests, such as parent and child or parent corporation and subsidiary. U.S. Code Title 26 Section 318 contains a commonly used list of related parties.

gets free marijuana, a price-based tax would be hard to calculate. Vermont already has detailed antibundling rules for some taxes (Vermont Department of Taxes, 2006), and a price tax base for marijuana could require more. But antibundling rules do not prevent disputes about valuations and thresholds. There is a way to protect a price-based tax from bundling: by allowing marijuana sellers to sell only marijuana. Then there is nothing with which to bundle.

Phony transfer prices turn up between related parties, who can charge one another any price they want. Naturally enough, the price they want is the one that results in the least tax.⁷ So a price-based tax depends on the existence of a real price—normally, on an arm’s-length sale between unrelated parties.

Washington and Colorado have already faced the problem of phony transfer prices. Washington insists on actual prices for its price-based taxes. It prohibits any cross-ownership between retailers and growers (RCW 69.50.328). So there, sales of marijuana should routinely reveal an actual arm’s-length price.

Colorado’s solution was much less straightforward: Colorado side-stepped its constitutional authorization of a 15-percent “excise tax to be levied upon marijuana sold or otherwise transferred by a marijuana cultivation facility to a marijuana product manufacturing facility or to a retail marijuana store” (Constitution of the State of Colorado, Art. XVIII, § 16) and ended up taxing something it could measure, so it taxed bud at \$0.62 per gram, trim at \$0.10 per gram, and seedlings at \$1.35 each.

The problem arises when the cultivation facility does not sell marijuana to anyone and transfers it only to itself.⁸ That is standard in Colorado, where, most of the time, marijuana is not “sold or transferred” before retail. That is because Colorado once *required* all marijuana businesses to be vertically integrated. *Vertical integration* means that only one company handles marijuana from farm to market—all the way from seedling to retail sale, with no sellers in between. Vertically integrated companies still dominate the market in Colorado—with no sale from a producer to a manufacturer or retailer. So there is no market-based or arm’s-length price to tax at 15 percent. There is no sale of any kind, not even a related-party sale, just an intracompany transfer.

So Colorado had to alter tactics and tax not a price, but “fifteen percent of the average market rate” (AMR) of a producer’s marijuana (Colorado Revised Statutes § 39-28.8-302, 2014). That rate is supposed to reflect the value of marijuana as it leaves the producer’s hands (“Average Market Rate,” undated). The Colorado Department of Revenue (CDOR) is in charge of finding that AMR. For 2014, it found the AMR of bud, the potent flower of the plant, to be \$1,876 per pound, so it imposed on bud a tax of \$281.40 per pound, or approximately \$0.62 per gram (CDOR, date unknown). Finding immature plants to have an AMR of \$9, it imposed a tax of \$1.35 on each. Finding the AMR of trim (i.e., everything else) to be \$296 per pound, it imposed a tax of \$44.40 per pound, or approximately \$0.10 per gram, on trim.

⁷ Uncertainty about transfer pricing or intercompany pricing among related parties in the cross-border context has especially bedeviled the field of international income taxation. It is not just the money. See Kingson (2005): “Deciding how much one’s left hand contributes to one’s right may constitute a career, but not much of a life.” Arguing and litigating about uncertain taxes constitutes an economic deadweight independent of the taxes themselves.

⁸ The only third-party sale or transfer is eventually to the retail customer. This is not a retail tax; Colorado has a separate 10-percent excise tax and a 2.9-percent sales tax on retail sales.

These rates apply, surprisingly, to sales even to unrelated parties, for which there is an actual arm's-length price. So Colorado essentially could not make its price-based tax on producers work and has de facto completely converted that price base to a weight base.⁹

A potential final drawback of an ad valorem tax might be the perception that it is excessive. In Europe, for instance, various tobacco taxes often combine to take more than 80 percent of the after-tax price that consumers pay (European Commission, 2014a). Stating that high a burden as a percentage of pretax price would show a rate of more than 400 percent.

Note that Vermont's normal 6-percent sales tax would apparently be collected on *recreational* marijuana unless the legislature created an exception,¹⁰ even though, for now, no sales tax is being collected on *medical* marijuana (Vermont Legislative Joint Fiscal Office, 2012). If Vermont enacts a retail-level marijuana-specific excise tax, the legislation might clarify whether the standard sales-tax base should include or exclude the excise tax.¹¹

Actual Tetrahydrocannabinol Potency Base

There are precedents for taxing alcohol as a function of potency (e.g., federal tax on liquor depends on alcohol content; see Alcohol and Tobacco Tax and Trade Bureau, 2013).¹² We are not aware of any jurisdiction that has levied a THC tax on marijuana, although a bill introduced in the Massachusetts legislature in 2013 proposed imposing a tax of \$1,000 per ounce on THC (General Court of the Commonwealth of Massachusetts, 2014).

To clarify, a THC base might work this way: Say 10 g of marijuana were tested and determined to contain 12 percent THC content by weight. Then the THC potency base would be 1.2 g.¹³

A THC base, or potency base, could correlate with intoxication better than any other base.¹⁴ Thus, taxing actual THC or potency has an important policy advantage if it can be

⁹ Another possible solution to this kind of transfer pricing problem is a mechanism to defer assessment of a price-based tax until the first sale to an unrelated party, as discussed in Oglesby (2015).

¹⁰ Many states and localities that impose retail sales taxes now collect them on sales of legal medical marijuana. Washington and Colorado impose their standard sales taxes on sales of recreational marijuana.

¹¹ Inclusion or exclusion can be arranged to produce the same total overall state-level revenue gain. For instance, the legislature could enact a 50-percent retail marijuana excise tax that is in the 6-percent sales-tax base or a 53-percent tax that is not. In the first case, the state tax on \$1 of sales would be \$0.50 excise tax plus sales tax of 6 percent of \$1.50, for a total tax of \$1.59. In the second case, the tax would be \$0.53 excise tax plus 6 percent of \$1.00, for the same total. Localities that impose add-on sales taxes might prefer a larger sales-tax base.

¹² In the early 1970s, New York City briefly taxed cigarettes by tar and nicotine content. Tar and nicotine were measured by the discredited smoking-machine method. The chair of Governor Nelson Rockefeller's New York State Committee of Investigation said that this tax base "opened up another hornet's nest in terms of enforcement and administration over and above the normal straight-out problems of too high a tax to start with" (Fleenor, 2003, p. 9). The tax was repealed by 1976. A rare contemporary document referencing the tax is Tobacco Tax Council (1973).

¹³ More-nuanced potency bases might go beyond THC to favor, for instance, products with higher amounts of CBD, another cannabinoid. Some research suggests that the presence of CBD buffers some of the adverse effects of THC, e.g., anxiety and panic attacks (further discussed in Chapter Six). To the extent that that is true, one might want to tax products with not only high THC but also THC-to-CBD ratios that are higher than other products with the same THC content but more CBD and, thus, a lower THC-to-CBD ratio. But this is leaping out into uncharted territory. In light of all the unknowns at this early stage of marijuana science, the legislature might, at most, grant regulatory authority to deal with CBD, or even to tax other cannabinoids if science finds them harmful.

¹⁴ But THC content does not correlate as well with intoxication as one might think. A sample's potency, even measured accurately, could change over time: Although raw usable marijuana anecdotally has a long shelf life, potency of some products increases during storage. And even for the blunter purpose of labeling,

made to work, but it does pose some important implementation challenges. We consider a THC or potency base for two very different marijuana products: concentrates and raw, usable marijuana.

Tetrahydrocannabinol Base for Concentrates

We can tax distilled spirits based on alcohol content because they are homogeneous liquids that can be stirred and mixed thoroughly, so one needs to extract and test only one sample taken from any corner of a well-mixed vat. Marijuana concentrates, such as oil, wax, or shatter (wax hardened to a glasslike state), are products made from raw marijuana and used in various forms, such as edibles (cookies, cooking oil), electronic-joint cartridges, tinctures, sublinguals, and dabs (an intensely powerful vapor material). Raw marijuana made into concentrates is something like wine distilled into brandy, an intoxicant made stronger. But concentrates are not simply stronger marijuana: Concentration changes the form of the intoxicant.¹⁵ The production of concentrates could involve a stage when material is homogeneous enough for replicable testing, but resources will need to be devoted to develop and validate testing procedures.¹⁶

Tetrahydrocannabinol Base for Plant Matter

Raw, usable marijuana—that is, dry plant matter—is far from homogeneous. Indeed, THC content can vary from bud to bud within a single plant, and powerful trichomes make material even from a single bud heterogeneous. Thus, the threshold issue for a potency tax base is whether it can provide replicable, auditable results, close enough for the government work of honest taxation. If the tax base can be gamed,¹⁷ some taxpayers will try to beat it, and the state will try to stop them—all at a cost, possibly a significant cost. To be clear, potency testing is already at work, informing and even warning consumers about products they are buying. For consumers, ballpark numbers are helpful and usually adequate. For taxation, though, ballpark numbers are problematic.

Ensuring representative samples would be critical for an auditable THC tax on raw usable marijuana. One possibility would be to sample 1-lb. lots of usable marijuana at the processor level and base the tax on the median THC value or even the maximum value. But this approach raises some issues. One is determining the appropriate number of samples. A more

[t]he high variability in bioavailability of cannabinoids, both within and across different methods of intake, limits the usefulness of precision in potency labels. This variability introduces an uncertainty about psychoactive effect that cannot be eliminated, even if cannabinoid content is tested for with very precise methods, with small lot sizes, and conveyed to the consumer with effective product labels. An overwhelmingly large share of the variability in psychoactive effect arises from the method of use and drug metabolism, rather than the chemical contents of the product. (Habib, Finighan, and Davenport, 2013, p. 20)

¹⁵ Another analogy is that concentrates would be to raw marijuana as wine is to grapes—if grapes were intoxicating.

¹⁶ According to analytical chemist Rosemary Habib, “[V]alidated methods by which a specific test must be conducted” need to

cover instrumentation, calibration curve, compensating for possible interferences and sample preparation methods. They must be proven to work through a series of standardized benchmarks including Precision, Accuracy, Appropriateness, Robustness, Linearity, Range, Repeatability, Detection Limit, Quantitation Limit, and Interlaboratory Reproducibility. (Oglesby, 2014b)

¹⁷ According to Sexton and Ziskind (2013),

Since a cannabis producer is typically aware which parts of the plant are most well lit, he often knows where to find the most potent flowers from the cannabis plant—typically, those at the top. Potentially, this represents a crucial information asymmetry between the producer and the testing agency. (p. 5)

serious challenge is monitoring the sampling. If processors sample, they can be expected to avoid trichomes, for instance, and select low-potency material. If the government samples, one danger is ignorance and randomness. Another is overreach—deliberately seeking nonrepresentative potent matter to increase tax collections.

Both Tetrahydrocannabinol Bases

Setting up the world's first tax-worthy THC-testing regime would require significant planning and resources. In Vermont, the costs associated with designing the regime and conducting the testing would be spread over a small number of taxpayers. Although possession of marijuana for a criminal case does not violate the CSA, testing by a state laboratory might—for the lab and state employees. Thus, a state could distance itself from the enterprise by hiring or authorizing third-party testing facilities.

At first, the cost of testing might be passed on to consumers, to the benefit of the black market. As the legal market takes market share, the black market will become less worrisome. When the black market is so marginalized that the legal market can bear high prices, the cost of testing could be more acceptable. Time is the friend of a potency base. Regulators might implement a particular potency base once they have time to set up a workable system.¹⁸ That kind of implementation schedule is common administrative practice for a new tax law. In the meantime, tax could be imposed on some other base.

Taxing Bud More Than Trim by Weight

The many uncertainties in testing for THC content lead us to a discussion of other, indirect ways of approaching the goal of taxing THC. We start by looking at different weight bases for different parts of the raw, usable plant, because some parts are usually more potent than others. We then look at different tax bases for (1) raw, usable marijuana and (2) concentrated forms.

There is a precedent for this in Vermont with tobacco, for which cigarettes, roll-your-own tobacco, and snuff are taxed at different rates per ounce (Vermont Department of Taxes, 2014). The federal tax on wine is higher per ounce than the federal tax on beer (which generally contains less alcohol than wine).

For marijuana, Colorado taxes bud and trim at different rates. Colorado regulations define bud as “the product of the Flower or ‘Flowering’ stage . . . including the actual flower and the small leaves immediately below the actual flower which contain levels of THC comparable to the Flower” (“Colorado Proposition AA,” undated).¹⁹ Trim is “any part other than the Bud of a . . . Marijuana plant.” Colorado’s producer tax rate on bud is around \$0.62 per gram; on trim, around \$0.10 per gram. It chose those rates by concluding that bud, in the market, was worth some 6.2 times more than trim. In November, Oregon Ballot Measure 91 enacted statutory tax rates for bud and trim of \$1.23 and \$0.35 per gram, respectively (“Oregon Legalized Marijuana Initiative,” undated). Alaska’s newly passed law provides a general rate of \$1.76 per gram but allows regulators to reduce that rate for “certain parts” of the plant (Campaign to Regulate Marijuana Like Alcohol in Alaska, undated)—presumably trim. An introduced

¹⁸ Other components might be taxed. Colorings and flavorings, which appeal to young users, might be taxed. Such taxation would tend to push such products into the luxury category and at the margin out of the financial reach of a disproportionate number of young users. Because only tiny amounts of chemicals are needed to color or flavor products, extraordinarily high tax rates would be required to make much of an economic difference and to actually tilt the market. Instead, an add-on tax might apply by weight or serving to colored or flavored finished products.

¹⁹ The law uses different terminology—flowers and leaves—but follows the Colorado scheme.

bill in Rhode Island taxes bud at \$1.76 per gram and trim at \$0.35 (State of Rhode Island in General Assembly, 2014).

Trimming is a process in which some raw, usable marijuana is separated into two categories. Small leaves, which grow out of the powerful bud or flower, are removed from it and categorized as trim. Although machine trimming is possible, workers typically cut the trim off by hand (Hawken, 2013).

Bud is typically smoked in raw form in joints or pipes but is increasingly vaporized and is sometimes used to make concentrates. Trim is typically used to make concentrates, eventually used for edibles, dabbing, tinctures, and so on. Bud is generally stronger than trim. Higher tax rates for bud (flowers) than for trim (leaves and everything else) would roughly reflect potency, although potency can vary quite a bit within each category.²⁰

In general, observers can agree on what is bud and what is trim—but not at the margin (Oglesby, 2014e). Thus, there is danger of tax evasion. One ploy would be to deliberately characterize a little bud as trim and sell it for concentrates. That is, sellers would have an incentive to put bud, normally more potent than trim, into the trim pile. Then its potency could flow through to concentrate form at a low tax rate and, finally, still undertaxed, into consumer products, such as edibles and electronic-joint liquids.²¹

Taxing Raw Usable Marijuana and Concentrates Differently

Different taxes for concentrates and for plant matter can reflect potency. Several distinct options are possible. An introduced New York bill would tax raw usable marijuana at \$1.76 per gram and concentrates at \$7.05 per gram (State of New York Senate, 2013). A proposal in Washington State would result in dry tobacco being taxed by weight, and e-cigarette liquids by potency (Smith, 2014). As noted earlier, the federal government taxes spirits by alcohol content; it taxes beer, which is weaker, by volume.

For marijuana, these options avoid two practical difficulties: measuring THC in raw usable marijuana, and drawing a line between bud and trim, both of which were discussed previously.²²

The state could start by taxing all raw usable marijuana that is to be sold to consumers without processing at one weight-based rate. Then, concentrates could be taxed at *either* a high weight-based rate (the CW option) *or* by THC potency (the CP option).²³

²⁰ Trim from high-potency plants could even be more potent than bud from lower-quality outdoor-farmed plants. Although the ratio of bud *prices* to trim *prices* no doubt reflects potency somewhat, other factors could influence price. For instance, traditional consumer preference for using bud might boost the price of bud beyond the value of its THC content. Colorado's 6.2:1 ratio was designed to reflect prices in the market, not to reflect potency.

²¹ Another ploy might prove less promising from the taxpayer's perspective: to mischaracterize high-taxed bud as low-taxed trim and sell it in raw form for smoking with that label. For the ploy to create an advantage for the seller, raw mislabeled product, not incorporated into concentrate, would have to sell for a high pretax price. That abnormally high price for "trim" (really bud) could risk catching the attention of law enforcement.

²² These options reduce the benefit of the ploy of putting bud in the trim pile—that is, in the pile to be concentrated. Concentrates made from bud are not necessarily stronger than those made from trim; it just takes less bud than trim to make concentrates (Oglesby, 2014e).

²³ With any option, the legislature could set tax rates to nudge users toward one form or the other. Although an hour of intoxication from smoking bud is qualitatively different from an hour of intoxication from, say, consuming edibles, the legislature might crudely seek to make an hour of intoxication from bud more expensive—or less expensive—after tax than an hour of intoxication from products made from trim and concentrates.

Both options treat potent bud like weak bud—a flaw with weight-based taxation. So an ad valorem base for raw marijuana, instead of or in addition to a weight base, could be used in connection with CW or CP.²⁴ Tax rates on bud would need to be high enough to dissuade consumers from arbitraging the tax rates by concentrating bud themselves—often, a dangerous practice (Crombie, 2014).

Weight of concentrates is only a proxy for THC content. The CW option rewards sellers who pack the most intoxicating material into concentrates. The CW option is cruder and less targeted at potency than the CP option but easier to implement. The CP option is available only if testing provides auditable results.

Claimed-Tetrahydrocannabinol Alternative Minimum Tax Base

For a short time, the federal government imposed an alternative minimum tax on corporations' "book" income, the income they claimed in reports to shareholders, without regard to normal tax concepts (Lyon, undated), though taxing claims is unusual.

But if the state cannot verify *actual* THC content for any product, the state might use the seller's *reported* or claimed THC content as a secondary or backup alternative minimum tax of sorts (Oglesby, 2014a; Ball, 2014). If the producer's report of THC content is exactly right, a stated-THC tax is a potency tax. If the producer overstates THC, a stated-THC tax penalizes deception of consumers.

But sellers might intentionally *understate* THC. Sellers could dodge this tax entirely by falsely understating the THC content, although, if the tax were modest, they might not do that because high THC content is appealing to consumers. Sellers might also react to the tax by making non-THC claims to lure consumers—by a whisper campaign to discredit a low stated-THC number, for instance, or by claims that other, non-THC cannabinoids provide desirable intoxication. Claims might extend beyond cannabinoids: "In popular wisdom, different strains of cannabis are thought to produce distinct experiences, even where cannabinoid content is identical" (Habib, Finighan, and Davenport, 2013).

So stated THC seems too easy to game to serve as the sole or as a primary tax base for marijuana—or to be more than a supporting element in a package of marijuana revenue provisions. So, to mitigate gaming, reported THC could be only an *alternative minimum* tax base. That is, the stated-THC base could apply only when the primary tax base—say, weight or price—yielded a low number, one that is inconsistent with high stated potency. The tax owed would be the greater of (1) the tax computed using the primary base and (2) the tax computed using the alternative base—claimed THC.

Square-Footage Base

For medical marijuana, many California localities tax growing area. Rancho Cordova, California, taxes each 12.5 sq. ft. of outdoor grow area at the same rate as one indoor square foot.

Vermont could also choose to tax square feet of grow space. Such a tax would be only moderately difficult to set up and collect, just requiring decisions about exactly what square footage to count (Caulkins, Cohen, and Zamarrá, 2013).²⁵ Its administration overlaps with regulatory oversight. It allows the option of higher rates for indoor growing. Collection per

²⁴ We do not examine all possible combinations in depth. The rate for an ad valorem tax on raw marijuana might more easily be held down to a nonalarming level if other taxes supplemented that tax. See "Combination of Bases," below.

²⁵ For instance, the state would need to decide whether to count walkways, storage space, and areas used for seedlings.

plant cycle (not per year) would reduce the incentive to choose strains that produce more crops per year. (Counting plant cycles in indoor facilities would require some government oversight, perhaps as an element of a comprehensive tracking system.)

A square-footage base correlates poorly with potency, so it could be used as one element of a package of revenue measures. The tax could be collected up front, providing cash flow to the state in the start-up phase of legalization and reducing the danger of leakage into the gray market but straining undercapitalized growers.

Indoor-Electricity Add-On Base

Indoor growing uses valuable energy and could harm the environment. Vermont taxes certain electric generating plants at the rate of \$0.0025 per kilowatt-hour (kWh) of electrical energy produced (32 V.S.A. § 8661). That tax applies regardless of who consumes the electricity. On marijuana growing, that low rate would be inconsequential.

The City of Arcata, California—an area where marijuana growing is intense—is collecting a more ambitious excessive residential electricity–user’s tax aimed at indoor marijuana growing and designed specifically to curb electricity use (Arcata Municipal Code § 2628.5). When a customer exceeds 600 percent of a baseline designed to reflect normal use, the city taxes 45 percent of the customer’s entire electric bill.

Arcata presumes that abnormally high use of electricity correlates with marijuana growing under high-powered lights. After enactment of the tax, the number of residences exceeding the 600-percent threshold fell, from a pretax level of 633 to 82. Although designed primarily to reduce use of electricity, the tax was, at one point, bringing in more than \$40,000 a month, in a city with fewer than 18,000 people (Scott-Goforth, 2014).

An electricity tax could apply to legal indoor grows without any threshold, on the theory that outdoor growing is ordinarily preferable on environmental grounds. To be sure, that theory would tax any crop grown indoors—not just marijuana. Taxing only legal grows because they are easy to find would work in favor of the black market. Arcata’s approach, targeting all excess use, has the advantage of taxing both legal and illegal growers.

A central problem with electricity as a tax base is that, in the long run, at least after national legalization, one would expect most growing to be done outdoors or in greenhouses. So this base would best serve as a green add-on to another, more substantial base.²⁶

Concluding Thoughts on Base

Table 5.1 puts those criteria in columns and presents our view of how the various bases (in the table’s rows) meet those criteria. It summarizes the tax bases discussed in this section and compares them on a number of dimensions.

Finally, it might be prudent to consider combining several bases. Vermont could adopt a variety of cumulative add-on taxes, like it does with its motor-fuel regimen,²⁷ or a greater-of

²⁶ Oglesby (2015) discusses another environmentally targeted tax approach: discriminating against products that were grown indoors.

²⁷ The Vermont motor-fuel tax consists of four components: the Motor Fuel Tax Assessment, which is “the amount of \$0.134 per gallon or 4% of the tax-adjusted retail price upon each gallon of motor fuel sold by the distributor not to exceed \$0.18, whichever is greater”; a \$0.121-per-gallon state tax; a \$0.01 petroleum cleanup fee, and a Motor Fuel Transportation Infrastructure Assessment in the amount of 2 percent of the average quarterly retail price. See Vermont Department of Motor Vehicles (undated).

**Table 5.1
Tax Bases**

Item	Prevention of After-Tax Price Collapse	Swiftness of Initial Tax Assessment	Potential for Gaming	Simplicity	Start-Up Costs to Administer	Ongoing Costs to Administer	Revenue Maximization as Industry Evolves	Federal Conflict
Simple weight	Low	Fast	Low	High	Medium	Low	Low	Ordinary
Price	Very low	Fast	High unless transfer pricing is solved	High if transfer pricing is solved	Low	Low if transfer pricing is solved	Low	Ordinary
Potency	Low	Slow	Low, eventually	Low	High	High	High	Labs need state involvement
Different weight rates for bud and trim	Low	Medium	High	Low	Medium	Medium	Medium	Ordinary
CW: Different weight rates for raw and concentrates	Low	Medium	Low	High	Medium	Low	Medium	Ordinary
CP: Raw by weight, concentrates by potency	Low	Slow	Low, eventually	Low	High	High	Better than medium	Labs need state involvement
Claimed-THC alternative minimum tax	Low	High	High	High	Low	Low	Medium	Ordinary
Square feet	Low	Fast	Low	High	Low	Low	Medium	Ordinary
Electricity add-on	No	Fast	Low	High	Low	Low	Low	Ordinary
Monopoly (for comparison)	Yes	N/A	No	High	High	Medium to High	High	Extraordinary

NOTE: CW = concentrate by weight (concentrates are taxed at a high weight-based rate). CP = concentrate by potency.

alternative minimum tax. An example of the latter is from Europe, where cigarette taxes must be at least the greater of (1) 57 percent of price, and (2) €64 per 1,000 cigarettes (European Commission, 2014b). (Value-added taxes impose a separate, additional burden.)

Collection Point

In addition to choosing a tax base, jurisdictions that decide to tax marijuana need to decide where the tax will be collected. Taxes can be collected at various points along the supply chain, and this decision will have important implications for the industry structure, state budgets, and the black market. The ideal collection point depends on what the tax is measuring—that is, its base. Collection points for square-footage and electricity taxes are self-evident. Collection points for other bases are discussed in detail in Oglesby (2015).

Federal taxes on alcohol and tobacco are collected from the manufacturer or importer. Vermont takes a similar approach, taxing the in-state manufacturer if there is one, and upon entry to the state otherwise. Vermont's taxes on cigarettes are imposed on the wholesaler, which puts a tax stamp on each pack (32 V.S.A. § 7774). Vermont, like most states, typically collects tobacco tax in the middle of the supply chain, after manufacture and packaging.

Colorado collects marijuana tax from retailers and from producers—but most often, in practice, from vertically integrated businesses. Washington collects from retailers and typically from integrated processor-producers, although, if processors and producers are separate, it collects from both. Both Colorado and Washington hope to track marijuana from seedling to retail store, to prevent leakage—diversion of legally grown product before collection of tax.

Other things being equal, it is best to assess excise taxes from a small number of taxpayers and locations—from choke points in the supply chain. There, fewer people will need to pay and collect tax, so the cost of tax administration should be less for taxpayers (as a whole) and for government. Collecting at a choke point could allow adequate audit coverage with fewer audits. When retailers are numerous, as with beer, wine, and cigarettes, a retail tax could prove particularly impractical (Gravelle and Lowry, 2014).

Large corporations could be easy to collect from, and some argue that, in the context of drugs, they are “likely to be concerned with keeping the image of the industry clean and respectable” (e.g., Levine and Reinerman, 2004). But the tax goal of easy collection could conflict with other policy goals, such as a desire to prevent industry concentration of the big-tobacco model.

Other things being equal, it is also advisable to assess tax before leakage can occur. That criterion suggests collection early in the supply chain.

This conventional preference might be moot if tracking of product were as bulletproof as Colorado and Washington would like to make it. The hope is that thorough tracking, combined with adequate no-fault penalties for lost product, could turn leakage and late collections into small problems. However, it is far from clear when, if ever, tracking will meet that promise. Video surveillance, for instance, requires more eyes on monitors than states might be able reasonably to afford.

One final, technical point applies uniquely, and perhaps temporarily, to collection of state marijuana excise taxes: The state can choose a collection mechanism that will reduce federal income taxes on marijuana businesses. Section 280E of the federal Internal Revenue Code (26 U.S.C. § 280E, discussed in Appendix B) allows marijuana businesses to deduct only the cost

of goods sold, amounts paid to produce or purchase marijuana. Washington's producer excise taxes, for instance, are imposed on the sale of marijuana. Those taxes do not seem to qualify as a cost of production, so they *prima facie* do not qualify as cost of goods sold and might not be federally deductible under Section 280E. To lessen the federal tax burden on marijuana businesses, the state might structure any excise tax (on any base) to apply to the privilege of growing or doing business or to *production* rather than sale (Roche, 2013). In that way, the tax would be part of cost of goods sold and federally deductible—even if collected at the time of sale.

Mechanisms for Changing the Tax Burden

Writing revenue laws for a nascent and tumultuous marijuana industry could be like buying clothes for a newborn baby. Whatever you choose will not fit for long. This new industry will evolve in unpredictable ways, so taxes on marijuana will need to be revisited and updated. But how? Here we begin by looking at the need to adjust. We then review five options for doing so and contrast their pros and cons.

The Need to Adjust

A brand-new legal marijuana market will not soon be stable. Fluctuating pretax prices would push after-tax prices around. Early on, the industry would likely suffer from lack of production capacity. Short supply would result in high early legal pretax prices.²⁸ Adding high taxes to those high pretax prices would tend to drive consumers to bootleggers, whose main selling point would be lower prices. So revenue and drug policy would suffer from too ambitious a tax plan.

Over time, legal businesses' pretax costs should drop, for two reasons. One is that the state prohibition premium, extra costs caused by illegality under the laws of Vermont, will disappear. Continuing federal illegality will impose some continuing premium. The other is that maturing businesses generally tend to see costs go down because of such factors as innovation, increased capacity, amortization of start-up costs, movement along the learning curve, economies of scale, and the need to meet competition.

Lower costs are likely to result in lower pretax prices to the consumer. If so, *unless taxes go up*, after-tax prices will go down, encouraging use by youth and abusers.²⁹ A tax burden that was just right at first could prove too low. If the state's goal were steady after-tax *prices*, neither steady tax *rates* nor steady tax *collections* in dollar terms would achieve it.³⁰ If, as we think likely, an increasingly high tax burden is appropriate as the legal marijuana industry matures, a tax increase will face the opposition of by-then vested interests. An old saying has it that raising taxes repeatedly and gradually is like cutting off a cat's tail an inch at a time.³¹

²⁸ On the demand side, novelty purchases or pent-up demand in early days of legalization might tend to push prices up (Hartmann, 2014; Belville, 2014).

²⁹ Elasticity of demand among youth is reportedly greater than for users generally (Gravelle and Lowry, 2014). The problem of lower after-tax prices is especially acute if taxes are based on price, as discussed in "Bases for Taxing Marijuana."

³⁰ A discussion of the goal for the tax burden appears in Oglesby (2015).

³¹ If the federal government legalizes marijuana, it could also seek tax revenue. New federal taxes, combined with until-then appropriate levels of state taxes, might make the total tax levels too high. But a well-designed federal tax could honor

In any event, the need for change in the tax burden is foreseeable. Whatever goal the state sets for after-tax prices, static tax laws, like a frozen airport flight-status screen, might be right only once. A dynamic tax burden is a facet of the need for adjustment generally. As Caulkins, Hawken, Kilmer, Kleiman, et al. (2013) note, “Since we are still learning about cannabinoids and how they interact, one may want to design a tax regime that can be easily amended to incorporate new insights” (p. 1054).

The federal government foresaw just this problem for another newly legalized intoxicant in 1933, after repeal of alcohol prohibition. As Congress and the administration studied “post-repeal liquor taxation, . . . [i]t was generally agreed that the immediate objective should be directed to the elimination of the bootlegger” (Hu, 1950, p. 73). Their plan, once legal businesses and law enforcement succeeded with that objective, was to raise taxes. President Franklin D. Roosevelt’s team put it this way:

It seems reasonable to suppose that a more drastic price competition by the legal industry will be necessary in the early post-prohibition period while the illegal industry is still organized and well financed. It would probably require a considerably higher price to revive a defeated illegal industry [than] it would to keep a well entrenched one in business. This price could be facilitated by keeping the tax burden on legal alcoholic beverages comparatively low in the earlier post prohibition period in order to permit the legal industry to offer more severe competition to its illegal competitor. When that competitor has been driven from business the tax burden could be gradually increased. Investigators . . . estimate that it will require three years of such competition to break the organization of the illegal industry. (Choate, 1933b, p. 309)

The plan worked. As Hu (1950) noted, “The syndicated type of illicit operation was virtually destroyed by the end of 1937, and since that time the control of production and distribution of illegal distilled spirits became largely a problem of coping with relatively small violators” (p. 95).

As bootlegging faded, Congress enacted four tax increases within 12 years.³² The tax increased by 450 percent (from \$2.00 in 1934 to \$9 in 1944). In after-inflation real dollars, the increase was 414 percent.³³ When the revenue was needed, the tax base was there.

Legislative bodies routinely arrange for tax rates or rules to change in advance—without contemporaneous legislation. Here we discuss five of these options: indexing, scheduled future rate increases, staggered starts for tax bases, discretionary rate changes, and nonrate adjustments.

Five Options for Adjusting Taxes

Indexing

Indexing dollar amounts for inflation changes the tax burden automatically. For instance, Vermont indexes income-tax brackets, conforming to federal indexing (V.S.A. § 5822[b][2]).³⁴

state taxes and resist interstate marijuana tax competition by giving credit for a certain level of state taxes against the federal tax owed (see Humphreys, 2013).

³² All the rates come from Ripy (1999).

³³ The \$2 tax was imposed in January 1933. The \$9 tax was imposed in April 1944. Between those months, cumulative inflation was 35.66 percent (McMahon, 2014).

³⁴ Vermont also indexes, for instance, the cap on the tax on tracked vehicles (32 V.S.A. § 9741[38]). In nontax law, Vermont indexes the minimum wage (21 V.S.A. § 384).

Indexing has distinct advantages when taxes are imposed on nonprice bases. In the long run, as the market stabilizes, indexing nonprice bases (weight, THC, plants, square feet) would prevent inflation-based erosion of tax receipts in real terms. Federal collections for alcohol and tobacco taxes would be billions of dollars higher per year in real terms if rates were indexed. But indexing aims at a steady tax *burden* in real, inflation-adjusted terms—not at a steady after-tax *price*—or at any price level. Thus, it is of only marginal use in adjusting to a dynamic marketplace.

Scheduled Future Rate Increases

To try to maintain marijuana prices that consumers pay or to aim at any price goal, the state could schedule rate increases in advance. That is, current legislation could provide that tax rates would increase at specified future times by specified amounts.

Scheduled future tax rate increases have been huge, in dollar terms. In late 1977, Congress enacted the Social Security Amendments of 1977 (Pub. L. 95-216, 1977, § 101), boosting the employer's share of hospital insurance under FICA from 0.90 percent for 1977 to 1.00 percent for 1978, to 1.05 percent for 1979 and 1980, to 1.30 percent for 1981 through 1984, to 1.35 percent for 1985, and to 1.45 percent thereafter. Other increases to FICA taxes were stretched over longer periods: The same act of Congress increased Old-Age, Survivors, and Disability Insurance (OASDI) taxes by seven discrete steps over 13 years (Pub. L. 95-216, 1977).

Setting tax rates that go up in advance is a variation on the concept of an income-tax holiday—a temporary zero or low rate for new activity, long used by developing countries (see, e.g., President of the Republic of Indonesia, 1970). Conceptually, rates that stair-step up over time are like a sunset of low rates. The old, low rate expires in favor of the new, higher rate, unless the legislature intervenes.

With respect to the repeal of alcohol prohibition, arguments against automatic increases then were that bootleggers would “hive up” inventory until taxes went up and that the future was too unpredictable (Choate, 1933a). But to the extent that bootleggers wait for higher taxes with which to compete, their cash flow suffers, and they are squeezed—perhaps squeezed out. To be sure, setting rates for out-years involves guesswork and will not achieve perfection. But prescribed, increasing tax rates could achieve a better result than static rates. Even in the best case, the legislature is likely to have to revisit early iterations of any legalization plan. A series of increasing rates would address, however tentatively, one of the uncertainties that legalization entails.

Staggered Start for Tax Bases

Introducing tax bases one by one—that is a lesson one could draw from the historical evolution of alcohol revenue measures (see generally Rabushka, 2008, and Hu, 1950). The simplest, least evadable revenue sources come first. Flat annual license fees are easy to collect: Authorities have to find the enterprise just once and do not have to measure anything. Import duties are easier to collect than excises: They require policing just the borders, not the entire territory. Capacity-based license fees (e.g., fees based on the size of a liquor still) require just a modicum of tax administration, perhaps annually. With progress, volume-based excises are collectible across the jurisdiction. Private so-called tax farmers, who buy the right to collect taxes at auction, give way to state officials. Potency-based taxes for homogeneous materials, such as proof-based liquor taxes, mark the final step in the tax-base march of progress.

As if speeding up tax history, the state could adopt revenue bases one by one, using later-adopted bases to replace or supplement early ones. Some marijuana bases are easier to implement from a standing start than others. For instance, square-footage taxes and electricity taxes could get an immediate start. Price-based taxes would require little lead time. Weight-based taxes, which require establishment of standards, procedures, and weighing locations, could follow. Potency-based taxation would require more time to implement.

Colorado, in effect, adopted a staggered start for its 15-percent producer tax in early 2014, by a one-time-transfer exemption for marijuana transferred from existing medical-marijuana businesses to commonly owned recreational businesses (Sullum, 2014a). Marijuana in inventory of a medical-marijuana business as of December 31, 2013, did not bear any 15-percent tax either when it entered the recreational channel or ever.³⁵

Discretionary Rate Changes

The legislature might consider delegating rate-setting authority to the executive branch. That is what Colorado does. Its marijuana tax statute says that CDOR must reset, every six months, the AMR to which a 15-percent producer excise tax applies. In August 2013, the department was officially notified that the AMR had increased.³⁶ If the department had gone along, taxes would have gone up. Using its discretion, the department disregarded the notification and continued a lower marijuana tax rate that will advantage the early legal market versus the black and fake-medical markets. Delegation of tax-rate setting would allow rapid administrative action. A legislature's strength could lie more in prudent deliberation than in speedy reaction to a dynamic market. Delegation could in particular help avoid legislative impasses that tend to arise when statutory tax increases are proposed.

A more limited form of delegation would allow administrative action only to *postpone* legislatively scheduled rate increases. The administrative authority could be merely binary: to allow a scheduled increase to take place or to delay it until further action. That is, the legislature would enact a set of scheduled future rate increases but would authorize their delay until such time as they would advance the goals of the legalization plan. Such delays could be automatic (hard trigger) or discretionary (soft trigger).

A hard trigger to raise federal taxes—a “‘failsafe’ that will automatically trigger should Congress and the Administration not succeed in enacting legislation by 2013 that meets specified revenue targets”—was recommended by the National Commission on Fiscal Responsibility and Reform (also known as the Simpson-Bowles Commission) in 2010.³⁷ That recommendation would have meant that bureaucratic counters of fiscal flows, not Congress, would have said yes or no to a tax increase. In the marijuana context, setting criteria for a hard trigger

³⁵ Ordinarily, inventory on hand at the time of imposition of a tax or a tax increase is subject to the new tax or rate (Hu, 1950; Gravelle and Lowry, 2014).

³⁶ Colorado's Marijuana Policy Group, assigned to research the price so as to provide a July–December 2014 tax rate, reported that the AMR for bud had risen to \$2,865 from \$1,876 per pound of plant matter. If the group's reported price were right, Colorado's 15-percent tax on bud for the last half of 2014 should have been \$429.75 per pound, or \$0.95 per gram, an increase of more than 50 percent over the \$0.62 rate for the first half of 2014. The Department of Revenue balked. Without numerical analysis, it stated, “[The department] will not be adjusting the market rate at this time” (“Average Market Rate,” undated).

³⁷ Hard triggers for federal spending cuts were enacted and fine-tuned in the 1980s in the Balanced Budget and Emergency Deficit Control Act of 1985 (Pub. L. 99-177, 1985, Title II), known as the Gramm-Rudman-Hollings Act, and subsequent legislation (Lynch, 2011).

seems difficult. A possible criterion for allowing a scheduled tax increase to proceed would be strength of the legal market versus the black market. If the black market were found weak, the scheduled tax increase could proceed. But measuring that strength would seem a subjective task, without easily quantifiable guidelines. Instead, a soft trigger, granting discretionary authority, might allow flexibility to take all relevant facts and circumstances into account. In all cases, a simple act of the legislature could override or undo any trigger at any time.

Nonrate Adjustments

Although delegation of tax-rate setting is an unusual way of avoiding possible legislative impasses, administrators often adjust tax rules that legislatures have enacted. One scenario is this: A legislature enacts a rule, but regulators delay its application and make adjustments that are prospective only. That is, administrative rules change the tax base or other rules, but only for transactions or taxable years after regulations have been written. The regulatory process can bog down, so regulatory adjustments could take effect long after legislative action.

An example is the delayed effect of antidiscrimination rules of Section 2716 of the Patient Protection and Affordable Care Act:

Because regulatory guidance is essential to the operation of the statutory provisions, the Treasury Department and the IRS, as well as the Departments of Labor and Health and Human Services (collectively, the Departments), have determined that compliance with § 2716 should not be required (and thus, any sanctions for failure to comply do not apply) until after regulations or other administrative guidance of general applicability has been issued under § 2716. (IRS, 2011)

In the marijuana tax context, administrative discretion might advance the legislature's goals. For instance, administrators would need time to get a weight-based taxation process up and running. Potency-based taxation would need even more time. In the sound exercise of administrative discretion, state officials could allocate time and expense to the projects of instituting new tax bases in light of the urgency for those bases to operate. That is, as the marijuana market became ready to bear a higher tax burden, officials could bring that burden, in the form of a new base, on line—by shifting scarce resources toward establishing that new base and certifying that it is operative. Such a procedure could aim in the direction of a particular after-tax price target, if only on an interim basis.

Table 5.2 presents a visual comparison of those options on the basis of several criteria, including effectiveness (whether a mechanism can respond quickly enough both to defeat bootleggers at first and to prevent a collapse in after-tax prices in the long run); delegation (whether a mechanism requires the legislature to delegate some of its power to other actors); finality (whether a mechanism is likely to require repeated legislation); and revenue potential.

Fees and Auctions

This section describes two options for charging money for the privilege to sell and grow marijuana: set fees and auctions. For each option, we describe precedents and then discuss the potential implications. We then discuss the option of charging fees for the privilege to buy marijuana, with particular attention to nonresidents.

Table 5.2
Mechanisms for Changes in the Tax Burden

Change	Example	Effectiveness Against Bootleggers and Price Collapse	Delegation of Legislative Power	Need for Ongoing Legislation	Revenue Maximization Potential
Static tax burden	Federal liquor tax	Lowest	None	Highest	Low
Indexing	Vermont income-tax brackets	Negligible	Minimal—to statisticians	High	Low
Schedule future rate increases	FICA changes	Medium	None	Requires midcourse correction	Moderate
Staggered start for tax bases	Colonial alcohol taxes	Medium	None	Requires midcourse correction	Low to medium
Discretionary rate setting	Colorado marijuana market rate	High	High	Only oversight	High
Discretionary nonrate adjustments	Patient Protection and Affordable Care Act (Pub. L. 111-148, 2010)	Low to medium	Varies	Medium to high	Low

NOTE: FICA = Federal Insurance Contributions Act (Pub. L. 74-271, 1935, Title VIII).

Set Fees

In Vermont, applicants to run medical-marijuana businesses pay a \$2,500 nonrefundable fee. Successful applicants then pay a “registration fee of \$20,000 for the first year of operation, and an annual fee of \$30,000 in subsequent years” (18 V.S.A. Chapter 86). Those are sizable fees. Because there are approximately 1,500 medical-marijuana patients spread across four dispensaries, those fees, in total, approach \$100 per patient per year.³⁸ Colorado collects a fee from marijuana businesses that depends on the number of their plants (“New Retail Marijuana Establishments Licensed Pursuant to 12-43.4.-104[1][b][II],” undated).

Sometimes fees are set at only nominal levels to discourage frivolous filings or to compensate the associated bureaucracy for its costs of processing applications.³⁹ There is nothing unique to marijuana about such fees, so nothing further needs to be said about them. However, fees are also sometimes set high enough to matter, both in terms of generating nontrivial revenue streams and in terms of influencing the structure and behavior of people and organizations who are subject to those fees. At these levels, fees serve purposes comparable to those of taxes, but, because of their different character, offer a distinct set of pros and cons and can be used either as an alternative or as an adjunct to taxes.

³⁸ Still larger fees have been contemplated. For example, in 2010, the Oakland, California, City Council adopted a \$211,000 annual fee for “marijuana factories” and would have allowed four of them (Sanchez, 2010). That fee never took effect, in light of federal concerns expressed in the Cole memo about large-scale private operations (Downs, 2011).

³⁹ The line between fees and taxes is often fuzzy (Cummings, 2011). Unlike a tax, a fee cannot be coerced: The payer chooses to pay a fee but not a tax. In addition, the fee amount should relate somehow to a benefit to the payer or a cost to the government. A sale by the government of a privilege to sell or buy marijuana would grant the willing buyer a benefit the buyer thinks is worth the price and so would be considered a fee, not a tax.

The state could impose flat license fees on all marijuana businesses. Business privilege licenses are a standard tool for identifying market participants, so as to regulate them. Fees for the out-years could be scheduled to increase to reflect the likelihood that other producer costs will drop—like a tax holiday. The out-year increase in the Vermont medical-marijuana business fee already follows that model.

If one wants a relatively small number of outlets for law enforcement to monitor, charging a fairly large fixed fee will tend to limit the applicant pool. Using a substantial fee as a barrier to entry could reduce the difficulty of dealing with appeals from applicants who do not succeed in obtaining licenses.⁴⁰ In addition, a large fee encourages substantial, well-capitalized operations that could exhibit a degree of professionalism in the industry. But to hit a total production goal that provides just enough supply, but not too much, fee-setters would periodically need to estimate the demand curve for the privilege of growing (or selling) marijuana legally. So some other restricting mechanism would need to help allocate the privilege.

Fees need not necessarily be per business. Fees could pay for weighing or potency testing. Vermont, like Colorado, could impose a fee based on number of plants to complement a regulatory scheme that tracks plants—recognizing that, if the fee were too large, growers would tend to shift to tree-like plants.

Fees Set by Auction

Governments routinely sell property, including intangible rights, at auction. In 1993, for electromagnetic spectrum, Congress authorized the Federal Communications Commission (FCC) “to use competitive bidding to choose from among two or more mutually exclusive applications for an initial license,” replacing “comparative hearings and lotteries” (FCC, 2006). Spectrum licenses are issued for a period of years but are generally renewable as a matter of course if the licensee meets standards.⁴¹

Government auctions of *short-term* intangible rights are not common, but they are not new. In New Hampshire in the mid-1700s, for instance, when excise taxes on spirits were imposed at set, statutory rates, “[t]he method of collection was tax farming, in which the right to collect excises was sold at auction to the highest bidder” for periods as short as two years (Rabushka, 2008, pp. 619–620). We are aware of no current short-term auctions of nonrenewable business licenses.⁴²

Vermont could auction off licenses to produce marijuana, more plausibly as a complement to taxation than as a complete replacement. Auctions could raise revenue by selling permanent or annual quotas. An auction method of allocating licenses could avoid arbitrariness and cronyism, which are problems that turn up when on-the-merits allocation goes wrong.

An auction would allow the market, rather than government, to allocate a scarce resource—the privilege to sell recreational marijuana legally. Fee-setting requires guesses by government about what the market will bear; an auction method lets the market speak for itself. An auction of quotas, like a tax, could capture some of the economic rents of legalized marijuana commerce. An auction could sell the right to grow (1) on a number of square feet,

⁴⁰ In Washington, for example, early in the process of issuing licenses by lottery, 127 applicants who were denied chances in the lottery had appealed the denials (Johnson, 2014).

⁴¹ See, e.g., FCC (2008): “Renewal will be subject to the licensee’s success in meeting . . . license conditions.”

⁴² The legislature might be concerned that trying out a novel approach on a novel industry creates a significant risk of unintended, harmful consequences.

(2) an amount by weight (or eventually THC content), or, more simply, the right to operate a store.

Auctions ordinarily favor well-capitalized bidders (e.g., existing businesses), which can pay in all events, without depending on results. This favors bidders with wealth—with risk capital. So auctions are regressive in their allocation of a state-owned intangible asset, but they tend to eliminate underfinanced bidders.

Auction design, though, presents difficult theoretical and practical issues and provides traps for the unwary (Klemperer, 1999). Collusion among buyers is a constant concern. The possibility of collusion, though it can be addressed by auction design, cannot be eliminated (see, e.g., “Competition Hammered,” 2014).

Auctions could yield permanent or temporary quotas. Auctions of permanent privileges—or privileges revocable only for cause—could provide winning bidders either (1) a fixed quota or (2) a fixed fraction of a total market amount to be set periodically by the state. Bidding for permanent licenses is likely, from the state’s perspective, to leave money on the table. As the nascent marijuana industry struggles to outperform the black market, entrants are unlikely to amass and risk the capital necessary to pay for the present value of future rents from a permanent marijuana license. That is, given uncertainty, firms would deeply discount the prospective profits from the out-years. Taxation can make up for that shortcoming by taking up economic rents as they materialize. But proceeds of a one-time auction for permanent rights would bring in a disproportionate amount of revenue up front and could help pay for the cost of setting up legalization.

Instead of permanent licenses, annual licenses could be auctioned. (Auctions could sell off licenses for any number of years; we consider one year as an example.) A series of annual auctions might, like nimble taxes, yield increasing revenue over time. As the cost of producing marijuana drops, the privilege of selling it legally in a restricted market increases in value. With annual auctions, the state might take at least some of the increasing value of that privilege. If so, winners’ payments to the state would increase their costs of production, which might help prevent an unfortunate price collapse.

The state could set a year’s quantity target for quotas based on prior volume (or, for the first year, on an estimate of likely first-year consumer demand). Several types of auctions are available (Klemperer, 1999). If the state seeks to avoid market concentration, it could limit producers to a certain percentage of the total quota. Related-party rules would be needed to enforce that kind of limitation. This gets back to the issues surrounding supply architectures in Chapter Four.

The winner of an annual auction has no guarantee of renewal. That uncertainty might keep bids low and might keep potential entrants out of the market. Indoor marijuana production, in particular, would seem to benefit from long-term investment. Typical investments in real property and in plant and equipment with a useful life beyond one year would be thrown into turmoil by the prospect of nonrenewal. Outdoor growers, whose operations are less capital-intensive, might be less daunted by the risk of nonrenewal. Annual licenses, perhaps more than any other allocation mechanism, could work against incumbent marijuana businesses. That would be a positive feature if government wants to disfavor entrenched incumbency in the marijuana industry. As Caulkins, Hawken, Kilmer, and Kleiman (2012) noted, “[O]nce business interests get entrenched in an industry, toughening the laws related to that industry becomes more difficult. . . . Private interests prioritize profit, not public health or public safety” (p. 245).

To be sure, annual licenses would entrench incumbents less than permanent licenses. But annual licenses would not eliminate entrenchment. Incumbents might tend to benefit from asymmetrical information (Yasuda, 2008), such as knowledge of production processes and of the market learned while operating with a license. In addition, investments in tangible assets might allow an incumbent to outbid new entrants. Indeed, annual auctions could *eventually* concentrate production in the most-successful and capital-rich enterprises, eventually leading to only a few major players with a high probability of regulatory capture. One way to weaken the advantages of incumbency would be to issue only nonrenewable licenses. Or perhaps the law could favor new entrants by requiring incumbents to outbid them. Either practice would disrupt the industry and invite disguised ownership arrangements in which incumbents try to pass themselves off as outsiders.

An auction process produces revenue in the short run that does not depend on the fortunes of private enterprise or the vagaries of the market. That is, an auction requires businesses to pay a set amount of revenue, possibly collected up front, whether the industry has a good year or a bad year, so it removes some uncertainty from the state's budgetary process, though only for one year. An auction shifts the risk from the state's budget to the private bidders, who could reflect that risk by bidding less than their best guess about the most likely value of the license.

Winners of auctions for the privilege to produce might have to pay up before the supply chain is in operation. If so, the capital available would be only that raised by the producers themselves, in contrast to a tax imposed on *sales* by a producer, in which case the purchaser would come in with cash. That kind of capital requirement might hold down bids—or favor vertical integration. If, instead, payment of bid amounts were delayed until after harvest, collection might fail.

As the industry evolved, producers could well receive a small share of total dollars spent on marijuana.⁴³ If auctions were the only revenue source from marijuana commerce, the level of government revenue necessary to set prices at tolerable levels could mean that minimum auction bids would dwarf all the other expenses of producers combined. That extraordinary cost structure would put pressure on anticollusion mechanisms.

Like any licensing plan, any quota system transfers scarcity rents from the state to quota owners (Donohue, 1998, p. 5). An auction process would need to be carefully designed, and bidders would need to be competitive, to bring an appropriate amount of those rents back to the state that is responsible for allowing them.

Consumer Fees

Vermont could charge consumers for the privilege of buying marijuana (Kleiman, 1992). Residents could pay less than nonresidents, or residents might even be exempt. Vermont charges fees for hunting, fishing, and trapping licenses and charges nonresidents more than residents—sometimes an order of magnitude more (Vermont Fish and Wildlife Department, undated). And nonresidents of Vermont pay \$50.00 for a license to hunt small game, while residents pay nothing. States routinely charge nonresidents more for such licenses. Colorado limits purchased quantities of recreational marijuana more severely for nonresidents than for residents, and most medical-marijuana states do not allow purchases by nonresidents at all.

⁴³ With taxes making up very roughly half of the retail price of U.S. cigarettes, and markups by resellers getting most of the rest, growers of raw tobacco get a tiny fraction of the final price.

A fee structure disfavoring nonresident marijuana buyers could limit both interstate leakage and harm from marijuana tourism. Game licenses that discriminate in favor of residents are constitutional, and federal illegality makes a claim of constitutional discrimination even more difficult for marijuana consumers.⁴⁴ But any after-fee price advantage for residents can extend only so far as the market will bear. If it is too large, out-of-state purchasers will find straw Vermont residents to do their marijuana shopping for them—for cash.

Determining the amount the market would bear for a consumer license would be a matter of speculation. If the state allows local option for any decision about marijuana legalization, it might let localities experiment with amounts of license fees and with price advantages for Vermont residents. To be sure, high local fees or taxes could result in de facto prohibition, so, if the state seeks uniformity, it could ban or limit local license fees or limit Vermont residents' price advantage. Or it could share in the revenue that border jurisdictions collect from nonresidents.

The ability of localities to impose a minimal fee on purchases might allow for further experimentation. For instance, as a pilot project, a locality, if not the state, might choose to impose a small fee on all purchasers but waive it for who set their own monthly purchase limits. Such limits might

keep consumers mindful of how much they're actually using, compared to how much they intend to use . . . Since using more, or more often, than intended is among the defining characteristics of substance abuse, helping users enforce on themselves their own chosen consumption patterns would address the problem at its root. (Kleiman, 2014a)

To be sure, users could adjust their own limits periodically and might seek to get around the inconvenience by traveling or by hiring straw purchasers. Even so, the limits would tend to enlighten users about their own use and maybe to nudge them toward their own goals.

Other Revenue Considerations

This section mentions briefly some other potential revenue streams to the State of Vermont. It is not exhaustive; for example, given the uncertainty about how legalization will influence alcohol consumption and alcohol tax revenue (Chapter Three), the revenue impact that legalization could have on alcohol revenues is not discussed in this chapter. Note that insights about public-health consequences and costs associated with regulation are discussed in Chapters Three and Seven, respectively.

⁴⁴ Although we do not undertake a full constitutional analysis, we quote Justice Harry Blackmun about one argument: "Whatever rights or activities may be 'fundamental' under the Privileges and Immunities Clause, we are persuaded, and hold, that elk hunting by nonresidents in Montana is not one of them" *Baldwin v. Fish & Game Comm'n of Montana*, 436 U.S. 371, 391 (1978). To paraphrase, during federal illegality, whatever rights or activities might be fundamental under the privileges and immunities clause (U.S. Constitution, Article IV, § 2, Clause 1), marijuana consumption by nonresidents in Vermont is not one of them. And an equal-protection challenge would fail if a legitimate state purpose exists. The U.S. Supreme Court allowed Montana to charge nonresidents more than residents for hunting licenses, accepting that "nonresident [elk] hunters create greater enforcement problems" than Montanans and holding that higher fees did not offend the equal-protection clause (*Baldwin*, 436 U.S. at 388). In light of attempts in the Netherlands to deter drug tourism, it is plausible to think that drug tourists would create more problems than marijuana-using residents. And restricting drug tourism is likely to reduce the danger of leakage to other states, an existential threat to legalization in light of federal warnings.

If Vermont legalized marijuana, a host of non-marijuana-specific taxes would kick in. These are important for two reasons. One is their contribution to Vermont revenue. Whatever its marijuana-specific taxes, Vermont will also benefit from the extra effect of nonspecific taxes, which is often ignored in the policy debate about marijuana legalization (this is further addressed in Chapter Seven). The second is these taxes' effect on total operating cost in a business that will be fighting for survival against the black market. In connection with that second reason, federal taxes, such as FICA and income taxes on employees, are large and important.

Vermont's general sales tax was considered briefly, along with price-based excises, in "Bases for Taxing Marijuana." Vermont's individual income tax, with a top rate of 8.95 percent, and its corporate income tax, with a top rate of 8.5 percent, will apply to income owners and employees earn from marijuana businesses. (In Appendix B, we discuss an obscure income-tax issue—Section 280E—Vermont's version of which denies some deductions to marijuana businesses.) Medical-marijuana businesses are already subject to all income taxes; so are illegal producers of marijuana, although the collection rate might be low. (Remember that prohibition-era racketeer Al Capone went to prison for tax fraud because illegal income is not tax exempt.) To the extent that the marijuana industry hires employees who were either not earning income in Vermont (this category includes workers moving into the state and chronically unemployed Vermont residents) or evading taxes before, Vermont's income-tax receipts will rise. So will unemployment taxes.⁴⁵

Whether or not black-market workers charge a prohibition premium for their labor, legal workers (leaving aside federal illegality) will not. For workers shifting from illegal to legal work, wages per worker could decline, but compliance with tax law should increase.

A key point is that these non-marijuana-specific tax bases could expand. A host of multiplier effects can be anticipated. Construction and employment will result from new business activity. Businesses will hire professional help. Tourists will come and spend. Legalization could free up cash in consumers' hands, leaving them more to spend on other items. That is, a consumer with fixed income and a static level of marijuana use will have extra cash to spend or save—*if* the price per intoxicated hour goes down.

When marijuana businesses buy or rent real estate, income for owners of that real estate benefits. Property values might go up,⁴⁶ benefiting local property-tax collections, while perhaps burdening property-owning taxpayers. Vermont residents not involved in marijuana commerce might see some increase in the general price level, to the benefit of sales-tax collections.

In summary, a host of collateral effects can be imagined. But predicting how a legal marijuana industry will affect the economy overall is speculative.

Concluding Thoughts

Revenue is not the only goal, and maybe not even the primary goal, of a tax scheme. In the case of marijuana, an upsurge of problem use and underage use in the wake of legalization could create social, educational, and health damage that would outweigh all the revenue collected

⁴⁵ We note the argument that increased marijuana use could decrease ambition and increase nonproductive idleness to the point that economic activity suffers.

⁴⁶ Prices for warehouse space in Denver are said to have soared in the early days of legalization (Raabe, 2014). Whether those price increases are sustainable or are the result of temporary supply shortages is not clear.

from even the most ambitious tax plan. The dangers of such an upsurge ought to dominate decisions about the level and form of taxation.

A licit marijuana market has some advantages over the illicit market. For producers, legal production can be much cheaper than illegal production, with no need to hide, sneak, or pay outlaw wages and the capacity to invest in long-lived assets. If marijuana were a fully legal product, produced the way tea is produced, a joint would cost just about what a teabag costs: pennies rather than dollars (Gieringer, 1994; Caulkins, Hawken, Kilmer, and Kleiman, 2012). For consumers, legal product will be easier and safer to buy and will have been tested both for potency and for the presence of adulterants and contaminants. So at some point, as the market matures, it can sustain fairly hefty taxation without generating much illicit activity. But finding the optimal level of taxation is a challenging and ongoing problem.

In addition to finding the right tax level, policymakers need to determine how and at what stage of production the tax will be collected and determine the base of the tax. An ad valorem tax is administratively simple but has the disadvantage that it will fall as market prices fall; if the goal is to keep the after-tax price at some target level, ad valorem taxation is not the way to go. A tax on gross weight produced or sold is also relatively simple, but it creates an incentive for producers to pack as much intoxicating power as possible into as little plant material as possible and thus gives a market advantage to the highly potent forms of marijuana that have become increasingly popular; insofar as those forms are more dangerous than milder forms, that counts as a disadvantage of taxation on gross weight. Taxation per unit of THC has many attractive features but depends on accurate and honest testing procedures. In any case, a decision has to be made about how to tax concentrates and edibles, as opposed to herbal marijuana; those product forms have been growing in market share in states with open medical or commercial sales.

Higher taxes will have only modest effects on casual use or the number of users; even at today's illicit-market prices, being stoned costs an occasional user without a developed tolerance to THC less than \$1 per hour. But taxes matter to heavy users because marijuana makes up a significant fraction of their personal budgets and because they use more often and use more per day of use than others. Someone averaging 1.5 g per day over the year—which would put that person in the top 10 percent of monthly marijuana users—and paying today's illicit prices spends more than \$5,000 per year on marijuana: about what a pack-and-a-half-a-day cigarette smoker paying Vermont retail prices spends on tobacco.

In addition, keeping Vermont marijuana prices higher than illicit-market prices in New Hampshire, Massachusetts, and New York will discourage both consumers and dealers from buying in Vermont to use or resell in neighboring states; effective control of out-of-state sales is part of the requirement for federal toleration of state legalization efforts.

That makes marijuana taxation a potentially important public-health measure and a means of avoiding a federal crackdown. But high taxes also have disadvantages:

- The higher the tax, the greater the incentive for evasion via diversion, illicit production, or import from out of state and the greater the need for enforcement. (A sufficiently high tax would be tantamount to prohibition.)
- Although high taxes help protect some users from slipping into substance-use disorder, other users will do so even in the face of high taxes. Those people will wind up not only chronically intoxicated but also poorer than they would have been had the price of marijuana been lower.

- If—and this is a big if because the causal relationships remain unclear—marijuana tends to substitute for alcohol (especially for heavy problem drinking or for alcohol use in combination with opiate use) or for other illicit or prescription drugs, higher prices for marijuana due to higher taxes could lead to more abuse of those other substances. Insofar as they are more dangerous than marijuana, the result could be to increase total harm rather than decreasing it.

We conclude this chapter by highlighting three threats to collecting tax revenue from state-level legalization regimes. In addition to taxes being so high that they sabotage legal sales and perpetuate the black market, taxes could also be too low. Although eliminating the black market, the revenue per unit sold could be so low that tax collections are meager or even so low that the public turns against legalization, which would wipe the revenue stream out. And the state would need to set shrewd tax rates on all products: Purchasers could flock to any particular product categories that are undertaxed.

Second, the public could eventually condone marijuana tax evasion. This threat might not materialize: If citizens embrace the new law and want tax collected, cheating will be a fool's errand, and the bulk of marijuana commerce will flow through legitimate channels that bring cash to the state. But two non-revenue-producing alternatives to legitimate channels could wreak havoc: One is tax-free medical products being, in fact, available to healthy users without means testing.⁴⁷ The other is the public viewing evasion of marijuana taxes as casually as it now views adult marijuana use. In that case, law enforcers and prosecutors might go easy on tax evaders, or jury nullification could set them free, or complicity among citizens could make detection close to impossible. Either way, meaningful revenue collection could be at risk.

Third, a tightening of federal law or policy, perhaps upon a change in administrations in 2017, could stop state taxation and licensing (not to mention state sales in a monopoly model). That could happen overnight under current law—after a court order or a simple modification of prosecutorial discretion. That would leave the state without marijuana revenue and the law in chaos.

This chapter presents only a first look at marijuana revenue. We offer no answers, just options—and warnings. It is unlikely that any plan will get marijuana revenue right at first, and the market is likely to evolve and prove tumultuous beyond anyone's ability to predict. So, as Vermont considers legalization, input from stakeholders, from the executive branch, from analysts, and from the ongoing experience in other states will allow more-informed steps toward or away from any particular revenue plan—indeed, toward or away from legalization itself.

⁴⁷ Tax and means-testing options for medical sales are discussed in Oglesby (2015).

Regulation

Introduction

Regulation, like taxation, presents opportunities for shaping who consumes, what they consume, and how they consume. Regulation can influence prices, product variety, product consistency, product safety, and the information made available to consumers, as well as the extent of diversion in the form of illegal sales to minors and leakage beyond Vermont's borders. Regulation can affect production, intermediary markets, and final retail markets. Regulation can reduce the opportunities for tax evasion, thus protecting revenue collection.

But regulations can also be costly to enforce, impose costs on those regulated, and create opportunities for evasion; the greater the incentive to break the rules, the greater the enforcement effort necessary to maintain them. Burdensome regulations can also limit the speed and completeness with which the legal market displaces the illicit market. Policymakers, therefore, face numerous challenges in seeking the right balance among all these competing considerations. Even well-intended regulations can be quite complex to implement and enforce.

The commercial marijuana regimes in Colorado and Washington have led the way in regulatory experimentation but are too recent to provide much empirical evidence about their strengths and weaknesses. Likewise, medical-marijuana programs in Vermont and elsewhere offer some insights but, for the most part, have not been subject to rigorous evaluation (Pacula and Sevigny, 2014a, 2014b).¹ Thus, this chapter draws heavily on the experience and lessons learned from regulation of other goods.

The previous chapters about supply architectures and taxes describe a range of options from which legalizing jurisdictions can choose. This chapter is different; it begins with a checklist in “A Regulatory Checklist” of possible regulatory areas, largely based on public-health principles and the existing research. The list includes regulations pertinent to a variety of policy goals, such as total government revenue generated from the new legal industry, reduction in tax avoidance, quality and safety of the product consumed, exposing products or marketing to minors, sales to minors, and diversion and sales out of state. Instead of discussing each kind of regulation in detail, we provide examples of how they have been applied to other goods and how they could be applied to marijuana specifically.

¹ As we were writing this report, the American Herbal Products Association published recommendations for marijuana regulators about cultivation and processing operations; manufacturing, packaging, labeling, and holding operations; laboratory operations; and dispensing operations. For more information, see American Herbal Products Association (undated).

“A Closer Examination of Eight Regulatory Decisions for Legal Marijuana” provides a deeper discussion of eight particular areas of regulation that need to be carefully considered if a jurisdiction decides to pursue a legal marijuana regime:

- types of products allowed
- cannabinoid content (e.g., THC, CBD)
- retail outlets and delivery services
- sales to nonresidents
- pricing control strategies
- prevention and countermarketing
- vertical integration
- local autonomy versus uniformity.

Before moving to the discussion of specific regulations, we highlight two higher-level decisions that will shape the regulatory environment.

First, what agency will be in charge of developing and monitoring regulations? In balancing commercial interests with public welfare, some agencies’ culture could predispose them to supplement conventional regulatory postures appropriate for any article of commerce with extra efforts that reflect concerns that are unique to this good. One might expect, as a general rule, that a liquor-control board (such as in Washington) might be more cognizant of the special circumstances surrounding a dependence-inducing intoxicant than would, say, a department of revenue, as in Colorado, which might be more focused on good governance that is mindful of matters of process and equitable treatment across licensees. One might also expect that neither would necessarily have as much of a proactive focus on protecting public health as a health or child-welfare agency would. Thus, it is useful and important to consider the role (and perhaps leadership or co-leadership) of a public health–minded state agency.

Second, how much flexibility will be built into the regulatory system? Because nobody knows how best to regulate legal marijuana, early-adopting states will be learning by doing and making mistakes along the way. That implies a need for flexibility. Those designing a legal regime must decide how much discretion they will give to regulators to adapt and adjust over time and what checks against regulatory capture they will implement. For example, if concentrates are initially permitted but the agency in charge later decides that they should be withdrawn from the market, will this require a new law or ballot initiative, or can the regulator simply make this the new policy?²

A Regulatory Checklist

A variety of legalization bills and ballot initiatives have proposed to regulate marijuana like they regulate alcohol. Indeed, government agencies, particularly state agencies, have lots of experience regulating other intoxicating and potentially addictive goods, including alcohol, tobacco, gambling, and now even sugary drinks. That said, the states have not converged on one single strategy for regulating these products and minimizing the harms from them.

² This is also relevant when thinking about taxation: If regulators decide that the tax base or tax rate should change, will this require new legislation and possible battles with industry groups?

Different objectives dominate each state's approach, and industry has responded to various regulatory approaches. Hence, considerable variation exists in strategies taken and outcomes obtained. Much has been learned from these experiences, and several scholars have already published valuable lessons learned from regulating these products when thinking about the development of a new legal market for marijuana (Rolles and Murkin, 2013; Barry, Hiilamo, and Glantz, 2014; Pacula, Kilmer, et al., 2014; Richter and Levy, 2014).

Table 6.1 lists a range of levers that might be useful for regulating marijuana, based on the experience of trying to limit the harms associated with alcohol, tobacco, and other regulated

Table 6.1
Examples of Regulations That Might Be Applied to Legal Marijuana

Area of Regulation	Precedent Pertaining to Currently Legal Products	Example of Application to Marijuana
Product		
Types of products that are permitted	At various times, jurisdictions have banned absinthe and Everclear, even when allowing most types of alcohol.	Restrict legalization to just usable marijuana plant materials (herbal cannabis).
Additives or products attractive to children	Flavorings (except menthol) are banned from cigarettes.	Ban fruit flavors and marijuana-infused candies.
Potency or strength	Many states restrict sale of products with more than 10% ethanol from being sold in grocery stores.	Create a THC ceiling or a CBD floor.
Product labeling	Australia adopted plain packaging for all tobacco products in 2012; similar efforts are being pursued in other countries.	Require unbranded packaging, devoid of logos or any form of commercial design.
Packaging	Child-resistant packaging is standard on a variety of household items, including prescription and over-the-counter medications, vitamins, pesticides, and household chemicals.	Require marijuana products to be sold in resealable, opaque, child-resistant containers.
Seller or server and sales		
Inventory-control system	Both Washington and Colorado are implementing inventory-control systems for recreational marijuana.	Require all licensees throughout the supply chain to participate in inventory-control system.
Age of sellers and servers	Many states impose a minimum age restriction of 21 for serving alcohol.	Require that anyone selling or handling marijuana in stores be at least 21 years old.
Vendor and server training and responsibilities	Many states require training for those who serve alcohol to (1) ensure they check the patron's age, (2) identify people at risk of excess, and (3) understand their legal responsibilities and risks as servers.	Require specific training course that includes how to advise consumers on potency and related risks.
Sold in certain types of outlets only	Many liquor-control states limit sale for off-premise consumption to specialized alcohol-only stores.	Require that marijuana be sold only in marijuana-only stores.
Outlet density and location	Washington restricts the total number of legal marijuana outlets and requires that licenses be distributed across the state according to consumption data.	Limit outlet density to ensure that there is no overavailability in any area.

Table 6.1—Continued

Area of Regulation	Precedent Pertaining to Currently Legal Products	Example of Application to Marijuana
Vending machines	The United States restricts tobacco-vending machines to establishments with over-18 age restrictions.	Prohibit sales of marijuana products in vending machines.
Days of sale and hours of operation	Most states limit the times when alcohol can be sold. Several states ban sale of alcohol for off-premise consumption on Sundays.	Restrict sales of marijuana to the same outlet hours as alcohol sales.
Happy hours and bulk discounts	Many U.S. states ban happy-hour pricing for alcohol sales.	Prohibit happy-hour pricing and discounts with bulk purchases.
Quantity and promotional discounting, free samples	In response to grocery stores using alcohol as a loss leader to get people into the stores, the UK banned promotions that sold alcohol below cost.	Prohibit coupons, discounts, and giveaways (e.g., free marijuana with purchases of other goods).
Sales quotas and limits	Dutch coffee shops limit marijuana sales to no more than 5 g per purchase, and Uruguay limits pharmacy purchases to 40 g per month (no more than 10 g per week).	Limit the amount of marijuana that can be purchased within a day or month (e.g., tied to driver's license).
Nonresident access	In Colorado, a nonresident can purchase only up to 0.25 oz. of herbal marijuana at a time; a resident can purchase up to 1 oz.	Restrict sales to residents only.
On-premise consumption	Various jurisdictions ban consumption in marijuana dispensaries; Washington State bans marijuana use in any establishment with a liquor license.	Allow the marijuana equivalent of liquor stores but not bars; ban consumption of marijuana at establishments that serve alcohol.
Product placement	As of 2010, FDA has restricted the sale of tobacco products in vending machines and self-service displays; they can be sold only behind the counter.	Ban self-service displays and so require a store assistant to access.
Minimum pricing	Many states have minimum pricing laws for cigarettes. ^a	Require that 1 mg of THC be sold for no less than a certain price.
Marketing		
Physical location and size of advertising	Washington bans advertising within 1,000 ft. of schools and playgrounds; in the Netherlands, only establishments that refrain from advertising are exempted from marijuana law enforcement.	Prohibit off-premise advertising.
Electronic advertising	Finland bans alcohol-branded social media communication.	Make refraining from sponsoring games and other online contests a condition for licensure.
Product placement and sponsorship	FDA bans the tobacco industry from sponsoring sporting and entertainment events.	Prohibit marijuana firms from sponsoring sporting and entertainment events and any event at a school.
Ads targeting youth	Both the tobacco companies and the beer industry have been challenged for the use of youth-oriented marketing materials. Joe Camel was effectively removed because of court challenges.	Prohibit use of cartoon figures, animals, and other marketing images geared toward youth.
Possession or use		
Age of possession, use, and purchase	Most states allow civil and sometimes criminal penalties for minors caught possessing, using, or purchasing cigarettes or alcohol, although tobacco PUP laws are weakly enforced.	Restrict possession, use, and purchasing by people under 21 years of age.

Table 6.1—Continued

Area of Regulation	Precedent Pertaining to Currently Legal Products	Example of Application to Marijuana
Method of consumption	Many states have strict rules pertaining to purchasing a keg of beer so as to reduce the chances that keg parties are possible for youth and young adults. ^b	Prohibit forms of cannabis suitable for dabbing.
Use in public	Many states have open-container laws effectively banning alcohol use in public and implement strict clean-indoor-air laws limiting where cigarettes may be smoked.	Prohibit the use in all places where tobacco is also prohibited or in all public spaces more generally.
Use before or while driving	Most states ban open alcohol containers in a car; all limit BAC as measured by a breathalyzer. Colorado and Washington limit active THC per unit of blood for drivers, but there is not a practical roadside test for that, akin to breathalyzer readings being assumed proportional to BAC.	Limit active THC per unit of blood for drivers. ^c
Possession of diverted (non-tax-paid) product	Many states ban possession of non-tax-paid alcohol.	Impose criminal penalties on possession of marijuana that does not bear a Vermont tax stamp.
Providing access to minors	Many states have social-host policies that hold property owners responsible for underage drinking occurring on their property. Both state-imposed liability and private-party civil liability apply.	Impose civil penalties on those who provide access to marijuana to minors, and extend social-host policies to marijuana.
Prevention	Many states, including California, increased the sales tax on cigarettes with a specified share going to an antitobacco public-health campaign.	Require that a substantial proportion of revenue generated by marijuana sales go to prevention campaigns designed or run by the state public-health agency.

NOTE: The fact that an example is listed is not necessarily an endorsement. FDA = U.S. Food and Drug Administration. PUP = purchase, use, and possession. BAC = blood-alcohol concentration.

^a Counter Tobacco, undated (b).

^b For a review of the literature on keg-registration policies and their effect, see Wagenaar et al. (2005).

^c On the basis of the strength of various studies and observations in the literature on impaired driving, a group of medical toxicologists (Neavyn et al., 2014) recommends that medical-marijuana patients abstain from driving for a minimum of eight hours after achieving a subjective high.

products. The very length of the table underscores the considerable number of forms of regulation that might be considered, so again it becomes clear that the question to legalize is really only the first step in thinking about whether and how to end the prohibition of marijuana.

The types of regulation one chooses to adopt depend on a few factors: (1) the goals of the state (e.g., revenue maximization, harm minimization, undermining the black market) (further discussed in Chapter Eight); (2) the structure of the market that policymakers decide to allow (see Chapter Four for options), and (3) the number and types of products that are deemed appropriate for legalization. With some of these decisions in place, other regulations no longer become relevant. For example, if policymakers decide to legalize the sale of only herbal marijuana, the task of specifying restrictions on other products would not be necessary.

The specific set of regulations that is best for any given jurisdiction depends on the priorities of the policymakers legalizing marijuana. If the sole goal were to reduce the size of the black market, less regulation would be more attractive than more regulation. To the extent that raising tax revenue and reducing youth use and exposure to marijuana are important, regu-

lations that place constraints on the supply chain, as well as on marketing and sales, would be desirable. Excessively tight regulations, however, might provide avenues through which an illicit market could remain. Thus, policymakers must be keenly aware of trade-offs when making these decisions.

We now discuss in greater detail some areas of regulation, some of which are unique to legal marijuana.

A Closer Examination of Eight Regulatory Decisions for Legal Marijuana

Types of Products Allowed

There are dozens of ways to consume cannabinoids, including buds (flowers), leaves, rolled joints, oils, and other concentrates, including hashish, lotions, waxes, and edibles. Further, there can be considerable variety within any one of these forms. Several dozen varieties of bud can be observed at dispensaries in California and Colorado. Although smoking dried marijuana buds via joints, pipes, or water bong remains the most common method of consumption in the United States, other products are becoming increasingly popular in places that have liberalized their laws, including Colorado, Washington, and some states with medical marijuana. These changes imply that regulators must decide *what* they will allow to be consumed in the legal market, as well as *how* it can be consumed.

The marijuana industry, like the alcohol and tobacco industries, markets products that might be especially appealing to youth, ranging from THC-infused lollipops and gummy bears to marijuana candies, colas, and cookies. Sweetened products could increase the probability of unintentional ingestion by young children (and other people) who fail to distinguish marijuana brownies or gummy bears from the ordinary forms of the same products. Even when the consumer is a well-informed adult, edibles can increase the probability of overdose because the slow and variable onset of effects makes it harder for consumers to judge and adjust (self-titrate) dosage.³

In light of these safety concerns and evidence coming out of Colorado about children accidentally ingesting unwrapped edibles (see Chapter Three), the Washington State Liquor Control Board (WSLCB) adopted emergency regulations surrounding marijuana-infused edible products, in June 2014. The emergency rules require all marijuana-infused products to be homogenized to ensure uniform distribution of cannabinoids throughout the products (and testing is required to confirm that this is the case), and such products sold in solid form have to be scored to indicate individual serving sizes. *Score* here does not mean rated, but rather divided into identifiable squares or tiles with just one dose or serving each.

The WSLCB also imposed a rule that “potentially hazardous” foods could not be infused with marijuana and sold in retail stores.⁴ The regulations define potentially hazardous foods

³ Users of smoked or vaporized marijuana might overestimate the accuracy with which they can manage the process of taking one or a few puffs, waiting, and then continuing or stopping based on how stoned they feel compared with how stoned they want to be. However, even slightly experienced consumers can use that technique to some extent because the full effect is felt within a minute or two from the time of inhalation. The comparable lag for edibles can be an hour or more, and the initially felt effect is small compared with the effect once all of the active agents have made their way from the gut to the bloodstream, leading not infrequently to the sort of grim experiences described by edible novice Maureen Dowd. It can happen to even experienced users (Dowd, 2014).

⁴ The complete contents of the emergency ruling are available at WSLCB (2014).

as those that require refrigeration, freezing, or a hot holding unit. This could cover a variety of food items, including fruit or vegetable juices and butters, any pies containing egg, dairy products, dried or cured meats, food items that have to be acidified to make the shelf life stable, and food items that are preserved by canning.

Regulators in Colorado have similarly adopted stopgap rules that require individual product servings to contain no more than 10 mg of THC. Moreover, all single-serving edibles have to be placed in child-resistant packaging before they are shipped to stores. So must potables, such as soda pop.

Another difficulty is that, once an outside wrapper or container is removed, marijuana-infused products could look like their nonintoxicating counterparts (e.g., gummies, cookies, soda). Thus it would be difficult to determine whether they are being consumed in locations where marijuana-infused products are not desirable (at school, at work, in a bar, in public places with children), making public intoxication harder to control.

Prohibition of specific types of marijuana products, or at least the retail sale of them, can go a long way in accomplishing some of the other public-health goals of the state (see discussion in Rolles and Murkin, 2013). However, such prohibitions provide an opportunity for the black market to operate if consumers highly value the products that are prohibited. In the case of edibles, none of the state laws prohibits a consumer from purchasing leaf marijuana and creating his or her own edibles; only selling those products in a retail store is regulated. Thus, in this case, the economic opportunities for the black market might be relatively small.

Cannabinoid Content

The intoxicating punch of THC gives it value in the consumer market. Recall that a relatively small number of heavy users account for the great bulk of total purchases; many of them have built up a chemical tolerance to the effects of THC and need higher doses than other consumers to achieve the effect they desire. Thus, THC content is widely used as a measure of potency, and many consumers identify potency with quality. Advances in breeding and growing techniques have enabled growers to cultivate strains of the plant with very high THC content; the resulting product also tends to be very low in CBD because CBD production in the plant appears to compete with THC production. Some believe that a combination of large doses of intoxicating THC and little of the offsetting effects of CBD creates a greater risk of getting “too stoned,” with resulting anxiety and, in some cases, even panic and transient psychotic symptoms; however, this remains an empirical question (Zuardi, Shirakawa, et al., 1982; Zuardi, Morais, et al., 1995; Bhattacharyya et al., 2010).

The concentrations of THC and CBD (and of other, less studied chemicals) vary considerably across the strains of herbal marijuana sold in medical and commercial dispensaries. Although the THC concentration in herbal product (bud) rarely exceeds 30 percent, concentrates and extracts can contain much higher levels of the intoxicant, sometimes more than 80 percent THC in the case of butane hash oil. These derivative products are often mixed into edibles and potables and are inhaled using vaporizers (some resembling e-cigarettes).

One important decision confronting jurisdictions is whether they should regulate the levels of cannabinoids. Just as many states set limits on the maximum alcohol allowed by volume for sale, policymakers might wish to cap the potency of marijuana sold. For example, there is an ongoing discussion in the Netherlands about whether to limit the cannabis sold in its coffee shops to 15 percent THC (which could drive out some imported hash). But the mere

fact that the discussion has been ongoing for so long hints that there are pros and cons to such a policy.

Even if Vermont were to impose a ceiling on potencies, the ideal maximum is unclear because the intoxicating effects of THC depend on body weight, method of ingestion, and the amount tolerance built up over past use (Hall and Degenhardt, 2009). Low THC limits could also leave space for a continuing illicit market in higher-potency products or induce consumers to try creating high-THC concentrates from low-THC marijuana, and a regulated industry can do that more safely than hobbyists can. So it is perhaps no coincidence that, although both Colorado and Washington limit the amount of active THC allowed in a single serving (dose) of an edible (to no more than 10 mg), neither limits the THC content in marijuana plant products.

Retail Outlets and Delivery Services

Jurisdictions allowing retail stores must decide how many to license. They would also need to devise procedures for license applications and perhaps for appeals of denied applications and to decide whether applications are secret or matters of public record. The number of licensees has implications for the costs of regulation, ease of access, and amount of competition in the market. The latter is especially important because competition can drive prices down and create incentives for marketing, both of which are associated with increased marijuana consumption. The alcohol literature suggests that alcohol outlet density is positively associated with the prevalence of alcohol-related problems (Campbell et al., 2009; Popova et al., 2009; Task Force on Community Preventive Services, 2009). There is suggestive evidence that marijuana could experience a similar fate: States that allow medical-marijuana dispensaries experience a higher adult prevalence rate (Pacula, Powell, et al., 2015).

Washington is set to license no more than 334 retail outlets throughout the state, the number of liquor stores it operated before privatizing liquor sales in 2013. With a population of 6.8 million in 2012, that is roughly one store for every 20,000 residents in Washington. Currently in Vermont, there is roughly one liquor store for every 8,000 residents. Colorado has not set a limit on the number of marijuana retail outlets; including both medical and recreational, as of July 1, 2014, Colorado had approximately 700 retail stores throughout the state (Rocky Mountain HIDTA, 2014), or about one per 7,500 residents. (By way of comparison, there is approximately one Starbucks for every 27,000 people in the United States.)

Somewhat related to store density is the decision about prohibiting marijuana businesses from locating within a fixed distance of schools, parks, treatment facilities, and other places frequented by teenagers and those who are likely to abuse the substance. Most of the U.S. states allowing medicinal or retail sale of marijuana ban outlets from operating close to schools, parks, and the usual public places.

In addition to considering the number (and density) of outlets, a regulating agency will want to consider the type of stores in which the product can be sold. Three important decisions must be made:

- Who will run the stores (e.g., the state, a nonprofit organization, a for-profit company)? (See discussion of these options in Chapter Four.)
- Will marijuana be restricted to specialty stores?
- Will delivery be allowed?

Potential options range on a continuum of state control from stand-alone state-run stores, to private stores carrying only state-regulated marijuana products, to private stores also carrying specifically approved items (e.g., smoking implements, storage accessories, snack foods), to convenience and grocery stores that also sell a full range of other products. The law could additionally restrict access by age. Hybrid schemes similar to Vermont's separation of spirits and other high-alcohol-by-volume products from beer and wine could also be employed for higher-potency marijuana products.

Two central concerns with less restrictive rules are the interaction with alcohol consumption and the response of youth to more open availability. If increased marijuana availability leads to a reduction in heavy alcohol consumption, the risks of stores combining the two products would be greatly mitigated. Alternatively, if alcohol use increases along with marijuana consumption, it is advantageous to keep them separate. Wider availability also connotes that marijuana use is acceptable. If policymakers are concerned that destigmatization of marijuana will lead to increased problem use or greater use by youth, separate stores could be advantageous.

Legalizing jurisdictions will have to decide whether to allow stores to deliver marijuana products pizza-style (an increasingly common way to obtain marijuana from California's medical dispensaries; see Pierson, 2014). In fact, one could imagine a system without any brick-and-mortar stores in which users could obtain marijuana only via delivery (with identification confirmation). Possible disadvantages of such an approach could include increased access to minors (if delivery services are less diligent than stores would be about checking identification), decreased privacy (because every transaction would create a record with a name and address), and the possibility of couriers being robbed. On the other hand, in theory, delivery services could be made to outperform storefront retailing in terms of denying access to minors: Require that the delivery be made to a person, that the delivery person verify age and address on the identification presented, and that a photo of the identification be later run against state records (e.g., department of motor vehicles).

Policymakers would also need to establish procedures for the revocation of licenses for cause. A possible model appeared as prohibition of alcohol was repealed, when a prominent voice for reform urged,

Licenses issued for the retail sale of liquor should run not only to the person who sells, but to the premises where the liquor is sold. Revocation of a premises license is a far more effective weapon of control than is the revocation of an individual license. (Fosdick and Scott, 1933)

Sales to Nonresidents

CDOR (2014) estimated that, in the first nine months of commercial marijuana sales in Colorado, 44 percent of metro-area revenue and 90 percent of sales in mountain communities came from buyers residing out of state. As is discussed in detail in Chapter Seven, the potential—good and bad—for marijuana tourism is vastly greater in Vermont than in Colorado. There are more than 1 million U.S. current (past-month) marijuana users within a two-hour drive of Vermont and 5 million within 500 miles (see Chapter Seven), so an influx of tourists can be expected immediately after stores open. This is a much larger pool of potential visitors than in

the areas surrounding Colorado or Washington even in absolute terms, and massively larger relative to the in-state population.

Policymakers face a choice on how to best balance the positive and negative consequences of potential marijuana tourism if most or all of Vermont's neighbors continue to prohibit commercial marijuana sales. Visitors from surrounding states and Canada present an opportunity in terms of tax and fee revenue from marijuana sales and complementary goods but a potentially very large burden in terms of public nuisance, traffic safety, and enforcement costs. Many users will also purchase and then smuggle the marijuana back to their home states or provinces. To partially mitigate this possibility, Colorado currently allows residents to purchase up to 1 oz. per transaction but limits nonresidents to 0.25 oz. per purchase. However, because nothing is stopping an individual from making multiple purchases from multiple stores even in the same day, it is unclear whether this is having a significant effect on out-of-state demand.

Policymakers may also want to consider banning sales to nonresidents. Although challenges to a ban on sales of marijuana to citizens from other states are possible, it seems unlikely that they would prevail on legal grounds.⁵ That being said, most of the court decisions that pertain to marijuana policies so far would have been hard to predict from a pure examination of the legal principles, so there is a remote chance that some court might find such regulation unconstitutional.

Pricing Controls

Retail prices will be shaped by the supply architecture (Chapter Four), the tax regime (Chapter Five), and the regulations imposed. For example, requiring potency and purity testing would raise production costs, much of which would probably be passed on to the consumer. Or regulators could, by law, set the after-tax price. Price would be set automatically in a state monopoly; in a private market, regulators could make compliance with a fixed retail price a condition for receiving and maintaining a retail license.

Mandated minimum prices have been adopted in various Canadian provinces for alcohol and the UK's Transform Drug Policy Foundation (Rolles and Murkin, 2013) suggests that they could be useful for marijuana, noting that they can help prevent some forms of price-based marketing. Recent research has found strong evidence that increasing minimum alcohol prices in Canada significantly reduced alcohol consumption (Stockwell et al., 2012) and alcohol-attributable mortality (Zhao et al., 2013).

If the state, on policy grounds, seeks to maintain a particular after-tax price, minimum pricing has the advantage of working automatically; it would not require ongoing adjustments as would be the case if taxation were the mechanism used to achieve a price target. But the decision to impose price controls should not be taken lightly. Minimum prices could create opportunities for black-market transactions, would tend to be regressive, and—unlike taxes—would transfer wealth to private businesses, whereas taxation brings in revenue to the state.

⁵ At least three constitutional arguments could plausibly be raised against restrictions on sales of marijuana to nonresidents: (1) the privileges and immunities clause of Article IV; (2) the dormant commerce clause (an interpretation of Article I); and (3) the equal-protection clause (Anderson, 2014). The first two arguments focus on state efforts to enact protectionist schemes, but it seems unlikely that limitations on out-of-state customers might be perceived as a protectionist act. The equal-protection clause challenge, which might be argued by someone outside of the state trying to purchase marijuana within the state, seems less likely to succeed because states have historically been given broad discretion in this legal area.

Prevention and Countermarketing

Although even the best prevention programs are only marginally to moderately effective at reducing initiation and consumption, they are typically cheap and therefore often cost-effective (Caulkins, Everingham, et al., 1999). Because it could be confusing for minors to see family members and other adults openly using marijuana after legalization, it seems prudent for the state to consider whether the current prevention messages and efforts can be modified or replaced.

Jurisdictions considering a new approach to marijuana need to make at least three decisions about prevention (Kilmer, 2014): (1) Will additional resources be devoted to prevention programming, and, if so, how much? (2) Will the prevention messaging be changed to reflect the new legal regime? (3) When will the changes to prevention programming take place? Although ear-marking tax revenue, or a portion of it, can answer the first question, and a coordinated effort between the state and public-health community can address the third, the uncertainty of the science regarding proper content and messaging of a prevention campaign in a legal regime means that considerable thought will be required to address the second question.

From a public-health perspective, one would presumably like to deploy the new or enhanced prevention programming before the new regime is implemented, but obviously the new tax revenues will not arrive until after legalization. Indeed, both Colorado and Washington experienced a considerable lag between when legalization of possession and use took effect and when retail stores opened and taxes began to be collected. Colorado's Amendment 64 to Article XVIII of the state constitution did not devote any funds to prevention (they were to be spent on school construction), but an additional tax was subsequently levied to cover new prevention messaging, as well as treatment and research (Ingold, 2014a). These monies were funding a somewhat-controversial campaign that raises questions about how to best spend prevention resources after legalization (Singh, 2014; Byars, 2014).⁶

Vertical Integration

The state could require, ban, or simply allow vertical integration of marijuana businesses. In a vertically integrated marijuana business, only one company handles marijuana from farm to market—all the way from seedling to retail sale, with no arm's-length transactions in between. Colorado initially required all marijuana businesses to be vertically integrated but now allows nonintegrated operations, too. Washington, in complete contrast, bans vertical integration: "Neither a licensed marijuana producer nor a licensed marijuana processor shall have a direct or indirect financial interest in a licensed marijuana retailer" (RCW 69.50.328).

Vertical integration in Colorado developed out of the medical-marijuana experience, in which a statute required seed-to-patient tracking. The main argument for requiring vertical integration is that, when there is only one company to deal with, regulations are easier to administer and taxes are easier to collect.

Vertical integration is ordinarily banned in the alcohol business in the United States. One argument against vertical integration is that concentrated economic power will lead to political power and effective lobbying to the benefit of the industry and to the detriment of public health. Proponents of a vertical integration argue that banning it is likely to result in inefficient

⁶ As this document was going to press, Colorado launched a new \$5.7 million marijuana use-prevention campaign. For more information, see Hughes (2015) and Good to Know (undated).

and costly operations (Kosar, 2011).⁷ However, some people who focus on protecting public health see inflating retail prices via this inefficiency as a feature, not a bug, for the long run.

Local Autonomy

Marijuana regulations could apply uniformly across Vermont, or the state could allow localities to exercise some independent regulatory authority. That is, the state might give localities authority to ban marijuana commerce, to regulate it, or, insisting on uniformity, to do neither.

Indeed, different localities might reasonably weigh factors differently. A locality on the border that fears being inundated with out-of-state pot tourists could wish to ban marijuana commerce. A resort town or artists' colony-type jurisdiction might strike a different balance and allow commerce.

The industry typically favors laws that ban local opt-out because it is easier to lobby effectively only in the state capitol rather than in every town, but an argument for local autonomy is that, where no one policy answer is clearly best, there are benefits to encouraging experiments on a small scale. Because small communities and bodies politic tend generally to be more nimble than large ones, correction of errors might happen more readily on a local scale rather than statewide. And new experiments might more readily replace failed ones. Quantitatively, local option for regulation and taxation allows more experiments to take place than statewide uniformity. And some experiments or pilot projects that a state would hesitate to try might find a home in a smaller jurisdiction.

Localities could be authorized to ban marijuana commerce outright. Some states, unlike Vermont, allow localities to ban alcohol sales (National Alcoholic Beverage Control Association, 2014). For medical marijuana, Vermont “municipalities have the authority to prohibit the establishment of a dispensary and may regulate the time, place and manner of dispensary operation through zoning and local ordinances” (VCIC, 2012). Colorado lets localities ban sales of recreational marijuana, and many jurisdictions have done so (Rayman, 2013). In Washington, the ability of local governments to ban sales of recreational marijuana is being litigated (ACLU of Washington State, undated).

Binary local *bans* are not the only option for local autonomy. The state could also allow localities some authority to regulate. A locality could seek to establish, for instance, a marijuana commerce district and ban such commerce elsewhere.

Local taxation of marijuana businesses is also an option and is common in Colorado and, for medical-marijuana businesses, in California. On the other hand, if the state allows local jurisdictions to levy marijuana taxes instead of rather than in addition to the state doing so (e.g., like California's 2010 Proposition 19 [Legislative Analyst's Office, 2010]), there could be a race to the bottom in which jurisdictions would compete with each other to offer the lowest taxes as a way of attracting producers and purchasers (Kilmer, Caulkins, Pacula, et al., 2010).

Concluding Thoughts

Readers should consider this chapter more like a discussion checklist than like a series of competing alternatives. A jurisdiction considering something other than marijuana prohibition

⁷ But vertical integration might, in some commercial contexts, instead be relatively inefficient, creating more problems than it solves (Stuckey and White, 1993).

needs to encourage serious conversations about each of these choices. Marijuana is a very different commodity from other regulated goods (even alcohol) and early-adopting states simply cannot use cookie-cutter regulations for alcohol to cover all of the important choices.

Further, various categories of regulations interact. For example, the magnitude of an increase in revenue from sales to nonresidents depends in part on whether consumers are allowed to smoke in public, in hotel rooms, or in private residences only. Similarly, the effectiveness of programs to mitigate use among adolescents could be undermined if the state allows marketing, especially if ads target younger consumers, but could be strengthened by regulations requiring appropriate packaging and labeling. In some circumstance, regulations—or at least their enforcement—could be limited by technology or information. For example, the current lack of a reliable chemical test to measure marijuana impairment among drivers makes it difficult to enforce laws forbidding driving while stoned. (See Chapter Three for more details.) The science of THC measurement is a work in progress.

In general, product regulations are useful tools for increasing product safety and the information made available to consumers about the product they are consuming. Many such regulations impose costs on the producers (e.g., testing potency and placing that information on labels, requiring child-resistant packaging), so they have the additional long-term consequence of keeping production costs a little bit higher than they might otherwise be. Another outcome of product regulations, when done with the objective of limiting products that might be enticing to children, is that they can help limit exposure or interest among minors. However, to the extent that these types of regulations limit products that consumers prefer (e.g., marijuana-infused candy), they create an opportunity for the black market.

Seller, server, and sales regulations tend to raise the cost of providing and selling marijuana products. To the extent that these sorts of regulations monitor production and sales (e.g., inventory-control systems, selective stores, and Internet sales), they can reduce opportunities for tax evasion. They might also have the beneficial effect of increasing product safety (if products are more tightly regulated and sold in limited ways). All of these systems help reduce the possibility of direct sales to minors, although they do little to prevent straw purchasers from giving or reselling to minors, as commonly happens with alcohol and tobacco today.

Although most of these areas of regulation (product, sales, and even marketing) are well understood by public-health agencies in other contexts, the results of applying these policies to legal marijuana markets are far from certain. Thus, we would advise, as we did in the discussion of taxation, flexibility in approaches. Much has yet to be learned about the dozens of cannabinoids in marijuana other than THC and CBD and their potential benefits or harms. Similarly, little is known about what sorts of products, when consumed a particular way (e.g., dabbing), are potentially more dangerous than when consumed another way. Thus, it will be very important to keep the regulatory structure flexible and adaptable enough to accommodate growing knowledge that is likely to accumulate in the next decade regarding risks and benefits associated with specific marijuana products.

In following an ongoing adaptive regulatory process, however, one needs to keep in mind that industry lobbyists are likely to be patient and persistent in conveying information and opinions to policymakers about the effects of the existing regulation. Although entitled to be heard, these interests are not the only ones that need consideration when designing adaptive regulation. It would seem wise to try to protect the regulatory adjustment process from industry capture. To that end, child-welfare and public-health interests could be guaranteed an ongoing role in the process of overseeing regulatory development and changes.

Finally, it is one thing to write regulations; it is another to enforce them. Making sure that marijuana suppliers, distributors, and users comply with applicable codes and laws will require time and resources. Enforcement of regulations will fall on a variety of agencies, as described in greater detail in Chapter Seven, and is likely to involve the cost of regulating licenses (growing, processing, distributing, and retail selling), regulating products (testing inspections, product availability in stores, random compliance checks), checking compliance and enforcing marketing regulations, regulating sales to out-of-state residents, regulating sales to and possession by minors, and regulating use and possession (e.g., in public parks, in restaurants).

How Legalization in Vermont Could Influence Tax Revenue, Consumption, and Public Budgets

Introduction

The amount of tax revenue that can be collected by legalizing marijuana depends on the overall supply architecture of legalization (see Chapter Four) and a host of tax and regulatory parameters (see Chapters Five and Six, respectively).

Net revenues to the state will also depend on how much money is spent regulating the market. As discussed in Chapter Two, legalizing marijuana will reduce but not eliminate the burden of enforcing laws constraining producer and user behavior. The magnitude of the residual burden will depend on how much effort is devoted to going after producers who operate outside the regulatory framework and to people and organizations who sell or give to underage users. Further, it takes time to develop a regulatory infrastructure, assess compliance, and collect taxes, so some of these costs will be incurred before the first significant new revenue is collected.

Revenues will also depend heavily on the actions of the federal government and of other states. If Vermont legalizes with high taxes and neighboring states legalize but assess low taxes, people in Vermont could cross state lines to purchase, just as cigarette smokers now do in places with high tobacco taxes (see, e.g., Merriman, 2010). Conversely, as noted in earlier chapters, if Vermont is the first state in the Northeast that legalizes, then, until other states do the same, Vermont could generate considerable revenue from sales to residents of other states; this chapter tries to give some sense of the magnitude of those potential revenues by looking at numbers of users in other states who live within certain distances of Vermont.

For all these reasons, it is not possible to provide a specific estimate of how much net revenue legalization would produce; too much depends on the particulars. We can, however, provide a rough sense of the magnitude of the upside potential revenues from taxing Vermont's own marijuana users and an analytic framework that will allow readers to revise parameters and develop their own estimates.

The qualitative conclusions of this exercise can be summarized thusly. Vermont (or indeed any other eastern state) is not an island, so the idea that individual states can function as separate policy laboratories is optimistic. The effects of Vermont's legalization on state income are highly uncertain and depend very much on what neighboring states do about their own marijuana policies. Rates of marijuana use in neighboring states supplied via marijuana tourism are likely to be substantial, and the income generated therefrom is likely to be very attractive to a legal marijuana industry and perhaps to a cash-strapped state government. Regulation might be able to contain this trade to a degree, but it will require enforcement and designing

the regime with that objective in mind. The appeal of such revenue might also motivate other states to legalize marijuana within their own borders.¹

The remainder of this chapter is structured as follows. “Potential Revenue from Taxing Vermonters’ Marijuana Consumption When the Only Competition Comes from the Black Market” presents a model of potential revenue from taxing marijuana consumed by Vermont residents in the short to medium term, paying close attention to whether the potency-adjusted legal prices are below or above the black-market prices. It begins with reasonable assumptions about the input parameters (e.g., expected near-term drop in production and distribution costs) and then explores how incorporating more uncertainty into the model influences the consumption and revenue figures. “Sales to Marijuana Tourists and Exports” explores the impact of sales to nonresidents because more than 2.7 million regular marijuana users in other states live within 200 miles of Vermont (roughly 40 times the number who live in Vermont), and hundreds of thousands more live in Ontario and Quebec. If Vermont acquiesced to its enterprises supplying this market and if the federal government did not intervene (two big ifs), Vermont could earn so much from taxing nonresidents that revenues from taxing Vermont’s own residents would seem almost inconsequential. “Threats to Tax Revenue Collection in the Longer Run” then discusses why those potential tax revenues might well not be available in the long run. “Cost of Regulation” discusses possible regulatory costs associated with different legalization regimes and the amount of effort devoted to enforcing those regulations, and the final section offers concluding thoughts.

Potential Revenue from Taxing Vermonters’ Marijuana Consumption When the Only Competition Comes from the Black Market

The starting point for tax revenue calculations is Vermonters’ current spending on marijuana. One then adjusts this figure for changes in price and the amount consumed to estimate spending after legalization, then partitions that spending across black market, medical market, and legal market. Legal-market sales are then multiplied by taxes’ proportion of the cost to consumers to get a sense of the magnitude of likely tax revenues.²

Recall from Chapter Two that we estimated that Vermont has roughly 60,000 to 100,000 past-month users who consume about 15 to 25 t per year and spend about \$125 million to \$225 million per year on marijuana.

The width of these uncertainty intervals is important. To the extent that all estimates of potential tax revenues in this section are built up from estimates of the amount Vermonters spend on marijuana today, none can escape inheriting this degree of uncertainty.³ Nevertheless, constantly factoring in that uncertainty would muddy the exposition, so, as a rhetorical device, we temporarily pretend that we know that Vermont residents are now spending exactly

¹ We are indebted to Wayne Hall for providing this “forest view” from the many details below.

² *Taxes* in this discussion should be construed broadly to include marijuana license fees, but not income tax, property tax, social security tax, and the like.

³ One partial caveat is that there is less uncertainty about the size of the marijuana market in the Northeast as a whole, which is pertinent to estimates of tax revenue from sales to out-of-staters. However, that is more than offset by greater uncertainty about the share of that market that Vermont sellers will capture.

\$175 million per year on marijuana and work through the tax revenue logic for that benchmark spending figure. We will then restore this uncertainty later in this discussion.

If Vermont legalizes commercial marijuana production in 2015, the nearest direct competitors in the legal recreational market will be Colorado, almost 2,000 miles away.⁴ The estimates in this section, which we call short- to medium-term estimates, presume this market context. However, it seems unlikely that Vermont will remain in that unique status in the long run. If the federal government does not quash the Vermont market, one would expect other states to follow suit, and that would alter the calculus dramatically, as we discuss in “Threats to Tax-Revenue Collection in the Longer Run.”

Identification of Two Basic Scenarios When the Black Market Is the Main Competitor

In terms of tax revenue, there are basically two scenarios to consider depending on whether Vermont’s legal price, with taxes, is above or below the price of competing sources—which, in this section, means the black-market price. (That black-market marijuana could come from traditional foreign sources or domestic production that might or might not be associated with medical or recreational systems in other states.)

If any adult can purchase at a (taxed) legal price that is below the black-market price, one would expect the black market to eventually disappear as an important source for Vermonters.⁵ So taxed sales would basically equal total consumption, after making modest subtractions for home growing, sales within the medical market, and any minor residual black market. We take as a working hypothesis that restrictions on access to medical recommendations will limit medical marijuana to a very modest share of Vermonters’ total marijuana consumption. This is not an innocuous assumption. Both Colorado and Washington are, for different reasons, finding it difficult to wind down their large medical markets (which produce no excise taxes) and shift those sales over to the taxed, legal market (compare with Light et al., 2014). However, it might be easier for Vermont to prevent the growth of a large medical sector than it has been for those states to rein in one that already existed.

The second scenario would be that the (taxed) legal price was appreciably higher than the black-market price. In that case, one needs to guess how many people would be willing to pay that price premium in order to gain the benefits of purchasing from a legal store. (Those benefits could include not only reduced risk of arrest but also better quality control and labeling, as well as greater product variety.) There are precious little data in the literature about consumers’ willingness to pay extra in order to purchase legal rather than black-market marijuana. Later in this chapter, we tap some data that we collected from an opt-in web survey in 2013. Those data are not directly relevant to Vermont because they come primarily from users who report living in Washington State and, more importantly, are not a random sample. Normally, one would strive to avoid using data from such a survey, but we know of no better data, and they illustrate the concept and give a flavor of what at least some users say about this issue.

⁴ Although the Washington, D.C., proposition passed, it legalizes only small-scale personal growing and gifting, not large-scale production for commercial distribution.

⁵ Sales to minors would presumably still be illegal, but, as with alcohol and cigarettes today, underage users would likely be supplied by older users making conventional (taxed) purchases. That is, there is no obvious reason that the proportion of those straw purchases that come from legal and taxed sources versus the black market, home production, or other untaxed sources should be appreciably lower than the corresponding proportion of adult purchases made for adult consumption. Likewise, even if adults who purchase legally do supply some other adults indirectly, that does not materially affect the projection of tax revenues.

Prices Today and in the Future

Before proceeding, a few notes are in order about prices. First, the marijuana market has traditionally been dominated by basic “usable” (unprocessed) marijuana, and price data still pertain primarily to marijuana in that form. Extraction of concentrates tends to happen on a large scale only after marijuana supply laws are liberalized, and, as has been discussed above, it remains unclear whether concentrate-based products (including not only waxes and hash oils but also edibles and beverages made with concentrates) will gain a large market share or remain more of a novelty. But regardless of how the market develops, we are stuck discussing prices and, by extension, tax revenues, through the lens of prices for usable marijuana. Only time will tell how serious a limitation that is for this analysis.

Second, even usable marijuana comes in many varieties. Potency in terms of THC content varies enormously from perhaps 4 to 8 percent for some commercial-grade imports to 10 to 25 percent for sinsemilla,⁶ and price per unit weight tends to increase with potency. Price per gram is not strictly proportional to potency, but that would be closer to the truth than imagining that all grades sell for the same price. Because much of Vermont’s market is already high-potency and we expect most production after legalization to be of higher-potency strains,⁷ prices referred to here are for high-potency strains.

Many other characteristics of quality besides potency command a price premium, including brand, appearance, aroma, and whether produced organically, but that is not unique to marijuana. There are also higher and lower qualities of tea, cheese, and bread that sell for higher and lower prices. So any given price should be thought of as a typical or average price within a range of quality-adjusted prices for that product class.

Third, vendors of both legal and illegal marijuana offer quantity discounts for bulk purchases. Marijuana prices are most often quoted by the pound (wholesale transactions), ounce (high-level retail), or gram (lower level of retail), where the gram price applies not only to purchases of literally 1 g but also to “eighths” (meaning eighths of an ounce, or about 3.5 g) and 5-g purchases.

As a rough rule of thumb, the price of 1 oz. is about 15 times the price per gram in a lower-level retail purchase, and the price per pound is about ten times the price of 1 oz. Because there are 28.35 g in 1 oz., not just 15, and there are 16 not just 10 oz. in a pound, that 1:15:150 set of price ratios reflects quantity discounting. When prices are in these ratios, the price per unit weight at the ounce level is 44 percent below that at the gram level, and the price per unit weight at the pound (wholesale) level is 38 percent below that at the ounce level (and 65 percent below the retail price per unit weight).⁸

As an additional complication, the outdoor growing harvest drives seasonality in marijuana prices. But in very rough terms, black-market prices for high-potency marijuana in Vermont today appear to be about \$350 and \$3,500 per ounce and pound, respectively (personal

⁶ Sinsemilla is a potent form of marijuana from female plants that have not been pollinated.

⁷ One exception to production postlegalization being high-potency could be industrial (outdoor) farming of marijuana, but that likely would not occur until after national legalization. In portions of this report that consider that possibility, we adjust that production back to the THC equivalent of the high-potency types produced indoors and in greenhouses.

⁸ Quantity discounting is not unique to marijuana. A local grocery store sells milk for \$0.99 per pint, \$1.59 per quart, and \$3.63 per gallon, so the quarts and gallons are discounted by 20 percent and 54 percent per fluid ounce, respectively, relative to the price when buying a pint. These are actually larger quantity discounts than for marijuana, because there are 128 eighths of an ounce in a pound but only 8 pints in a gallon.

communications with Vermont growers, September 1–2, 2014).⁹ When estimating possible changes in consumption induced by changes in price, we use this \$350-per-ounce figure as the baseline price because it is our best guess of the price that pertained when the data that underpin Chapter Two’s estimate of current consumption were collected.

Black-market prices from the western United States are lower. Even excluding Mexican imports, pound-level prices in California in 2013 ranged from \$1,000 to \$2,500 (with outdoor-grown toward the lower and indoor toward the upper end) and were falling fairly quickly.¹⁰ Rocky Mountain HIDTA (2014) quoted wholesale prices for five recent cases involving pounds of marijuana bought in Colorado and shipped east, and they average \$2,260 per pound.¹¹

Prices on the East Coast will continue to be higher as long as national prohibition remains in place because smugglers need to be compensated for the risk they incur when transporting contraband.¹² The price gradient for wholesale marijuana has been about \$400 per pound per 1,000 miles (Caulkins and Bond, 2012). That explains much of the gap between West Coast and Vermont wholesale prices because Humboldt County is 3,000 miles and Denver is a bit less than 2,000 miles from Vermont.

Nevertheless, we would predict Vermont’s black-market prices to fall somewhat within the next year given how far West Coast wholesale prices have already fallen, perhaps to \$300 per ounce and \$3,000 per pound, and to fall further in coming years along with anticipated further declines in prices there.¹³

Scenario 1: Legal Prices Are Lower Than or Equal to Black-Market Prices

If the legal (taxed) price is lower than the black-market price, legal sales will capture (almost) the entire market, so the main analytic task is to guess how large that market will be. Consumption will presumably go up for two categories of reasons: (1) nonprice and (2) price effects. Nonprice effects include reduced risk of arrest, reduced social stigma, lower risk of contaminants or mislabeling, and greater product variety and marketing.

A RAND team’s analysis of marijuana legalization in California (Kilmer, Caulkins, Pacula, et al., 2010; Kilmer, Caulkins, Bond, et al., 2010) assumed that nonprice effects would increase consumption by 5 to 50 percent, with 35 percent being a best guess. Vermont has already decriminalized marijuana possession, and key informants in Vermont reported that it was common for some residents—particularly youth—to misinterpret that to mean that marijuana had already been legalized. So some of the nonprice effect of legalization might already

⁹ For example, the Vermont Drug Task Force (2013) describes hydroponic marijuana as selling for \$2,800 to \$5,000 per pound and \$250 to \$400 per ounce. The Vermont growers we interviewed quoted similar black-market ounce prices, and the website Price of Weed quotes high-quality marijuana selling for about \$375 per ounce in Vermont (average reported on September 23, 2014) (“How Much Does Weed Cost?” undated).

¹⁰ The Western States Information Network generously provided us with access to its price and purity reports for 2010, 2011, and 2013 (Western States Information Network, 2011, 2012, 2013).

¹¹ More specifically, the prices cited were \$1,800 for 1 lb., \$2,500 for 1 lb., \$2,000 per pound for 5 lb., \$2,200 per pound for 9 lb., and \$2,800 per pound for 4 lb.

¹² After nationwide legalization, shipping costs will be negligible compared with current prices. Fruits and vegetables that *retail* for \$1 to \$10 per pound are routinely shipped great distances.

¹³ Sullum (2014b) quoted a marijuana business owner in Colorado who would “not be surprised . . . if we see \$10–\$15 eighths and \$50 ounces by early next year.” We do not think that prices will fall that quickly but agree with the general direction.

be incorporated into current rates of use, and the remaining bump up in consumption due to nonprice effects if Vermont legalized might be more modest. There is no way to be more precise about such statements, but we use 25 percent in our illustrative calculations below.

In terms of price effects, in past studies, RAND researchers have assumed that the price elasticity of marijuana consumption is between -0.4 and -1.2 , with a point estimate of -0.54 (Kilmer, Caulkins, Pacula, et al., 2010; Kilmer, Caulkins, Bond, et al., 2010). The more-recent literature provides a few additional empirical estimates, and they support both that point estimate and consideration of a quite broad range of possible values.¹⁴

Because black-market prices are trending downward and this scenario contemplates a situation in which the (taxed) legal prices match or undercut those black-market prices, we consider legal after-tax prices of \$12, \$200, and \$2,000 per gram, ounce, and pound, respectively, which is about a 40- to 45-percent decline relative to current prices. These figures are really nothing more than best guesses that form the basis for this scenario we are using to illustrate how the tax calculations can be done. Later, we consider a range of possible future black-market prices.

There are no data on which to base guesses at the postlegalization market shares for home-grow, medical, and any residual black market. We expect them to be small if legal prices are below black-market prices, but, as a placeholder and a reminder that they will necessarily not literally be zero, suppose that each of those three sources gets 2 percent of the market, meaning that 94 percent of Vermonters' consumption would come from legal, taxed supply sources.

The final question is what share of the final (taxed) retail price will come from taxes. For the purposes of developing an analytical model, we look to taxes in the early-legalizing states for a starting point, though we note that these taxes were the product of nondeliberative ballot proposals and that the tax burden can grow over time (see Chapter Five). Colorado imposes a 15-percent excise tax on the wholesale price, a 10-percent marijuana-specific sales tax, 2.9-percent state sales tax; about half of the jurisdictions that allow marijuana sales in Colorado impose local taxes (Murray and Aguilar, 2014) (the added taxes in Denver, the dominant market, are 8.22 percent of the retail price). As they compound, these taxes take up about 24 percent of the final price to the consumer in Denver, and a little more or less in other parts of Colorado.¹⁵

Caulkins, Andrzejewski, and Dahlkemper (2013) did similar calculations for the more complicated three-tier tax structure in Washington State and concluded that “the tax burden—

¹⁴ For example, the point estimate of -0.54 for the total elasticity was worked up from a participation elasticity estimate of -0.3 , and the Gallet (2014) new estimates for participation elasticity (-0.28 to -0.31) are consistent with the earlier judgment about that parameter. Likewise, the Davis and Nichols (2013) new estimate of total elasticity carries a range of -0.3 to -0.6 . For reviews of this literature, see Pacula and Lundberg (2014) and Gallet (2014).

¹⁵ The so-called 15-percent producer tax (actually imposed on weight) is likely to be less than 10 percent of the retail price. See Stiffler (2012), where that 15-percent producer level tax amounts to around 7 percent of the retail price. The current 15-percent tax has been converted to a weight-based tax of \$0.62 per gram or \$17.59 per ounce (“Average Market Rate,” undated). So any price of recreational marijuana under \$200 per ounce makes a 10-percent figure comfortable. Looking at Denver, the dominant market, we see that local taxes of 8.22 percent of retail apply (Denver Department of Finance, 2013). Making a conservative estimate in which the so-called 15-percent producer tax amounts to 10 percent of retail pretax price, we see that $10 + 10 + 2.9$ plus (say) $8.22 = 31.12$ is the percentage that corresponds to 44 percent for Washington; that means the total tax burden as a percentage of retail price the consumer pays is some 23.7 percent, which corresponds to 30 to 40 percent for Washington.

meaning tax as a share of final price to consumer—will probably be between 30–40%” (p. 2).¹⁶ A somewhat larger proportion of cigarette smokers’ spending goes to taxes.¹⁷

Of course, no one knows what the proportion would be for Vermont, but, for the sake of argument, suppose that, when its only competition is the black market, Vermont can capture as taxes one-third of what users spend to buy marijuana.¹⁸ Or, more precisely, suppose that it not only can but does do so; needless to say, if Vermont imposes taxes at lower rates, the potential revenue described below would not be achieved.

Now we have all the ingredients needed to make a first-pass estimate of potential tax revenues. The calculations, summarized in Table 7.1, would suggest a potential tax revenue of close to \$50 million per year if taxes were set this high and the black market were largely eliminated, although, when considering revenue estimates, one should always think in terms of ranges, which we do in the next section. The corresponding estimated increase in consumption is 54 percent.

Table 7.1 computes the 23-percent price-induced change in consumption simply by multiplying the elasticity of demand (-0.54) by the -43 -percent change in price. That makes the very strong assumption that the demand curve is linear throughout that substantial change in price. Perfectly linear demand curves are much more common in freshman textbooks than they are in the real world. Caulkins (2000) and Kilmer, Caulkins, Pacula, et al. (2010) showed how a different model of demand, called a constant-elasticity model, can sometimes give substantially different results, with the linear model likely understating the price-induced increase in demand and the constant-elasticity model arguably going too far in the other direction. However, in this case, the constant-elasticity demand model projects only 10 percent greater consumption, and a quite similar estimate (\$53 million versus \$48 million) of tax revenue. So with this numerical example, uncertainty about the shape of the demand curve is not a great concern.

However, keep in mind that, if users spend only \$200 per ounce and the government captures one-third of that \$200, then only two-thirds goes to the producers (including not just the growers but also the processors and retailers). That works out to \$133 per ounce or \$2,133 per pound. It is not clear whether Vermont-based companies could be viable in the short to medium term with sales revenues that low.

Certainly Vermont’s medical dispensaries could not be with their current operations. They are integrated producer-retailer operations and so receive the full retail price, which we understand is generally \$15 per gram. That translates to \$425 per ounce or \$6,800 per pound;

¹⁶ Consistent with this is the Chokshi (2014) report that Moody’s estimates an effective tax rate of 44 percent, under which 30.6 percent ($0.44 \div 1.44$) of what the consumer pays is taxes.

¹⁷ The Campaign for Tobacco-Free Kids (2014) reported that the national average price of a pack of cigarettes was \$6.03, including the \$1.01-per-pack federal tax and \$1.54 average state taxes but before any local sales or excise taxes. In a locale with no local excise tax but a 7-percent sales tax, that local sales tax is \$0.42 per pack, and the total tax is \$2.97 ($\$1.01 + \$1.54 + \0.42) per pack, which is 46 percent of the total cost to consumers of \$6.45 per pack.

¹⁸ To be clear, this scenario, in which one-third of the cost to consumers comes from taxes, is neither a prediction nor a bound. It merely provides a useful and plausible base for carrying through this exploratory exercise. Other tax levels are conceivable, and Chapter Five suggests that a very low initial tax burden might well precede a very high tax burden in the long run. In Europe, for instance, cigarette taxes often amount to 80 percent of the final consumer price, but that figure includes all taxes on a mature industry. One-third of the still-high prices considered in this short- to medium-term scenario could well be greater than 80 percent of a long-run, considerably lower price. Discussion of the uncertainty around a proper tax level over time appears in Oglesby (2012, 2015).

Table 7.1
Hypothetical Calculations to Illustrate One Scenario Pertaining to Revenue from Taxing Sale of Legal Marijuana to Vermont Residents

Row	Description	Value	Note
1	Vermonters' spending prelegalization (millions of dollars)	175	
2	Price prelegalization (dollars per ounce)	350	
3	Amount consumed before legalization (millions of ounces)	0.50	Row 1 Row 2
4	Postlegalization price per ounce, with taxes (dollars)	200	
5	Legalization-induced percentage change in price	-43	Row 4 – row 2 Row 2
6	Price elasticity of demand	-0.54	
7	Price-induced percentage change in consumption (linear model)	23	Row 5 × row 6
8	Nonprice effect of legalization on consumption (percentage)	25	
9	Amount consumed after legalization (millions of ounces)	0.77	Row 3 × (1 + row 7) × (1 + row 8)
10	Market share of home-grow, medical, and black markets (percentage)	6	
11	Spending in legal, taxed market (dollars)	145	Row 4 × row 9 × (1 – row 10)
12	Percentage of consumer spending recovered as taxes	33.3	
13	Tax revenue (millions of dollars)	48	Row 12 × row 11

NOTE: Yellow indicates a parameter (input to the calculation). Unshaded cells contain data computed from data in other cells.

yet, by their reports, all of that revenue is needed to cover expenses, albeit including various business taxes and repaying start-up loans.¹⁹

Nor could the operations underpinning the Zamarra (2013) analysis of the West Coast industry's cost structure circa 2012–2013. Pooling accounting data from ten producers, Zamarra describes direct costs before taxes as totaling \$1,307 per pound for a small organization producing 200 lb. per year.

Likewise, drawing on financial information from nine marijuana retailers, Zamarra (2013) estimated that a retailer selling \$3.1 million per year had operating costs of almost \$1 million above and beyond the \$1.7 million purchase cost of the goods sold while selling about 570 lb. per year. That works out to retailer costs of \$106 per ounce sold (\$1,702 per pound).

So an integrated producer-retailer operating along the lines of those Zamarra studied would face costs of \$3,000 per pound, and that is before factoring in the costs of extraction or other processing (which Zamarra analyzed separately), the additional tax burden from federal Section 280E requirements, or returning a profit to investors.

¹⁹ We do not adjust for quantity discount here because our understanding is that the \$15-per-gram figure already factors in the distribution of purchase sizes and any associated quantity discounts, but recognize that this parameter is based on interviews, not inspection of accounting records.

Larger firms exploiting economies of scale can do better. Hawken (2013) estimated a slightly more optimistic long-run average cost for small indoor producers of about \$1,023 per pound for a 1,000 sq. ft. facility and \$937 per pound for a 15,000 sq. ft. facility even with rapid recovery of fixed costs, versus the Zamarra (2013) estimate of \$1,307. And if fixed costs can be amortized over a five- to ten-year planning horizon, the Hawken (2013) average costs for indoor production drop to \$500 to \$600 per pound. Denman and Cooley (2013) cost figures are even a shade lower.

It is not clear, however, what time horizon Vermont growers should use because, if the nation legalizes, other states or production modalities are likely to displace Vermont as the low-cost producer. So those investing in building production facilities in Vermont might not be able to depend on five or ten years of sales over which to recoup their investment.

For example, the Denman and Cooley (2013) \$250-per-pound cost estimate for outdoor farming and the Hawken (2013) estimate for large-scale (5,000 to 100,000 sq. ft.) greenhouse-based production (\$434 to \$681 per pound) suggest that the window for operating indoor marijuana-production facilities might not be that long.

Furthermore, the challenge of costs associated with operating a brick-and-mortar retail establishment remains. Recall that, if the marijuana business retains only two-thirds of a \$200-per-ounce cost to the consumer, that is \$133 per ounce, and Zamarra's data suggest that West Coast retail dispensaries had operating costs before taxes of \$106 per ounce. That leaves little to cover production and processing, taxes, and return on investment, and they were probably larger operations than Vermont's current medical dispensaries, which restrict occupancy to one patient at a time.²⁰

So if Vermont wants its domestically produced marijuana to compete with black-market prices not just now but also in a few years, it might have to permit other retail distribution models that allow sales to occur in a less controlled environment, such as via home delivery.

And of course if any grocery, convenience, or other retail store were allowed to sell marijuana, then the retailing cost would fall precipitously. Compared with a typical item sold by a high-volume retailer, 0.125 oz. of marijuana selling for \$25 is a big-ticket item.

So it is possible that a legal marijuana industry might be able to compete with the black market despite returning one-third of users' spending as tax revenue and complying with all of the various and sundry costs of operating a legal enterprise. But that might require all the stars to align or abandoning a distribution model that confines marijuana sales to single-purpose brick-and-mortar stores.

This scenario might also leave Vermont in a somewhat curious position. It would be cheering on aggressive federal enforcement to shut down unlicensed West Coast production or drive up the costs of transporting bulk quantities of marijuana across the country. Yet it would simultaneously need the federal government to turn a blind eye toward violations of the CSA in Vermont. If the CSA were repealed and more states were to jump into the market, other states with lower production costs (e.g., because their climates are better suited to outdoor and

²⁰ If a dispensary that is open 12 hours per day, 365 days per year, utilizes 75 percent of its 15-minute appointment slots and achieves \$150 sales per customer, that is still only

$$12 \times 365 \times 0.75 \times \left(\frac{60}{15}\right) \times \$150 = \$1,970,000 \text{ per year.}$$

greenhouse-based production) or lower tax structures than those contemplated here would likely outcompete Vermont.

Recall that, in the second scenario, Vermont's legal industry sells at prices above the black-market price. That scenario depends on some users being willing to pay a premium in order to purchase legally, so, before turning to it, we first examine some data on users' willingness to pay more to obtain legal rather than black-market marijuana.

Willingness to Pay a Premium for Legal Versus Black-Market Marijuana

As far as we know, there are no available data concerning how much of a premium Vermont users would be willing to pay to obtain marijuana through legal channels, as opposed to resorting to the black market. Indeed, there are little data on this matter for any jurisdiction.

However, as part of its analysis to support the WSLCB's regulation of its commercial marijuana industry under I-502, RAND fielded a web survey of marijuana users. Kilmer, Caulkins, Midgette, et al. (2013) described this Washington Cannabis Consumption Survey (CCS) in detail, but the important limitation to stress is that it was an opt-in survey, meaning that anyone could volunteer to take it. So the respondents were not a random sample and cannot be presumed to be representative of the market. Indeed, we know that the respondents tended to be heavier users than the average respondent to a household survey (perhaps light users do not care enough about marijuana to complete a survey) and were better educated (perhaps because they had to have Internet access to take the survey). Normally, one would not want to rely on data from such a survey, but we are not aware of any better survey that asked its respondents how much more they would be willing to pay for legal than for black-market marijuana of comparable potency.²¹ The CCS was taken 3,488 times during the ten days it was available (June 24 through July 3, 2013).²² Table 7.2 summarizes the distribution of answers of the 1,368 U.S. respondents (possibly nonunique) who answered this question and reported their past-month frequency of use.

To clarify how to read the table, consider the 17.2 in its upper left corner. That 17.2 indicates that 17.2 percent of respondents who reported using on only one to three days per month said that they would be willing to pay more than \$10 per gram extra in order to obtain legal, as opposed to black-market, marijuana. The 21.0 near the bottom of that column indicates that 21 percent of those same users said that they would not be willing to pay anything extra for marijuana that came from a legal source. Scanning across the <0 row, one sees that a handful of more-frequent users perversely reported a negative premium, indicating that they actually prefer to buy from the black market.

If one compares the four columns for the different frequencies of use, one sees a consistent pattern. The more-frequent users were less willing to pay as large a premium to buy legal marijuana. That is not surprising. The more marijuana one consumes, the more salient might

²¹ The question text read as follows:

Please fill in the blank in the following sentence. I would be willing to pay \$_____ per gram more for *sinsemilla* (very high quality cannabis) that is legal, labeled, and tested for pesticides and other contaminants, *relative to what I would pay for black market sinsemilla* of the same average potency. Enter a dollar value below. [emphasis in original]

²² With an opt-in web survey, there is no way to guarantee that one person does not complete the survey multiple times from different computers. Kilmer, Caulkins, Midgette, et al. (2013) applied a series of tests to try to detect those who might be answering strategically in order to sway results. The responses to the questions of interest here were very similar regardless of whether respondents with suspicious response patterns are eliminated, in part because many of them did not persist in answering all questions and the willingness-to-pay questions came late in the survey.

Table 7.2
Respondents Willing to Pay a Premium to Obtain Legal, as Opposed to Black-Market, Cannabis

Premium (\$)	Past-Month Use-Days				Weighting by NSDUH Use-Days		
	1-3 (median = \$4; mean = \$7.22; 157 respondents)	4-10 (median = \$5; mean = \$9.52; 190 respondents)	11-20 (median = \$4; mean = \$6.30; 193 respondents)	21-30 (median = \$2; mean = \$3.59; 828 respondents)	Raw Total (median = \$2; mean = \$5.22; 1,368 respondents)	Vermont (median = \$2.73; mean = \$4.77)	United States (median = \$2.76; mean = \$4.84)
>10	17.2	15.3	10.9	8.0	10.5	9.5	9.6
5-10	31.9	44.2	38.3	27.9	32.1	31.6	31.7
3-5	8.3	8.4	5.7	5.2	6.1	5.7	5.7
2-3	13.4	10.0	13.5	12.7	12.5	12.6	12.6
1-2	7.6	6.3	9.3	7.0	7.3	7.4	7.4
0.01-0.99	0.6	0.0	0.0	1.5	1.0	1.0	1.0
0	21.0	14.2	20.7	35.5	28.8	30.2	30.0
<0	0.0	1.6	1.6	2.3	1.8	2.0	2.0

SOURCE: Analysis of CCS data. For information about these data, see Kilmer, Caulkins, Midgette, et al., 2013.

NOTE: The number in each cell represents the percentage of respondents with that number of use-days willing to pay that amount extra for legal marijuana.

be modest differences in price, and those who use frequently presumably have already identified a (black-market) source with whom they are satisfied.

Nevertheless, this pattern presents a bit of a challenge. We should not use the simple aggregation across those four columns (given in the “Raw Total” column) because the CCS respondents tended to be more-frequent users than is typical. So instead we weight each of the four frequency-specific columns by their proportions of the total number of days of use reported in NSDUH.

We are most interested in weighting those columns to match the demand distribution for Vermont (second-to-last column), but state-level NSDUH estimates can be noisy, so, as a check, we also use weights based on the entire United States (last column). The results with either weighting are extremely similar and, not surprisingly, fall in between those for the least- and most-frequently using respondents.

This is most easily seen by converting the table into a graphical display (Figure 7.1) showing the legal supply’s market share (proportion of demand, measured in terms of days of use) plotted as a function of how much more expensive legal marijuana is than black-market marijuana.²³ The curves slope downward because the more expensive legal marijuana is than black-market marijuana, the smaller the proportion of marijuana sales will be captured by legal sources. The curve for the least frequent users is highest because they are the most willing to pay a premium. The curve for the most-frequent users is lowest because they appear to be most price-sensitive—or perhaps the most comfortable dealing with the black market. The two weighted averages (solid lines) are in between and lie on top of each other to such an extent that they look like one line in Figure 7.1. The solid lines are the ones of interest; the others just give a sense of how much answers tended to vary with frequency of use.

To illustrate how to read Figure 7.1, look at the height of the solid line above the \$4 point on the horizontal axis. It suggests that, if legal marijuana sold for \$4 per gram more than did black-market marijuana, legal supplies might capture a shade less than half of the total market. We use that particular point in our second market hypothetical, discussed in the next section.

However, it is important to stress that one cannot view Figure 7.1 as providing great precision in quantification of this market division. There are many reasons the CCS respondents might differ in important ways from the average Vermont marijuana user. Nevertheless, the figure provides some sense of what might happen.

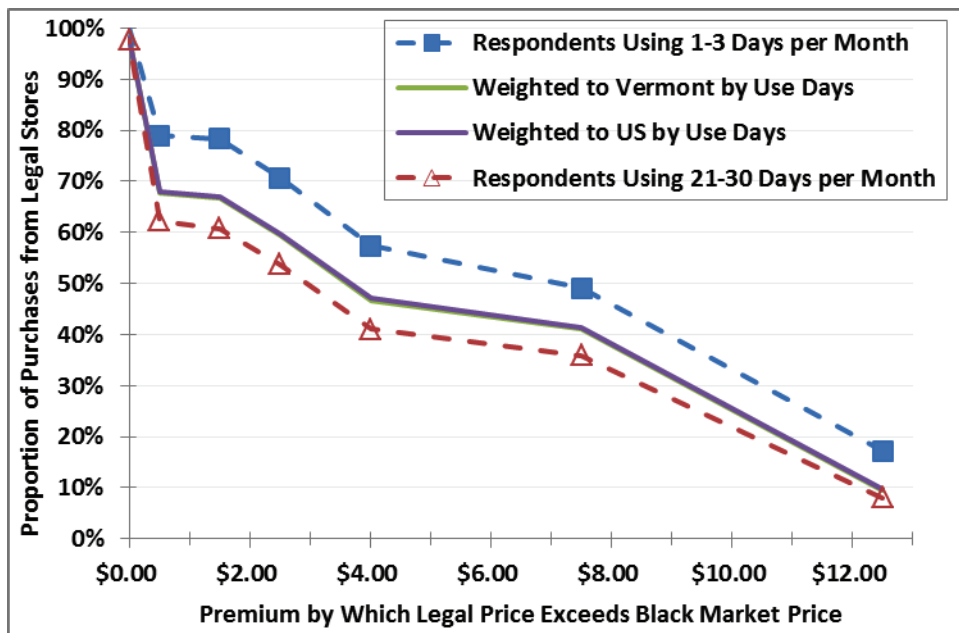
Scenario 2: Legal Prices Substantially Exceed Black-Market Prices

If the (taxed) legal price is above the black-market price, the legal-market share will be limited primarily to (1) people who pay a premium for being able to buy legal and (2) people who want to buy product types that are not well served by the black market (e.g., edibles).

The calculations in this second scenario proceed almost as before, except that one pays attention to only that subset of the market that would be willing to pay the price premium to purchase legally. Table 7.3 illustrates a scenario in which 50 percent of all consumption is by people who would pay a \$4-per-gram premium, the black-market price has fallen to \$235 per ounce, and the legal (taxed) price is \$350 per ounce—the same as the current black-market price and \$4 per gram higher than the new black-market price.

²³ Categorical ranges are converted to midpoints; the \$10-and-up category is plotted at \$12.50 per gram.

Figure 7.1
Legal Supply's Market Share as a Function of Its Price Premium, Based on the Washington Cannabis Consumption Survey



SOURCE: Analysis of CCS data.

NOTE: The two weighted averages (solid lines) are in between and lie on top of each other to such an extent that they look like one line.

The interesting thing to note is that tax revenues are only about 25 percent lower even though sales volume by weight has fallen by 60 percent, because the higher price supports a greater tax revenue per gram purchased, at least if we continue to assume that the government captures the same proportion of users' spending on marijuana in the form of taxes.

On the other hand, this also leaves intact half of the black market and so half of the black-market problems, thereby undermining one of the principal arguments in favor of legalization.

Restoring the Uncertainty

The hypothetical calculations for the two scenarios above serve a useful expository purpose by explaining what the principal parameters are and how they combine arithmetically. They are not, however, serious estimates because they sweep under the rug the rather considerable uncertainty surrounding more or less every one of the parameters in the calculation, starting all the way back with the assumption that Vermonters are now spending \$175 million per year buying marijuana products. In particular, one should *not* view the two estimates (\$35 million and about \$50 million) as somehow bounding the range of possible revenues for many reasons. Tax rates and enforcement effort could combine to yield greater revenues, but there is no guarantee that tax rates would be set high enough to capture one-third of users' spending.

As discussed in Chapter Two, Monte Carlo simulation is a tool for pooling the implications of uncertainty about a large number of different parameters. It simulates thousands of random draws from each parameter's distribution of possible values, inserts them into the calculations illustrated above, and keeps a running tab of how often the bottom-line tax revenue

Table 7.3
Hypothetical Calculations to Illustrate a Scenario in Which Black-Market Prices Fall to \$235 per Ounce and Legal Marijuana Sells for \$350 per Ounce

Row	Description	Value	Note
1	Vermonters' spending prelegalization (millions of dollars)	175	
2	Price prelegalization (dollars per ounce)	350	
3	Amount consumed before legalization (millions of ounces)	0.50	$\frac{\text{Row 1}}{\text{Row 2}}$
4	Postlegalization price per ounce, with taxes (dollars)	350	Note the higher price.
5	Percentage change in price for those who buy legally	0	$\frac{\text{Row 4} - \text{row 2}}{\text{Row 2}}$
5b	Black-market price per ounce postlegalization (dollars)	235	
5c	Premium that a user must pay to buy legally (dollars per gram)	4	$\frac{\text{Row 4} - \text{row 5b}}{28.35}$
5d	Percentage of users willing to pay that premium	50	
6	Price elasticity of demand	-0.54	
7	Price-induced percentage change in consumption, legal markets	0	Row 5 \times row 6
8	Nonprice effect of legalization on consumption (percentage)	25	
9	Amount sold in legal market (millions of ounces)	0.31	Row 3 \times row 5d \times (1 + row 7) \times (1 + row 8)
10	Percentage of untaxed (medical) marijuana within legal market	4	
11	Spending in legal, taxed market (dollars)	105	Row 4 \times row 9 \times (1 - row 10)
12	Percentage of consumer spending recovered as taxes	33.3	
13	Tax revenue (millions of dollars)	35	Row 12 \times row 11
14	Price-induced percentage change in consumption, nonlegal markets	18	Row 6 \times $\frac{\text{Row 7} - \text{row 2}}{\text{Row 2}}$
15	Consumption outside legal markets after legalization	0.37	Row 3 \times (1 - row 5d) \times (1 + row 14) \times (1 + row 8)
16	Total amount consumed (millions of ounces)	0.68	Row 9 + row 15
17	Percentage change in consumption relative to status quo	36	$\frac{\text{Row 16} - \text{row 3}}{\text{Row 3}}$

NOTE: Yellow indicates a parameter (input to the calculation). Unshaded cells contain data computed from data in other cells.

takes on each possible value. Plotting the resulting distribution of revenue outcomes can shed light on how uncertain the tax-revenue estimate is because of uncertainty about these param-

eter values. That is useful. However, we must stress that the simulation captures *only* the variability that comes from uncertainty about the parameter values. Any additional uncertainty, such as uncertainty about how aggressively the federal government will enforce the CSA or what happens if and, if so, when the entire nation legalizes and confronts Vermont with competition from other states, is over and above this parametric uncertainty. And of course if the human specifications of the ranges over which the parameters might vary are ill-informed, there is nothing the computer simulation can do to recover from that.

We state this final caveat explicitly because we genuinely have little basis for even guessing at sensible ranges for these parameters. Marijuana legalization remains an experiment with no effective historical precedent. Of course, Colorado and Washington passed their propositions in 2012, but their nonmedical retail markets did not open until 2014, and it will take many years, perhaps even decades, before the full ramifications become known.

However, it would be irresponsible to produce point estimates without some sort of range. An imperfect estimation of the uncertainty range is preferred to none at all. So we ran this Monte Carlo simulation process assuming that each parameter could take on any value between the lower and upper plausible values indicated in Table 7.4, with the base-case values being most likely.²⁴ In addition, we “smear” the market-share proportion read off Figure 7.1 by an amount uniformly distributed between its value and halfway to the nearest logical limit—meaning the closer of 0 percent and 100 percent.²⁵

Before proceeding to their interpretation, we want to stress again that this scenario pertains to a situation in which Vermont gets time to build out its marijuana industry with only the black market as a serious competitor, meaning that other East Coast states have not also legalized commercial marijuana industries. It is entirely possible that this scenario will never

Table 7.4
Low, Base-Case, and High Values for Key Parameters Underpinning Estimates of Potential Revenue from Taxing Vermont Residents’ Marijuana Purchases

Row	Parameter	Low	Base Case	High
1	Vermonters’ spending before legalization (millions of dollars)	125	175	225
2	Price before legalization (dollars per ounce)	300	350	400
4	Postlegalization price per ounce, with taxes (dollars)	150	300	425
5b	Black-market price per ounce after legalization	150	235	320
6	Price elasticity of demand	-0.40	-0.54	-1.20
8	Nonprice percentage effect of legalization on consumption	5	25	50
10	Percentage of untaxed (medical) marijuana within legal market	2	4	6
12	Percentage of consumer spending recovered as taxes	20	33.3	50

NOTE: The row numbers correspond to those used in Table 7.3.

²⁴ To be more specific, each parameter’s value was independently drawn from a triangle distribution stretching between the low and high values, with a peak at the base-case value.

²⁵ For example, if Figure 7.1 would suggest a market share of 30 percent based on the price differential, that 30 percent was replaced with a proportion randomly selected between 15 percent and 45 percent in an attempt to recognize the potentially large differences between the CCS sample respondents and the behavior of Vermont users. Of course, this (appropriately) leads to no smearing when the (taxed) legal price is below the black-market price, so the market share is 100 percent.

come to pass, even if Vermont does pass legalization, as we discuss further in “Threats to Tax Revenue Collection in the Longer Run.”

The results of the simulation are shown as histograms in Figure 7.2 (for tax revenues) and Figure 7.3 (for changes in consumption), as well as in summary statistics as Table 7.5. The average annual tax revenue over the 10,000 simulation trials was about \$45 million per year with either demand curve, but the distribution in Figure 7.2 shows that revenues could easily be as low as \$20 million or as high as \$75 million per year—just because of uncertainty in these parameters, not yet factoring in uncertainties concerning federal response, other states’ actions, or anything else.

Figure 7.3 shows that, in these model runs, consumption always grows, usually by between 25 and 100 percent and, on average, by 50 percent or more, with noticeably but not dramatically larger increases predicted when using the constant-elasticity rather than the linear demand curve.

Table 7.5 shows that the black market usually shrinks after legalization. The average decline is 40 to 50 percent, although the extent of the reduction is extremely variable. In about one in five runs, the black market is effectively eliminated. In two in five, the black market is cut by 50 percent or more, and, in about three in five of the runs, it is cut by at least one-third.

One reason legalization is not more successful at eliminating the black market in these scenarios is that we anticipate a continuation of the current downward trend in black-market

Figure 7.2
Distribution of Annual Tax Revenues Produced by Monte Carlo Simulation Independently Varying the Parameter Values over the Ranges Specified in Table 7.4

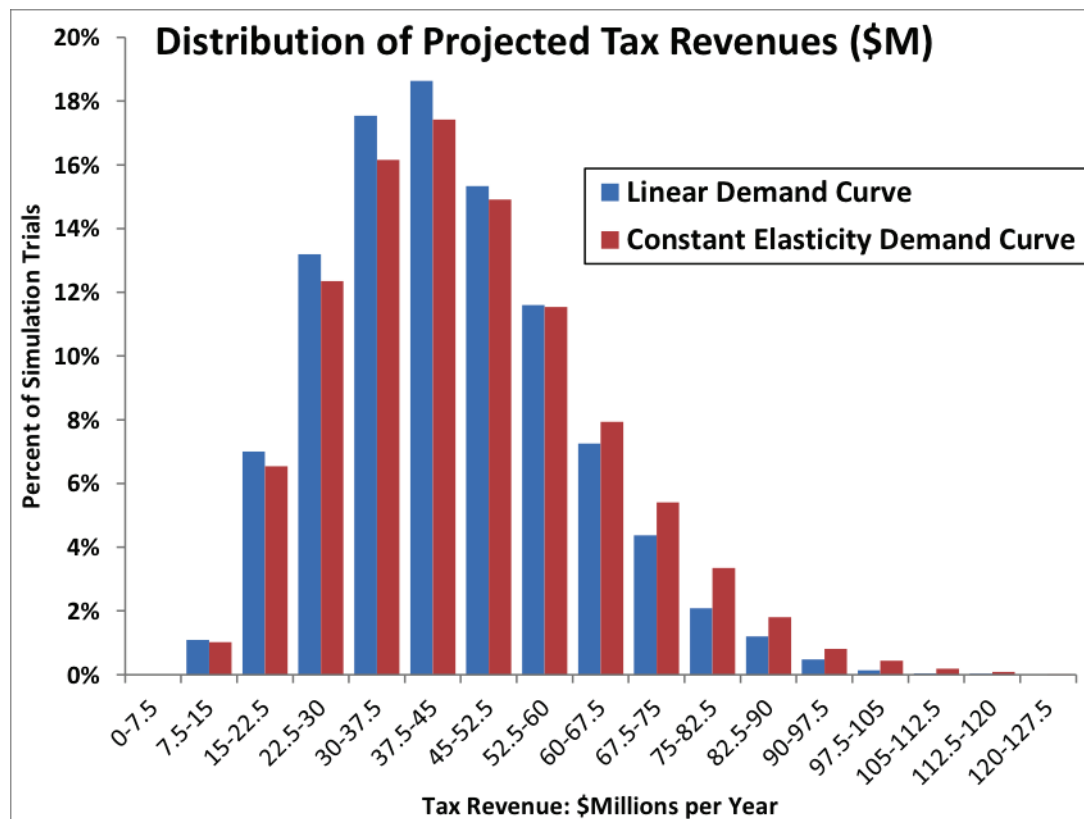
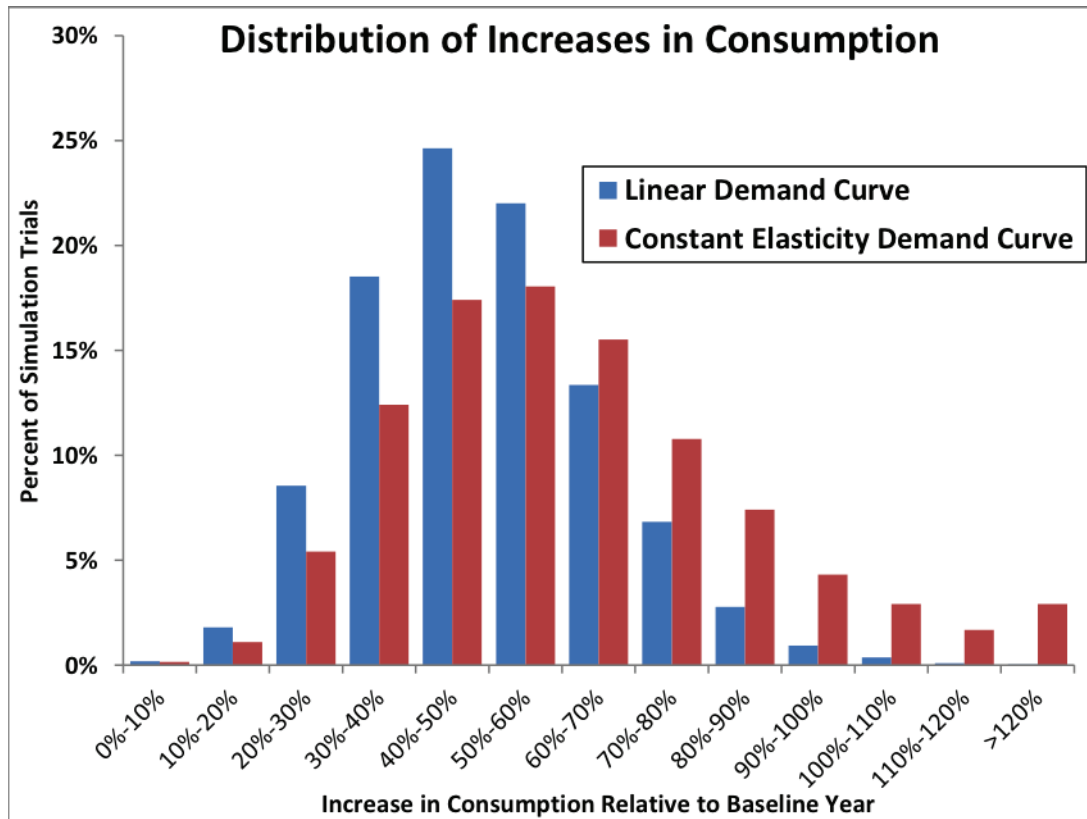


Figure 7.3
Distribution of Increases in Consumption Produced by Simulation



prices. But a zealous postlegalization effort to take on the black market could prevent a decline in black-market prices. So judging legalization's effects on consumption and black-market sales relative to the status quo might be unfair.

Relative to a no-legalization counterfactual that also involves declining black-market prices, the legalization-induced increases in consumption appear smaller, almost always less than 50 percent, and legalization cuts the black market relative to this counterfactual growth scenario by at least half in slightly more than half of the simulation trials.

Sales to Marijuana Tourists and Exports

The previous section explored scenarios pertaining to tax revenues collected on marijuana purchases made by Vermont residents when the primary competition was restricted to black markets. However, Vermont is a small state that is surrounded on all sides by much larger populations that are within easy driving distance. That geography, coupled with Vermont's natural charm, means that many people already come to Vermont as tourists or in transit between points on either side of the state. To put this in perspective, Vermont, with its population of 625,000, receives more than 10 million tourist visits per year (Chmura Economics and Analytics, 2012). So sales to non-Vermont residents present a real business opportunity for the State of Vermont in terms of raising tax revenues in the interval before other states legalize.

Table 7.5
Descriptive Statistics for Annual Tax Revenues and Change in Use Produced by Monte Carlo Simulation, Independently Varying the Parameter Values over the Ranges Specified in Table 7.4, by Demand-Curve Shapes

Statistic	Tax Revenue (\$)			Relative to Status Quo (%)			Relative to No-Legalization Counterfactual (%)					
	Change in Use			Change in Black-Market Quantity			Change in Use			Change in Black-Market Quantity		
	Linear	Constant Elasticity	Constant Elasticity	Linear	Constant Elasticity	Constant Elasticity	Linear	Constant Elasticity	Constant Elasticity	Linear	Constant Elasticity	Constant Elasticity
Average	43.6	45.7	61	-47	-41	21	20	28	20	-58	-58	-58
Standard deviation	16.2	17.8	25	36	42	12	17	42	17	28	28	28
95th percentile	72.7	78.6	108	12	28	43	51	28	51	-13	-13	-13
90th percentile	65.5	70.1	94	0	13	37	40	13	40	-21	-21	-21
75th percentile	53.8	56.5	74	-22	-13	29	28	-13	28	-37	-37	-37
50th percentile	41.9	43.6	57	-45	-40	20	18	-40	18	-55	-55	-55
25th percentile	31.6	32.4	44	-72	-71	13	9	-71	9	-77	-77	-77
10th percentile	24.0	24.4	33	-100	-100	7	2	-100	2	-100	-100	-100
5th percentile	20.0	20.3	28	-100	-100	3	-2	-100	-2	-100	-100	-100

Officially, the federal government's position is to deprioritize enforcement only if a state has strong regulatory and enforcement systems that prevent diversion of its state-legal marijuana to other states, but Colorado already reports that sales to out-of-state residents account for a substantial proportion of its marijuana tax revenue (Light et al., 2014), with no indication that this has stirred the federal government to intervene.²⁶ Thus, it is useful to take a few moments to quantify just how large the potential market is for Vermont to "export" marijuana.

Broadly speaking, a legal marijuana industry in Vermont could supply residents of other states in three ways: (1) selling taxed marijuana to nonresidents when they come to Vermont as tourists, (2) selling taxed marijuana to Vermont residents who resell (illegally) to nonresidents, and (3) illegally diverting product to the black market before taxes are collected. All are easy to imagine and difficult to thwart. The first is classic drug tourism, as occurred in the Netherlands. The second sometimes goes under the name of reverse smurfing.²⁷ If, relative to the black market, Vermont's legal stores offer lower prices, higher quality, or novel products, Vermont might want to take proactive steps to stop someone from making a large number of (legal) retail purchases and reselling to residents of other states. (Colorado elected to do the opposite, explicitly banning stores from collecting identifying information from purchasers.) Such entrepreneurs would not even need to grow their own product, so the barriers to entry are extremely low and preventing it would be difficult, just as it is difficult to prevent 21-year-olds from buying and reselling alcohol to underage users.

Opinion is divided as to whether the third—large-scale diversion before taxes are paid—is likely. If producer licenses are hard to obtain, valuable, and subject to forfeiture from vigilant state monitoring, such activity would be rare. That is the promise made by so-called seed-to-sale monitoring. Of course, promises are not always kept. Colorado also promised stringent seed-to-sale monitoring of its medical market but failed in that endeavor, as documented by its own auditor reports (State of Colorado Office of the State Auditor, 2013).²⁸ A new radio-frequency identification (RFID) seed-to-sale system for Colorado's recreational market (Marijuana Enforcement Tracking, Reporting, and Compliance, formerly the Marijuana Inventory Tracking Solution) is up and running.

Vermont would have a strong financial interest in shutting down pretax diversion while turning a blind eye toward marijuana tourism and reverse smurfing, so it is at least plausible that Vermont would tax much of what it supplied to residents of other states. And sales to marijuana tourists could produce collateral benefits if those marijuana tourists also purchased other goods and services, such as hotel rooms, in Vermont.

The primary source of data on marijuana use broken down into relatively small geographic areas is from NSDUH, previously discussed in Chapter Two, which provides estimates

²⁶ At this point, little is known about how much of this marijuana is consumed in Colorado versus smuggled out of state, and only that which crosses state borders violates one of the eight federal priorities.

²⁷ *Smurfing* is a term from money laundering that involves breaking up a large amount of cash into smaller units by making a large number of small deposits. Here the process would be reversed in the sense that a large number of small purchases could be aggregated into quantities that can be efficiently supplied to wholesale markets.

²⁸ According to that report,

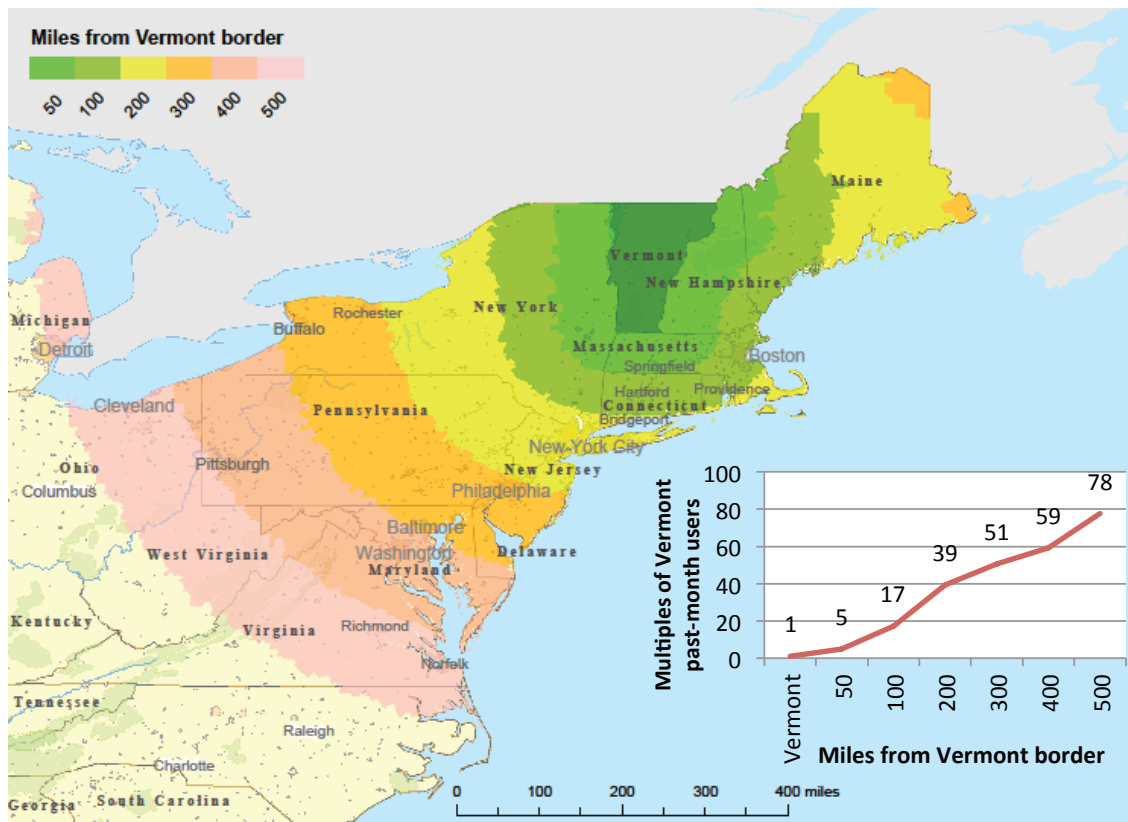
The envisioned "seed-to-sale" model for regulating Colorado's medical marijuana industry does not currently exist. The Division planned to develop a marijuana plant tracking system, spent about \$1.1 million in Fiscal Years 2011 and 2012, but was unable to pay the remaining \$400,000 and implement the system due to financial difficulties. The Division reports that it will implement the system by the end of Calendar Year 2013. (p. 1)

for 304 substate regions. Treatment data are inferior for comparing jurisdictions' rates of use because the number treated depends on several factors, including the supply of treatment facilities and criminal justice referral practices.

We prorated region-specific NSDUH estimates of the number of past-month marijuana users down to the constituent census tracts in proportion to the tracts' population within that substate region, computed the distance from each census tract to the Vermont border, and then summed the number of past-month marijuana users who lived within x miles of the Vermont border for various values of x , as shown in Figure 7.4.

Remember, these estimates are based on self-reports; adjusting for underreporting would inflate these numbers by roughly one-quarter. We are interested primarily in the relative number of users outside versus inside Vermont's borders, not the absolute number, so, to make an apples-to-apples comparison, we compare these figures with the household survey's estimate

Figure 7.4
Nearly 40 Times as Many Current Marijuana Consumers Live Within 200 Miles of Vermont's Borders as Live in Vermont



NOTE: These estimates come from self-reports circa 2012; adjusting for underreporting would inflate these numbers by roughly one-quarter. They do not include marijuana users in Canada. For this figure, we are interested primarily in the relative number of users outside versus inside Vermont's borders, not the absolute number, so, to make an apples-to-apples comparison, we compare these figures with the household survey's estimate of the number of past-month users in Vermont *before* that figure is adjusted upward for underreporting, which is 64,000.

of the number of past-month users in Vermont, which is 64,000, *before* that figure is adjusted upward for underreporting.

The household survey estimates that, in addition to Vermont's own 64,000 past-month users, another roughly 265,000 American past-month marijuana users live within 50 miles of Vermont's borders, or almost four times as many as live in Vermont. There are slightly more than that many past-year marijuana users in the greater Montreal metro area, portions of which are just about 50 miles from the Vermont border.²⁹ In the United States, there are about 60 percent as many past-month as past-year users, so one might guess that translates into roughly 200,000 past-month Canadian users who live within 50 miles or a bit more of Vermont. So in total, there are probably about 450,000 to 500,000 past-month marijuana users who live within 50 miles or so of Vermont, or roughly seven times as many as live within Vermont's borders,³⁰ although inspections at the international border would presumably deter some Canadian users from taking marijuana home with them.

Although some might view 50 miles as the maximum convenient range to drive just to buy marijuana, longer distances become practical if the buyer were willing to stay overnight. Overnight trips are not infeasible because marijuana is not particularly perishable, and Vermont already offers reasons for making such trips.

Recall from Table 7.2 and Figure 7.1 that, in data from the CCS (which was conducted before retail stores opened in Washington), about 60 percent of use is by people who would pay a premium of \$2.50 or more per gram in order to access legal marijuana. Four such people who used 1 g per day would value the benefit of a monthly foray to Vermont stores at about $4 \text{ people} \times 30 \text{ days} \times 1 \text{ gram per day} \times \$2.50 \text{ per gram} = \300 . That is not enough to cover four hotel rooms, but, if one person took the trip, buying on behalf of all four (a total of 4 oz.), the benefit would exceed the travel cost. The appeal becomes all the greater if the visitor enjoyed being in Vermont for other reasons.

If the traveler were buying on behalf of ten or 20 people, acting as a sort of alpha buyer or very low-level dealer, the economics become all the more compelling from the traveler's perspective. Could one individual buy 10 or 20 oz. on a single trip? That is essentially a policy choice that Vermont faces. If Vermont limits purchases to small fractions of an ounce and allows each customer to buy from just one outlet (as with Vermont's medical-marijuana program), this bulk buying would require local straw buyers. However, if Vermont allowed customers to buy even 1 oz. per day from any store, a cluster of five or ten stores (e.g., in Burlington) would enable an overnight visitor to buy 10 to 20 oz. on a single trip. Obviously, possession and transport of such quantities would still be illegal under federal law (and possibly under Vermont law; in Colorado and Washington, those over 21 can possess only up to 1 oz.), but, for domestic cases (as opposed to those crossing an international border), federal agencies rarely bother with such minor quantities, confining their prosecution primarily to cases involving 100 lb. or more.

²⁹ The Canadian Community Health Survey (CCHS) estimates past-year marijuana use in 2012 (by those 15 years and up) for Quebec to be 12.2 percent, and the Canadian Alcohol and Drug Use Monitoring Survey (CADUMS) estimates that to be 9.0 percent. Multiplying those rates by the 2011 Canadian census estimate that the population 15 years old and older in the Montreal metro area is 3.19 million yields estimates of 389,000 and 287,000, respectively.

³⁰ Light et al. (2014) also found that marijuana prices are higher in ski-resort areas frequented by out-of-state visitors than in Front Range communities, particularly for smaller amounts, citing prices of \$14 versus \$7 per gram for the same strain, whereas ounce prices are similar across regions at \$200 per ounce.

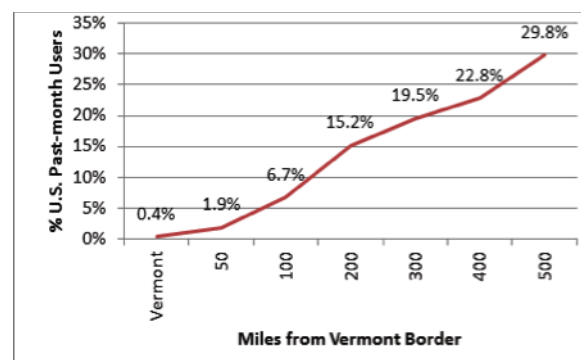
Figure 7.4 shows that, for every additional 50 miles that the radius of travel is expanded beyond the first 50, another approximately 500,000 or more American past-month marijuana users come within range of Vermont's stores. For example, if 200 miles each way (400 miles round trip) were deemed a reasonable radius for a weekend excursion, more than 2.7 million American marijuana users could source from Vermont stores via weekend trips—or about 40 times as many marijuana users as reside in Vermont. That range also picks up additional users from the Ottawa–Gatineau and Quebec City metro areas who might or might not generate some additional demand for Vermont.³¹

The graph inset in Figure 7.4 can also be plotted with two different axes to more directly address two other questions. The first, in Figure 7.5, expresses these numbers of users as a proportion of the total number of self-acknowledged past-month users in the entire United States. It speaks to the question of whether the rest of the country should care if Vermont legalizes. The answer is yes. Although some might argue that a laboratory of the states will permit independent state-level experimentation with legalization,³² this one state's experiment could alter availability for at least one-quarter of the nation's users (see, for comparison, Caulkins and Bond, 2012).

The second graph, shown in Figure 7.4, expresses these numbers of American marijuana users as a multiple of the number of users within Vermont's borders. It shows that, unless Vermont tries very hard to restrict sales to Vermont residents, most sales will likely be to out-of-state users until those states also legalize. By contrast, Colorado and Washington each has a larger in-state population and fewer out-of-state users within driving range.

The key lesson here is that the most-important determinants of how much tax revenue Vermont would derive from legalization in the short to medium term might not be whether the taxes are assessed per ounce or ad valorem or if the tax rate is 15 percent versus 30 percent. Instead, the key variables driving Vermont's tax revenue initially might be those governing the

Figure 7.5
Number of Past-Month Marijuana Users in the United States Versus Distance from Vermont
Replotted as a Proportion of All U.S. Past-Month Users



³¹ Canadian border control might be tough enough to deter many Canadian users from trying to return home with Vermont product.

³² Wallach (2014) made this argument in a Brookings Institution report, and Stableford (2014) quoted former President Clinton as saying, "This really is a time when there should be laboratories of democracy."

ease with which out-of-state users can purchase Vermont-taxed marijuana, including such rules as whether the maximum size of a retail purchase will be 0.25 oz. or 4 oz. and whether stores will be required to card users to check not only age but also state of residence.

If Vermont's objective is primarily to eliminate black-market supply to in-state users and it wishes not to violate the spirit of the August 2013 Cole memo, it could impose restrictions on retail sales akin to what it presently applies to the medical-marijuana trade. For example, medical users in Vermont are now required to associate with and buy from just one dispensary. On the other hand, if Vermont wanted to embrace revenue from sales to out-of-state users, it could adopt Colorado's rules that not only allow any user to buy from any store but also explicitly forbid the stores from collecting or retaining identifying information about the buyer.³³ That forced anonymity effectively makes it impossible to prevent buyers, including out-of-state buyers and their in-state friends, from walking down a street with ten marijuana shops and purchasing the maximum allowable amount from each.

The idea that sales to marijuana tourists could be a major driver of revenue and of the overall character of Vermont's legalization is reinforced by reference to statistics on Vermont's current tourism industry. A recent University of Vermont study (Valliere, Chase, and Manning, 2014) found that already the second- and third-most popular activities (after sightseeing) cited by tourists interviewed were shopping (42.9 percent) and "food and drink experiences" (39.1 percent), and the majority reported that they intended to purchase and take home Vermont-made products.

A study of the economic impact of visitor spending on the Vermont economy (Chmura Economics and Analytics, 2012) estimated that Vermont's roughly 10 million annual out-of-state visitors spend about \$1.35 billion in the state. The largest components of that spending are for lodging, gasoline, and prepared meals and beverages.³⁴

In theory, legal marijuana sales to out-of-state residents could match or even exceed total tourist spending by all out-of-state visitors today. To see why, recall that current spending on marijuana in Vermont is in the ballpark of \$175 million per year, and about seven times as many marijuana users live within 50 miles of Vermont as there are marijuana users in the state itself. So total marijuana spending by near-neighbors approaches the \$1.35 billion figure.

Naturally, Vermont would not capture all of the near-neighbors' spending, but it might also pick up some fraction of spending from more-distant neighbors. Total marijuana spending by out-of-state users living within a radius of 200 miles of Vermont could well reach or exceed \$5 billion per year. Because that spending is large, taxes on it could loom large even compared with entire sectors of the Vermont economy, including agriculture, forestry, fishing, and hunting (\$313 million combined); arts, entertainment, and recreation (\$253 million combined); and even accommodation and food services (\$1.263 billion), although it is hard to imagine that Vermont could collect those taxes without eliciting a response from other states (or the federal government).³⁵

³³ Section 5(c) of Colorado's Regulate Marijuana Like Alcohol Act (Amendment 64 to Article XVIII of the state constitution) states, "A retail marijuana store shall not be required to acquire and record personal information about consumers other than information typically acquired in a financial transaction conducted at a retail liquor store."

³⁴ Chmura Economics and Analytics (2012) also provided estimates of associated tax revenues (\$275 million) and jobs created (26,000 to 38,000), but those are for the \$1.7 billion spent by all visitors, including Vermont residents visiting other parts of the state.

³⁵ Figures on Vermont State product are taken from StatsAmerica (undated).

In summary, although there is enormous uncertainty concerning all amounts related to marijuana legalization, it seems clear that, if Vermont legalizes, unless and until other states followed suit, demand from neighboring states could dwarf demand from Vermont residents. How much of that demand gets converted to Vermont-based sales and tax revenues is, to some extent, a policy choice. Vermont could write a legalization law that welcomes these out-of-state customers or one that tries to erect barriers to deter them.

The policy choice is not entirely free. The marijuana industry would have a strong interest in capturing that revenue and would presumably lobby hard for those sales to be allowed either directly or via regulatory rules that de facto enabled them (as with Colorado's buyer confidentiality protection). And even if Vermont made a sincere effort to block distribution to out-of-state residents, there is a limit to the effectiveness of those barriers because any Vermont resident of legal age could buy on behalf of out-of-state friends and family.

The situation would be similar to trying to prevent 17-year-olds from obtaining cigarettes or 20-year-olds from obtaining alcohol when every 18- or 21-year-old, respectively, becomes a potential source. Considerable effort is devoted to enforcing laws against stores selling to underage drinkers, but 89 percent of high school seniors still say alcohol is fairly easy or very easy to get (Johnston et al., 2012, p. 426). Likewise, even if Vermont sought to aggressively enforce laws against stores selling directly to out-of-state residents, one would expect that a large proportion of those out-of-state residents would report that it was fairly easy or very easy to obtain Vermont-sold and -taxed marijuana.

Of course, Vermont would have to anticipate the likely response of other states and the federal government, a topic to which we turn next.

How all of this would play out is impossible to predict, but the simple numbers show that, if Vermont wishes to legalize marijuana, it has to think through how it wants to handle the reality that there will probably initially be substantially greater demand from out-of-state than from in-state residents. That enormous demand can be seen as a great opportunity for generating a tax windfall or as a threat to Vermont's current brand and economic niche, or both. But demand from outside the state is the elephant in the room that must be acknowledged and addressed in any plan for legalizing marijuana in Vermont at this time.

Threats to Tax-Revenue Collection in the Longer Run

The previous sections considered a situation in which Vermont's legal suppliers' only important competition was the black market, including supplies diverted from western states' legal or quasi-legal production and smuggled east. The punch line of that analysis was that Vermont might hope to generate tens of millions of dollars in tax revenues from its own residents' purchases and hundreds of millions of dollars from the residents of other states.

That scenario might not be sustainable. If Vermont legalizes and events unfold favorably, one would expect other states to follow suit. They might do so even if Vermont were not collecting substantial revenues by taxing their citizens. All the nontax considerations that make Vermonters favorably disposed to consider legalization apply in other states, including criminal justice cost savings and greater personal freedom. But watching tax revenues disappear across state borders would be an additional goad.

So the preceding sections pertain to the first of three distinguishable market scenarios: (1) No other eastern state legalizes and Vermont collectively enjoys a monopoly on supplying

legal marijuana to users in the region, (2) a few other small states legalize (e.g., Rhode Island, New Hampshire), so considerable out-of-state demand remains but so does competition for the opportunity to meet that demand, and (3) many or most states legalize, the federal government legalizes or otherwise acquiesces to interstate commerce, and production moves to states that have natural comparative advantage.

Although one cannot rule anything out, including a backlash and rolling back of legalization measures taken to date, one plausible trajectory is a progression through these three stages. The key question is how long each stage lasts. If the nation as a whole were to legalize within a few years of Vermont, Vermont's marijuana industry might not have time to develop or recoup its up-front investments. But it is plausible that each scenario lasts long enough to matter and so merits consideration.

We already described the first scenario. The second is, in some sense, intermediate between the first and third. So the bulk of this section is devoted to describing key drivers of the final scenario (national legalization) including that (1) shipping costs will be negligible, (2) production costs under natural light could be extremely low, (3) Vermont might have little comparative advantage in growing, (4) profits could come predominantly from subsequent stages in the marketing chain, and (5) tax collections could depend on energy invested in thwarting gray-market tax evasion.

We then return to a medium-run scenario in which a few other northeastern states have legalized but the nation as a whole has not.

Market Drivers After National Legalization That Bear on Vermont's Role in That Market

Shipping Costs

After national legalization, shipping costs will be negligible because the weight of product consumed is so low. A daily or near-daily user consumes about 1.6 g per use-day, which is about the weight of 1.5 cigarettes. Shipping costs are not a major factor driving the costs of cigarettes, and they will not be for legal marijuana either. (This stands in marked contrast to the currently observed price gradient of about \$400 per pound per 1,000 miles, or about \$2.50 per gram when shipping to Vermont from California.)

Production Costs

Caulkins, Cohen, and Zamarra (2013) found that the average yield of dried usable marijuana buds is currently about 40 g per square foot of canopy per harvest.³⁶ Indoor grow productivity exceeds greenhouse and outdoor growing mostly by having a shorter growing cycle and achieving more harvests per year, e.g., roughly four to six per year under artificial lights, two or three in a greenhouse, and one per year for outdoor in most climates.

U.S. Department of Agriculture data (Census of Agriculture, 2014) show that greenhouse farms generate about \$4 to \$7 in revenue per square foot per year for vegetables and herbs and \$8 to \$11 for flowers. That suggests that greenhouse farmers could sell marijuana for as little as \$0.05 to \$0.10 per gram if it were treated like any other crop. A more conservative estimate

³⁶ Since publication of that report, an industry analyst whom we judge has good access to information on industry practice has told us (anonymously) that 28 g per square foot is more typical. We use the 40 g figure here because it comes from a published source, but the qualitative conclusions would carry through with that lower yield estimate, particularly because neither the 40 nor the 28 g figure includes THC extracted from other parts of the plant—something that becomes more economical after legalization. The relative amounts of THC in buds versus elsewhere vary by strain, growing method, and other factors, but total THC yield might be very roughly double what is obtained when harvesting only buds.

allowing for just one harvest per year and area under canopy being only 50 percent of greenhouse space would increase those figures but only to \$0.20 to \$0.50 per gram.³⁷ As Table 7.6 shows, that is far below current wholesale prices in Vermont (\$3,500 per pound or \$7.70 per gram) or California (\$1,000 to \$2,500 per pound or \$2.20 to \$5.50 per gram). That is, if greenhouse farmers can grow marijuana like other crops, farm gate prices could fall precipitously, perhaps by 90 percent even relative to the lowest current wholesale prices.

If marijuana were grown outdoors as a field crop, the production costs per unit of THC could be even lower. Caulkins, Hawken, Kilmer, and Kleiman (2012) estimated outdoor production costs that would be the THC-equivalent of \$8 to \$33 per pound of sinsemilla (\$0.02 to \$0.07 per gram). To be clear, the outdoor product would not match the indoor product on other dimensions and might not be suitable for sale as roll-your-own usable buds. But if extraction methods can be scaled up, outdoor farming might be able to produce concentrates at very low cost.

There is little point estimating costs to grow indoors under artificial lights after national legalization. The cost of electricity alone would exceed the total production cost in greenhouses. In the long run, one should expect the proportion of marijuana grown under artificial lights to be very low. And therein lies the conundrum for today's marijuana entrepreneurs; it is not clear how many years they will have to recoup the considerable capital costs of building an indoor production facility before being undercut by greenhouse-based growers. The viability of indoor growing as a commercial enterprise depends on perpetuation of the curious limbo of legal enough for growers skilled in that art to attract capital but not legal enough or open enough for conventional farmers to enter the market and drive prices down to what is typical of comparable farm crops.

Vermont May Have Little Comparative Advantage at Marijuana Production

Current nationwide consumption is probably roughly the equivalent of 5,000 t of high-potency buds.³⁸ That could be produced by 50 million sq. ft. under canopy in greenhouses if greenhouses can produce 40 g per square foot and two to three harvests per year, which is close to the area now devoted to greenhouse-based production of tomatoes in the United States (55 million sq. ft.) and one-seventeenth the space devoted to floriculture (873 million sq. ft. for flowers, foliage plants, and similar plants). Outdoor production would require an even smaller proportion of cropland. Tiny Rhode Island, with its 19,000 acres of harvested cropland, could grow all of the THC consumed in the nation. And Nebraska, with its nearly 19 million acres, could supply the country from 0.1 percent of its cropland.

If national legalization passed, marijuana cultivation could concentrate in one or a few states that offer the lowest cost structure. Is Vermont likely to be one of those states? Perhaps, but there is no guarantee. Because the actual production costs appear modest, taxes and regulatory compliance could drive interstate differences in production costs. Conceivably, Vermont

³⁷ Kilmer, Caulkins, Pacula, et al. (2010) built up an estimate of \$100 to \$240 per pound or \$0.22 to \$0.53 per gram for greenhouse growing by costing out the various main input factors.

³⁸ Kilmer, Everingham, et al. (2014) estimated national marijuana consumption to be 4,200 to 8,400 t in 2010. Consumption has increased since then in terms of THC, but that weight included a considerable amount of lower-potency commercial grade. With quality adjusted to the higher-potency product varieties one would expect after legalization, 5,000 t is plausible. For example, if (1) THC consumption were to increase by 25 percent, (2) high-potency marijuana were to have 2.4 times as much THC per gram as commercial grade, and (3) high-potency were 30 percent by weight in 2010 and 100 percent by weight after legalization, then the range would be 3,075 to 6,150 t.

Table 7.6
Contrasting Farm Gate Prices Now
and When Cannabis Farmers Can
Grow Cannabis Openly Like Any
Other Crop

Price or Cost per Gram	Amount (\$)
Current wholesale price	
Vermont	7.70
California	2.20–5.50
Production cost when legal	
Greenhouse	0.20–0.50
Field crop	0.02–0.07

could position itself as the no- or low-regulation state with a pro-industry business environment and win the economic-development contest to host the industry, but climate and other considerations suggest that that is unlikely. So one might expect that, after national legalization, Vermont will be a minor producer, and marijuana sold in Vermont would mostly be imported. So, in the long run, Vermont's role in marijuana production, sales, and tax collection is likely to be undistinguished, just as is its role in tobacco production, sales, and tax collection today.

Profits May Come Predominantly from Subsequent Stages in the Marketing Chain

Very low production costs mean that profits and power could gravitate further out the supply chain. Recall that users today are paying \$10 to \$15 or even \$20 per gram for high-potency marijuana (which is our benchmark when quoting prices). There are three possibilities if production costs fall to \$0.20 to \$0.50 per gram, let alone the equivalent of \$0.02 to \$0.07 per gram for extracts and concentrates.

One possibility is that competition will drive prices down close to production costs. If that happens, a heavy marijuana habit would be far less expensive than a latte-a-day habit at a café, and the total value of the marijuana market will shrink considerably because few expect that a 90-percent decline in prices would be accompanied by a ten-fold increase in consumption. Producers might dominate that industry, but it would be considerably smaller than today's \$40 billion-per-year enterprise.³⁹

The second possibility is that the marijuana industry convinces users to pay prices considerably higher than production costs, through marketing, bundling marijuana with other products, and other techniques. In that case, the industry as a whole might be large and powerful, but the farmers and growers would capture only a modest share of the revenue.

The milk and tea industries might be familiar examples of these two situations. The price of a gallon of milk in a grocery store is marked up only modestly above the overall production cost, and farmers themselves (as opposed to processors and distributors) account for a sizable share of that cost (Yale, 2011). By contrast, the global tea industry is dominated by a handful

³⁹ If farmers make \$0.20 to \$0.50 per gram, they earn only about \$100 per year per daily heavy user, or about half what orchards make from someone who buys an apple a day.

of large multinationals that invest heavily in marketing and brand management, with independent tea farmers receiving only a very small fraction of the price paid by consumers.⁴⁰

A third possibility is that government takes a large share of revenue, at least as large as the 80 percent that European countries take of prices that consumers pay for cigarettes. That possibility would require great efforts to deter evasion, as we discuss next. Such a large government share would not endure in the face of tax competition among states, so this third scenario would likely see the federal government take the lion's share of revenue, leaving states with little to compete about—or to collect.

The long-run legalized-marijuana industry might contain elements of all three structures, with very cheap forms sold to poor and heavy users who need to economize and hand-crafted specialty strains sold to more-affluent users who are not price-sensitive, and with government taking a large share of all proceeds. But if even half of the marijuana by weight is sold under the tea model, as opposed to the milk model, then the bulk of the net private revenues will accrue to the intermediaries, marketers, and brand managers that induce consumers to pay prices far above production costs, not to the farmers.

Tax Collections May Depend on Energy Invested in Deterring Evasion

Whether most marijuana is sold at prices down near production costs or at high multiples of the production cost could affect tax revenues. That would follow literally when the tax is *ad valorem*. If prices collapse, so do *ad valorem* tax revenues. But even if the tax is assessed per unit weight, a \$50-per-ounce tax might induce greater tax evasion if it quintuples the price of something that would otherwise sell for \$10 per ounce rather than increasing the price of a \$100-per-ounce product by 50 percent. Or perhaps not; it is only the tax, not the base price, that would matter to an *überraational homo economicus*.

Tobacco could provide the best—albeit still quite imperfect—current model for how this could play out. A \$50-per-ounce tax is akin to a \$35-per-pack tax on cigarettes on a per-unit weight basis, and current taxes of \$2 to \$5 per 20 g pack induce considerable cross-border evasion involving tax-paid, branded cigarettes legally sold elsewhere. With a tax per unit weight comparable to that on tobacco (meaning, \$5 per 20 g), the revenues from a gram-a-day heavy user would be only about \$90 per year. Even if Vermont had 100,000 such users, they would still produce only \$9 million per year—not much more than the state now spends enforcing alcohol regulations (discussed at the end of this chapter).

Whether Vermont can collect taxes closer to \$50 per ounce or its equivalent using other tax bases, could depend on the tax rates in other states because marijuana is so compact and shipping costs are so low.⁴¹ Indeed, it might take only one of the lower 48 states breaking ranks and charging low marijuana taxes to challenge tax collections in the other states. After all, an industry is already dedicated to moving illegal marijuana around the country, and existing users have been willing to violate laws enforced much more harshly than laws against tobacco smokers possessing cigarettes that do not bear their state's tax stamp are.

⁴⁰ For example, see Monroy, Mulinge, and Witwer (2013) on Kenya's tea industry (Kenya being the third-largest producer).

⁴¹ Because a typical heavy marijuana user consumes 1 g per day, whereas a typical pack-a-day tobacco smoker consumes 20 g per day of cigarettes, it would, in some physical sense, be 20 times easier to (illegally) supply marijuana users from a distant low-tax state than it is to do the same today for tobacco smokers. Vaping-pen cartridges can be even more compact.

A Medium Run in Which Some Other Northeastern States Have Legalized

Recall that we distinguished three market scenarios: (1) Vermont is the only seller of legal marijuana in the region, (2) Vermont is joined by a few other small states, and (3) more or less all states and the federal government legalize.

Let us return to the second, in which a handful of states compete to serve demand from throughout the region. A key dynamic there is how energetically those states compete with each other by offering low taxes and lax regulatory environments.

New Hampshire's current alcohol policies demonstrate the economic benefit of undercutting the rate at which neighboring states tax intoxicants. If some nearby state adopted a similar stance with respect to legal marijuana, Vermont and that state might find themselves in a bidding war, trying to outcompete each other at providing the lowest taxes and most-convenient customer service to out-of-state customers.

The expectation that other states will follow is not necessarily a reason not to act. Substantial economic benefits could accrue during the window before other states react, and a first-mover advantage might persist for some time. New Jersey legalized casinos in Atlantic City in 1976, and the first one opened in 1978. For more than a decade, Atlantic City prospered with its monopoly on casino gambling east of the Mississippi. Eventually, other states wanted a piece of the action, and now there are 900 casinos in the United States. At this point, Atlantic City has excess capacity; four of its casinos have closed already this year, laying off 8,000 workers (Parmley, 2014).

So the strategy of taxing other states' residents' marijuana purchases might not be sustainable, but it might generate considerable profits for Vermont until such time as other states react. And an optimist could hope that, by moving first, Vermont might cement a long-lived brand and reputation as the place from which to buy marijuana, akin to Vermont's premium brands in coffee, cheese, or ice cream. Even if production moved to other states when the nation legalized, Vermont might still be able to capitalize on a reputation for quality by branding marijuana produced elsewhere with its label, or perhaps even importing raw marijuana for some final processing in order to reap a premium from a made-in-Vermont badge.

Cost of Regulation

Criminal justice savings and tax revenues associated with legalizing marijuana in Vermont are only part of the fiscal equation. Those tallying the fiscal impacts must also weigh the time and resources required to set up and administer a regulatory system and to enforce the rules and laws governing the new regime. Although the fees and taxes can cover these costs, one must nonetheless count them and so credit only taxes net of these costs. There is also an issue of timing; the regulatory system will require up-front expenditures before there are any offsetting tax revenues.

The costs will depend on choices made about the supply architecture, tax regime, and regulations (Chapters Four through Six). For example, if Vermont allowed only small-scale growing at home for personal use, with no licensing or commercial sale, the regulatory costs would be minimal, although there would still be costs associated with enforcing laws against minors in possession, DUI, and making sure growers do not overproduce. The regulatory system would be very different if for-profit companies were allowed to produce and sell marijuana.

Like with the tax projections, we do not try to estimate the time and resources required for each scenario; rather, we highlight some of the important cost drivers, focusing on the magnitude instead of specific amounts. The first section addresses the cost of designing and creating the regulatory regime, the second focuses on the costs of enforcing these regulations, and the third section presents new expenditure data from the agency tasked with creating and enforcing the regulatory regime for legal marijuana in Washington.

Cost of Designing and Creating the Regulatory Regime

Two high-ranking legal officials intimate with the marijuana-legalization process in Colorado warn, “Establishing a complex regulatory regime overnight is a massive endeavor” (Blake and Finlaw, 2014). And Colorado was not starting from scratch. It had already created a Marijuana Enforcement Division (MED) within CDOR and had built an infrastructure for processing applications and distributing licenses.

This section focuses on five areas associated with designing and creating the regulatory regime that could require significant investment of state resources: making rules, hiring and training regulators and administrators, tracking inventory, updating prevention messaging and programming, and developing a testing program.

Making Rules

The legalization initiatives that passed in Colorado and Washington left many of the regulatory decisions to be determined by others—even though the Washington proposition ran to more than 60 pages. Although Vermont lawmakers could debate all of these matters and address them in a legalization bill, one might expect the bill to delegate rulemaking to a separate entity (e.g., a newly created public authority, Department of Health, Department of Liquor Control, or Department of Public Safety). Regardless of when the rules are created, they will involve debates, hearings, analyses, negotiations, and updates that will likely require tens of thousands of person-hours.

If Vermont seeks to become the first state to pass legalization via the legislative process, there will be a lot of interest in Vermont and throughout the country. Not only will northeastern neighbors pay close attention; so will federal officials and the national and international media. Given the controversial nature of legalization and opponents’ desire to quash it, there will likely be considerable scrutiny as the rules are debated. In addition to the value of the compensated and donated labor involved with creating a new regime, Vermont policymakers will need to consider the opportunity costs of spending time and political capital trying to make this work versus focusing on other legislative priorities.

Hiring and Training Regulators and Administrators

Even if the regulatory regime is incorporated into an existing agency, the state will have to hire and train people to understand and enforce the regulations. *The Denver Post* reported that MED was expected to have 50 to 55 employees by the end of June 2014 (Gorski, 2014). We remind readers that MED regulates both medical and recreational marijuana and that Colorado has eight times the population of Vermont. The number of state employees that will need to be hired and trained in Vermont will depend on the number of producers and retailers or co-ops allowed to be licensed, which, in turn, will be influenced by the amount of tax revenue Vermont wants to collect from out-of-state residents.

Inventory Tracking System

Given the Cole memo's focus on making sure states have strong regulatory and enforcement systems, regulators will likely want to adopt some sort of seed-to-sale tracking system. Colorado started the process of creating the system before Amendment 64 passed but did not have the financial resources to complete or implement the system (State of Colorado Office of the State Auditor, 2013). Their seed-to-sale system is now up and running, and the cost to the state was on the order of \$1.5 million (Gilboy, 2014). Washington also implemented a seed-to-sale system (WSLCB, 2014) that is reported to cost the state more than \$850,000 (Simmons, 2014).

Updating Prevention Messaging and Programming

Substance use–prevention efforts can range from supporting school-based skill-building programs to distributing community-based prevention grants to paying Madison Avenue firms to develop media campaigns. If Vermont chooses to legalize marijuana, it could decide to devote additional funds to preventing use by minors, as well as problem use (e.g., driving under the influence of marijuana or alcohol). If so, another decision will have to be made as to when this updated programming will go into effect; will the programming be in place *before* legal marijuana is made available (and, hence, before new tax revenues arrive)? If so, with what funding?

It is difficult to project what the optimal amount of prevention spending would be if Vermont chose to legalize marijuana. As mentioned in Chapter Two, Vermont spends on the order of \$2.5 million on all substance use–prevention activities, not just those for marijuana (Vermont Department of Health, 2014b). Meanwhile, in Colorado, the governor recently spent nearly \$2 million on an antimarijuana campaign involving a website, ads in movie theaters, TV commercials, and the construction of a number of human-sized rat cages to bring home a message to minors: “Don’t be a lab rat” when it comes to Colorado’s marijuana-legalization experiments (Downes, 2014).

Developing a Testing Program

Information from marijuana testing can be used to monitor product safety, educate consumers, and determine taxes. Federal prohibition of marijuana puts states in the precarious situation of wanting to test but not wanting to order their employees to risk violating federal law by handling the product (labs testing drugs for law enforcement purposes are not at risk of federal prosecution). Both Colorado and Washington license third-party testers, and it is too early to tell whether this model is desirable or sustainable. If Vermont legalized marijuana and decided to buck the trend and develop its own testing program, particularly if THC content were used as a basis for taxation, the costs of creating the infrastructure to test and monitor the samples would need to be considered, regardless of whether they were simply passed on to the consumers.

Cost of Enforcing the Regulatory Regime

It is one thing to have regulations on the books; it is another to enforce them. As with alcohol enforcement, making sure marijuana suppliers, distributors, and users comply with applicable codes and laws will require time and resources.

Table 7.7 presents a framework for thinking about the costs associated with regulating a legal intoxicant *after* the regulatory system has been designed and created: regulating licensed

entities, enforcing laws against consumption, enforcing laws against possession, enforcing laws against reselling; and enforcing laws against nonlicensed producers and wholesale distributors.

Legalizing an intoxicant does not mean that the criminal justice costs associated with that substance will disappear. Although Chapter Two makes it clear that marijuana legalization in Vermont would reduce some of the criminal justice costs associated with enforcing prohibition, experiences with alcohol suggest that they will not fall to zero. Indeed, up-front costs could be quite significant if the Vermont Drug Task Force or some other regulatory body with police powers decided to aggressively pursue black-market producers to minimize tax evasion.

The third column of Table 7.7 also acknowledges that the state can generate revenue from enforcing marijuana regulations and laws. Although fines can be costly to collect and are often ignored (Piehl and Williams, 2011), Chapter Two made it clear that this is not the case in Vermont with respect to marijuana-related fines. Since decriminalization, roughly 60 percent of the fines for possessing less than 1 oz. have been paid, totaling nearly \$180,000.

The costs associated with categories 2 through 5 in Table 7.8 will fall largely on police departments, courts, and possibly corrections agencies; however, they could also fall on a regulatory agency if it has police powers. Those seeking to project these costs postlegalization must combine assumptions about violations and expected sanctions with some of the unit costs associated with marijuana prohibition presented in Chapter Two.

Because the criminal justice costs associated with enforcing marijuana laws are discussed in Chapter Two, the remainder of this section will consider the costs associated with the first category in Table 7.7: regulating licensed entities. As noted above, much will depend on the regulations that are imposed and the amount of time spent monitoring and enforcing compliance. We begin by focusing on the current costs associated with regulating liquor in Vermont. This is meant to serve as a benchmark from which one can make adjustments based on assumptions about intensity of enforcement.

Insights from the Vermont Department of Liquor Control

DLC has an annual budget on the order of \$6 million and is charged with regulating Vermont's partial liquor monopoly (it neither produces the liquor nor sells it in state-run stores).

Table 7.7
A Framework for Thinking About the Costs Associated with Regulating a Legal Intoxicant

Category	Example	Revenue Source from Noncompliers
1. Regulating licensed entities	Issuing and revoking licenses, vendor training, taxes	Fines
2. Enforcing laws against consumption	Public consumption, public intoxication, DUI	Fines, fees for diversion
3. Enforcing laws against possession	Minors, illegal products, those caught over the threshold	Fines, fees for diversion
4. Enforcing laws against reselling	Selling to minors or those exceeding quotas	Fines, fees for diversion
5. Enforcing laws against nonlicensed producers and wholesale distributors	Black-market suppliers, exporters	Fines, asset forfeiture ^a

NOTE: The table excludes costs associated with creating the regulatory system.

^a In Vermont, "none of the property seized through civil forfeiture is allocated to law enforcement. The money goes to the state treasury" (M. Williams et al., 2010, p. 95).

Table 7.8
Vermont Department of Liquor Control Budget and Full-Time Employees, by Function

Unit	Employees in FY 2013	Type of Cost	FY 2013 Actual Budget (\$)	FY 2014 Governor's Recommended Budget (\$)
Administration	15	Personal services	1,506,295	2,102,914
		Operating	388,384	647,264
Warehousing, distribution, and recycling	14	Personal services	783,997	859,469
		Operating	441,989	436,065
Education, enforcement, and licensing	21	Personal services	1,998,914	2,153,635
		Operating	402,813	445,222
Total	50		5,522,392	6,644,569

SOURCES: Hogan (2014). Employee figures from DLC (2014).

DLC warehouses all of the liquor that is distributed to the 78 licensed retail outlets (also referred to as agency stores) across the state (DLC, 2014). DLC alcohol activities are funded entirely by receipts from alcohol sales.⁴²

DLC also has responsibility for issuing licenses and permits, training alcohol and tobacco sellers and servers,⁴³ enforcing decisions made by the Liquor Control Board, and conducting tobacco compliance checks (Hogan, 2014). Each year, DLC issues more than 8,500 licenses and permits to manufacturers, restaurants, and retail alcohol and tobacco outlets and for serving alcohol at art galleries and festivals.⁴⁴ There are three main budgetary units in DLC: administration; warehousing, distribution, and recycling; and education, enforcement, and licensing. Table 7.8 presents budget data and numbers of full-time employees, by function.

If we are trying to estimate the costs associated with regulating agency shops in Vermont, we should exclude warehousing, distribution, and recycling from the calculation. We also need to consider how much time was devoted to (1) training those who do not work at liquor stores (i.e., other alcohol servers, tobacco servers); (2) conducting tobacco compliance checks; and (3) other activities not directly related to the retail liquor stores (e.g., enforcing Vermont's alcoholic-beverage statutes).⁴⁵ It is also unclear how to distribute the administration and operating costs associated with education, enforcement, and licensing. For example, the director of retail operations is classified in the administration budget, and some of the position is associated

⁴² In FY 2013, DLC generated \$20 million in tax revenues (Hogan, 2014). DLC also reports that, in FY 2013, it contributed \$1.4 million to the general fund in fees, violations, and transfers.

⁴³ Either in-person, online, or via a trained employer.

⁴⁴ This highlights another interesting regulatory decision confronting those thinking about marijuana legalization: Will an art gallery be allowed to get a permit that allows it to serve or sell marijuana products?

⁴⁵ As noted above, training for alcohol and tobacco servers and licenses, as well as monthly tobacco compliance checks, is covered by funds from the master settlement agreement, which has hovered around \$250,000 in recent years. One full-time equivalent (FTE) and some temporary workers help handle the 8,500 licenses and permits, and, because there are only 78 retail stores, it seems like most of these costs could justifiably be excluded.

with the cost of regulating agency shops. Similarly, the auditors and those providing customer support to liquor outlets also fall into the administration category.

Thus, there are reasons the \$2 million spent on education, enforcement, and licensing is an overestimate of what it costs to regulate Vermont's 78 liquor stores. We also know that the budget excludes some additional administrative costs associated with these stores. But, to put these numbers in perspective, if \$2 million were ultimately the correct figure, that would work out to roughly \$25,000 in regulatory labor costs per agency store. Still, the cost of regulating an established set of stores could pale in comparison with the cost of licensing new ones. For example, the cost of handling appeals from applicants who did not succeed in obtaining licenses could be significant and could call for a design of the license application process likely to minimize appeals.

What Has It Cost the Washington State Liquor Control Board So Far to Design, Create, and Implement a Commercial Marijuana System?

Colorado had a head start with legalization because it had already established a Medical Marijuana Enforcement Division within CDOR in 2010 (now called MED); Washington had to start from scratch. Although Washington, like Colorado, had a thriving medical market, no state agency in Washington regulated the production facilities and dispensaries. In addition, Colorado gave special preference to existing regulated medical-marijuana businesses to participate in the recreational market, in some part to help minimize regulatory costs to the agency.

Thus, it is not surprising that the rollout in Washington has been slower. The first retail marijuana stores opened in July 2014, and, as of January 12 2015, 111 retail stores had been licensed and 92 have reported sales (Simmons, 2015). More than 350 producer/processor licenses have been issued, and approximately 800 applications for marijuana producers and processors are waiting to be investigated (Simmons, 2015). It takes serious time and effort to rigorously evaluate these applications.

Table 7.9 presents information from the WSLCB about how much money it spent implementing I-502 from 2012 through fall 2014. The total cost so far is slightly more than \$9 million, with most of the costs coming from staff labor (\$5.1 million). This would include all of the time developing proposed regulations and meeting with stakeholders and the public about the

Table 7.9
Expected Washington State Liquor Control Board Expenditures on I-502,
2012 Through June 2015

Item	Amount (thousands of dollars)
Staffing	5,104
Consultant	818
Licensing software	858
Traceability system	875
Tax system	29
Miscellany (e.g., goods, services, training, travel)	1,488
Total	9,172

SOURCE: Simmons (2014).

new regulatory regime, as well as the time spent processing and distributing the licenses. The board also spent \$818,000 for analytic support (which included many authors of this report), \$858,000 for licensing software, \$875,000 for a traceability system, and about \$1.5 million on other items, such as training and travel. Note that these are the costs only to the WSLCB; they do not include efforts to develop prevention messaging or to arrest those participating in the black market for marijuana.

Costs of Regulation for Vermont

Vermont and other jurisdictions can learn from the innovation and growing pains suffered in Colorado and Washington (and potentially Alaska, Oregon, and Washington, D.C.), and we hope that this section helps regulators identify the key decisions they will need to consider. But even if new jurisdictions decide to closely emulate what is being implemented elsewhere, they would be fooling themselves if they did not think that it would take serious time and effort to implement something that would meet the standards put forth in the Cole memorandum.

If Vermont legalized marijuana and allowed it to be sold in retail stores, it is not hard to imagine a scenario in which the state could spend in the low to mid single-digit millions (e.g., approximately \$1 million for a tracking system, approximately \$1 million for prevention programming, and at least \$1 million to cover the cost of several people to administer the program, process applications, and inspect the growers, processors, retailers, and possibly testers). Costs would be larger if Vermont decided to build a testing facility or create a mobile testing unit. There would also be a cost to the Vermont Drug Task Force and other law enforcement and criminal justice agencies if serious efforts were made to drive out black-market production while the new industry gets set up.

In addition to this (very rough) quantification, three conceptual points are worth making. First, Vermont could end up spending more to regulate a legal marijuana market than it now spends enforcing marijuana prohibition (because Vermont has already decriminalized possession). Second, marijuana tax revenues should be able to cover these costs on an ongoing basis. Third, legalization will require considerable effort and expenditure *before* any stores have even opened and, hence, tax revenues begin to flow; i.e., there is a temporal mismatch between the timing of costs and the generation of offsetting revenues.

Concluding Thoughts

Recall that Chapter Four described a dozen different architectures governing what sorts of entities would be allowed to supply marijuana legally. The discussion in this chapter is most pertinent to situations in which the producers are professionally run regulated operations, whether those operations are owned by the state, nonprofit organizations, socially responsible businesses, or profit-maximizing firms.

We stressed repeatedly the enormous uncertainty surrounding estimates of legalization's effects on state revenues and costs. Nonetheless, it is possible to place outcomes in four categories in terms of their order of magnitude—meaning the number of zeroes that follow the first digit of the estimate. That is, we might not be able to predict whether an outcome will be \$3 million or \$9 million per year, but there is some value in clarifying that the figure is likely to be in the millions, not in the thousands or billions. Those four categories are as follows:

- less than \$1 million per year: current cost of enforcing marijuana prohibition in Vermont against those 21 and older
- low to middle single-digit millions: the one-time costs of creating a regulatory system for legal marijuana in Vermont and the ongoing annual cost of maintaining that system based on what it costs to regulate liquor in the state
- double-digit millions: potential annual tax revenue from Vermont residents once the black market is largely eliminated if neighboring states do not legalize with a lower tax rate
- triple-digit millions: potential annual tax revenue from non-Vermont residents if no other state in the Northeast legalizes and the federal government does not intervene.

Allowing non-Vermont residents to participate in the legal marijuana market would have large implications for revenues and regulatory costs. It could also be a red flag for DOJ, which, according to the Cole memo, seeks to prevent “diversion of marijuana from states where it is legal under state law in some form to other states.”

Revenues and costs could be quite different under other supply architectures. If Vermont chose only to allow home production, there would be little revenue to the state (aside from tax revenues from hydroponic shops and other gardening stores); however, there would also be few regulatory costs. Allowing small-scale, resident-only collectives might generate some revenue if transactions were taxed, and there would likely be some regulatory burden if the state were diligent about making sure that only members are being supplied. But both revenues and costs would likely be considerably smaller than in the scenarios that were the focus of this chapter. At the far end of the spectrum (recall Figure 4.1 in Chapter Four), the state could simply eliminate its marijuana laws and let the market blossom with no regulation beyond those that apply to all articles of commerce. That would still generate taxes, e.g., from sales taxes, from income taxes on now-legal wages, and from marijuana tourists buying restaurant meals and renting hotel rooms, while not devoting any money to regulating the drug *per se*.

However, any of these legalization options, including even this repeal-without-regulation scenario, could indirectly affect public budgets in myriad other ways. Legalization could affect the number of DUI arrests and accidents, hospitalizations, and dependence requiring publicly funded treatment; however, we are reluctant to attempt even a rough quantification of these costs. With respect to the net effect on DUI and hospitalizations, much will depend on how marijuana legalization influences the use of alcohol and other drugs, and, as Chapter Three explains, it is not even clear whether the effects would be positive or negative. One might expect tobacco smoking to go up, but that generates both additional tax revenue and additional health care costs borne by the state. Likewise, even though Vermont has already decriminalized, some marijuana treatment today might still be driven by criminal justice or other referrals of people with no genuine need for treatment. That would presumably disappear after legalization, at least for adults, and it is not clear how much that might offset some of the increase in the true need for treatment services. Effects on Vermont’s employment climate and ability to woo employers to locate in the state are even harder to gauge.

So it is important to stress that this section does not constitute a complete analysis of the net impact that legalization could have on the state’s fiscal position. Nonetheless, we hope that it provides a framework for thinking clearly about the more important of the direct effects.

Closing Remarks

Introduction

The decision about whether to make marijuana available for lawful purchase without a medical recommendation—and, if so, under what conditions—involves multiple and possibly competing considerations, including the extent of illicit transactions and the costs of efforts to suppress them; the prevalence of substance-use disorders and the troubles they bring; personal liberty and the benefits of marijuana consumption for the majority of users who do not suffer from substance-use disorders; economic opportunity for lawful marijuana vendors; and tax revenue on the one hand versus administrative effort and expense on the other for the state government and local governments. No one policy choice will be superior on all dimensions; there will be trade-offs, and differences of opinion about how much weight to place on the various outcomes will lead to disagreements about which policy to choose.

Moreover, those decisions must be made in a fog of uncertainties. There is no recipe for marijuana legalization, nor are there working models of established fully legal marijuana markets. It must be expected that any initial set of choices will need to be reconsidered in the light of experience, new knowledge, and changing conditions, including federal policy and the policies in neighboring states. That puts a premium on flexibility; the policy should not be frozen into its initial design.

The principal message of this report is that legalization of marijuana is not simply a binary choice between legalizing the production, sale, and possession of the drug on the one hand and continuing existing prohibitions on the other. Legalization encompasses a wide range of possible regimes, distinguished along at least four dimensions: the kinds of organizations that are allowed to provide the drug, the regulations under which those organizations operate, the nature of the products that can be distributed, and price. These choices could have profound consequences for the outcomes in terms of health and social well-being, as well as job creation and tax revenue.

Less is known about the consequences of specific choices than a decisionmaker would want to know. For example, there are only crude estimates of how much marijuana consumption will increase in response to the change in legal status and the probable long-run decline in the cost to the consumer per hour of intoxication; even more importantly, there is little understanding as to what kinds of users will increase their consumption most and how that will affect their health, well-being, and social functioning.

This report seeks to inform choices facing the State of Vermont, but we are aware that other jurisdictions are contemplating similar choices. Below we observe that the implications

of some design choices could be different for a state with Vermont's geography, population, and current policies, than for a state with a different mix.

State-level marijuana reforms operate under the shadow of federal laws and federal decisions about enforcement. For ease of exposition, we mostly focus on a state's choices in isolation, but the reader should bear in mind that interstate relations and the federal prohibition on marijuana create an additional layer of uncertainty and complexity. The present set of DOJ memoranda on the matter are ambiguous, and different parties—a marijuana entrepreneur, a district's U.S. Attorney, or the directors of a bank—could have different expectations about how the state–federal issues will play out under those memos. Furthermore, all must bear in mind that, at any time, those memos could be replaced with other, potentially quite different policies.

Uncertainty

All important policy decisions are made under uncertainty. The uncertainty associated with the legalization decision is thus hardly novel; however, it is extreme. The approximate sizes of important parameters—in some cases, even whether their effects are positive or negative—remain unknown. For example, we believe that ending prohibition, even a weakly enforced prohibition, will increase demand for marijuana at least somewhat over and above the effect of potentially lower prices; i.e., the law still matters to some. Yet the only directly relevant data come from the experience of Dutch coffee shops 30 years ago, and those data are subject to interpretive uncertainty. Populations differ in their respect for the law, their willingness to take risks, and other factors. Projecting from the Netherlands in the 1980s to Vermont in 2015 is questionable. The indirect effects that marijuana legalization can have on the problematic use of other drugs—especially alcohol, nicotine, and opiates—could easily be more important than its direct effects on the use of marijuana itself. And yet it is not now possible to say with any confidence whether cheaper marijuana will lead, on balance, to more or less use of any one of those drugs. The data hint of substitution for the opiates, show substantially stronger evidence for complementarity with nicotine, and show no consensus at all regarding the direction that effects have on alcohol, but it would be unsurprising to see any of these judgments reversed by five years' experience.

Other uncertainties of first-order importance include federal policy (DOJ policies can change in an instant), whether the industry evolves toward high degrees of market concentration (a macrobrew brand-driven beer model as opposed to the winery model), product innovation (notably whether vaping, dabbing, and other concentrate-based forms win substantial market share at the expense of traditional smoked marijuana), and interactions with tobacco with respect to both demand (will simultaneous consumption of THC and nicotine become the norm, as in Europe) and supply (e.g., whether so-called Big Tobacco will enter the commercial marijuana industry).

Given all this uncertainty, it is important to consider both the timing and the reversibility of legalization options. Over time, there will be evaluations of other states' initiatives. Washington State has commissioned the well-respected Washington State Institute for Public Policy to do a broad evaluation. NIDA has issued grants for more academic studies of the consequences of legalization in both Colorado and Washington. Although a true evaluation ought to be done over at least five years to see how the industry begins to develop and fundamental

behaviors change in response to the new regime, by 2016, useful information will already be available.

If the evaluations are negative—for example, finding that the marijuana industry is developing in ways that conflict with health priorities and there are large increases in use of other substances that turn out to be complements to marijuana—Vermont might want to reverse a legalization decision. That is much easier to do if the drugs are not being provided by private enterprise. None of the other options (home-grow only, co-ops, state monopoly) is likely to generate major commercial interests that have the capacity to influence elections through large donations. There is a long history of industries being able to influence legislatures to protect their interests; avoiding such “regulatory capture,” at least until more uncertainties are resolved, could be a useful hedge against risk.

That does not imply that private enterprise should be rejected as an option. It is simply an argument to consider when making this choice.

A further complication is that policymaking is a dynamic process. The decision Vermont faces in 2015 is not a one-time-only, seize-it-or-lose-it opportunity. The uncertainties just described could be taken as an argument for delay or for initially taking only modest, reversible steps; however little we will know about the various options two years from now, it will be more than we know today. Unless the costs of prohibition—even after Vermont’s recent decriminalization and implementation of medical dispensaries—seem intolerably high, that might make waiting an attractive choice. On the other hand, acting decisively now could give Vermont a first-mover advantage in the competition with other states to host the industry. Moving soon would also give Vermont a chance to form its policy against a relatively blank background, with no substantial commercial or medical markets in neighboring states. That might not be true later. Moreover, Vermont could be the first state to create a commercial marijuana market through the normal legislative process rather than by ballot initiative; it could therefore pioneer policies too complex to present directly to the voters but potentially with better outcomes.

Weighing Policy Options

Many and diverse considerations come into play when designing a drug-control regime, but we think that it is helpful to identify a small subset stated at a sufficiently broad level of abstraction that they encompass many of the concerns readers might have. We have tried to articulate these goals such that they are *unidirectional*—goals that different people could weight differently but that few would oppose.¹

Although we list five possible goals, it is crucial to stress that they should *not* be viewed as necessarily being equally important. It would be invalid to reason from the observation that alternative A “beats” alternative B with respect to three of the five goals that it is better than alternative B. Readers are urged to resist that temptation and to dismiss the arguments of others who fail to do so.

¹ We have tried to state goals that, *ceteris paribus*, are maximums (everything else being equal, more is better than less) rather than optimums (just this much but no more and no less).

With that preamble, five possible goals for marijuana policies that few would outright oppose are as follows (numbers do not represent priority order; for reference purposes only):

1. Minimize harms to health and to economic, educational, and social functioning, especially those associated with marijuana use by adolescents.
2. Maximize state revenue.
3. Minimize administrative costs.
4. Minimize illicit-market activity, both within Vermont and across state lines.
5. Maximize adult personal liberty, consumer convenience, and the benefits of marijuana use for those who use it without developing a substance-use disorder.

Stark differences in how people weight the first and last goals have characterized the marijuana-legalization debate for decades (see MacCoun and Reuter, 2001, for an analysis of typical arguments). Those who view marijuana through the lens of responsible adult users could tend to focus on the last; those who focus on youth or daily or near-daily dependent users could tend to focus on the first.

Excitement about marijuana's potential for increasing state revenue rose to prominence fairly recently, in the California Proposition 19 debate just after the 2008 economic crisis. The discussions often extend beyond excise taxes to possible effects on job creation and economic development; however, the effects of legalization in Vermont on the latter are unclear.²

We state the fourth goal in terms of illicit-market activity, not in terms of crime and violence, for the simple reason that the black markets for marijuana are already much less implicated in drug-related crime and violence than the markets for other illegal substances are. Where the problem is already modest, the potential changes are also necessarily modest.

Of these five goals, minimizing administrative costs is the least often articulated, but recent experience has shown that legalization is considerably more complicated than a simple yes/no decision. We also suspect that it looms larger for state officials contemplating a new regime than for activists or ordinary citizens. It is tempting to merge it with the second goal (i.e., maximize *net* revenue), but some policy choices have distinct implications for revenue versus administrative burden.

We did not include a separate goal about minimizing the cost of drug law enforcement because these costs are likely covered by goals 1 (minimizing harm, which can include issues surrounding racial disparities in drug law enforcement), 3 (minimizing administrative costs), and 5 (maximizing personal liberty). In addition, the cost associated with enforcing marijuana prohibition in Vermont is already quite low.

An argument can be made for adding "maximize medical benefits of marijuana use," although, at this point, it is hard to say that few would outright oppose it. This cannot be subsumed into our existing goals, but any option that maximizes personal liberty will also tend to enable medical use of marijuana. Although Vermont has a restrictive medical-marijuana program, legalization could reduce the price of marijuana for patients, expand the number of products available, and increase availability for those who do not meet current eligibility

² A new industry would create legal jobs in Vermont, especially if Vermont ends up exporting marijuana. But, at least in the short run, there could be challenges for employers who need to comply with federal drug-free workplace rules and, even in the long run, who worry about effects on workforce productivity and on the traditional Vermont brand.

requirements. In addition, legalization could also reduce barriers and the stigma associated with conducting scientific research on the therapeutic benefits.

Deciding how much to weight each policy goal—e.g., whether personal liberty is more important than public health and safety—is a personal matter for every citizen. On the other hand, specifying how much any given policy option would advance each policy goal is, in principle, an analytic task, requiring some combination of expert judgment, strong and well-validated theory, and empirical evidence. We hope that we have provided a foundation for thinking about the various consequences of different policy options while being explicit about the uncertainties involved.

A summary of that foundation would include the following points:³

- Chapter Two: Vermont has high rates of marijuana use and low costs of prohibition; decriminalization decreased the number of marijuana-related criminal offenses by 80 percent, and, at the time we asked, those incarcerated for offenses related only to marijuana accounted for 0.15 percent of all people incarcerated pre- and posttrial (three out of 2,045).
- Chapter Three: The harms of marijuana use are diffuse, debated, and more serious for behavioral and mental than physical health. With the exception of impaired driving, they are also borne mostly by the user, not third parties. Legalization's indirect effects via changes in the use of other substances could outweigh the importance of the marijuana-related outcomes themselves.
- Chapter Four: A broad spectrum of policy architectures is available to determine who produces and supplies marijuana. The typical framing of the debate, as choosing between prohibition and a regulated for-profit industry (commercial alcohol model), skips over many intermediate options, such as entrusting production to co-ops, nonprofits, public benefit corporations, or the state itself.
- Chapter Five: Taxing marijuana is more complicated than taxing alcohol. Over time, a for-profit marijuana industry is likely to gain strength, to push pretax prices down, and to evolve in unforeseeable ways, frustrating even the most-carefully thought-out tax laws. There are multiple alternative bases for taxation (e.g., value, weight, THC content) with substantially different pros and cons.
- Chapter Six: Many aspects of legalized marijuana can be regulated, and important lessons can be drawn from experience trying to regulate the alcohol and tobacco industries. Particularly important choices include the types of products sold, types of establishments that can sell these products, and whether nonresidents will be allowed to purchase marijuana in Vermont.
- Chapter Seven: A legalization plan designed to produce taxes could eventually net tens of millions in annual tax revenues from Vermonters, but interplay with other states' users and markets looms large.

Final Thoughts for Vermont

What is best for Vermont depends on what neighboring states decide to do. That, in turn, is likely to depend on what Vermont decides. If Vermont legalized private sales with a primary

³ The executive summary provides a richer summary of the document.

goal of raising public revenues, it could generate a competing response from at least some of its neighbors. That was the pattern of lottery legalization; one state in a region would create a state lottery, attracting sales from neighboring states, which would then themselves create state lotteries. Even with a restriction on marijuana sales to Vermont residents, there would inevitably be improved access and probably lower prices for visitors from other states.

For purposes of making decisions, Vermont would be well advised to assume that legalization, at least a relatively permissive version, could trigger *over time* a similar response from neighbors. The qualification *over time* is important because there could be a period of some years before these competitive responses occur, as happened with casinos in the Northeast. For all the angst about Atlantic City casinos shutting down in 2014 because of growing competition in New York and Pennsylvania, the state enjoyed a 30-year period in which casinos were a major source of state revenues and jobs. Likely, any regional first-mover advantage for Vermont if it were to legalize marijuana would last less than 30 years, but it might persist long enough to generate a substantial amount of revenues in the meantime. Although emphasizing the importance of this consideration, we also recognize how difficult it is to assess the speed with which neighbors, such as Massachusetts, might respond.

Vermont's situation differs in important ways from that of other states in different settings. Colorado did not have to worry too much about attracting large numbers of near neighbors; it is relatively isolated, at least from major U.S. cities. Vermont, on the other hand, has 40 times the number of its own marijuana users living within 200 miles of its borders. This fact should feature prominently in discussions about the future of marijuana policy in Vermont.

Evidence Concerning Substitution and Complementarity

This appendix reviews evidence from the literature concerning whether marijuana is a substitute or a complement for (1) alcohol, (2) tobacco, (3), opiates, or (4) other illegal drugs. It supports the corresponding discussion in Chapter Three.

Three general notes are in order before proceeding to the substance-specific reviews. First, the extent to which falling marijuana prices tend to increase marijuana use, or rising prices decrease use, is captured in what is called the own-elasticity of demand, meaning the percentage decrease in use that goes along with a 1-percent increase in price. (The own-elasticity is almost always negative; higher prices induce lower use.)

Spillover effects on other substances involve cross-elasticity of demand, meaning how much the use of product B changes when the price of product A increases by 1 percent. The cross-elasticity can be positive or negative. When it is positive (higher prices of marijuana increase use of the other drug), the two substances are referred to as substitutes. Conversely, when the cross-elasticity is negative, so increases in marijuana prices reduce use of the other substance, the other substance is referred to as a complement.

Second, the relationship does not have to be perfectly symmetrical; it can be stronger in one direction than in the other. So it makes sense to give more weight to studies that evaluate the effects of a change in the supply of marijuana on the use of another substance than on studies that look at changes in the opposite direction (e.g., how changing alcohol taxes affects marijuana use), though the latter can offer some circumstantial evidence.

Finally, neuroscience could eventually clarify a physiological basis for causal dimensions of the associations between cannabis and other substances. For example, it is believed that THC not only interacts with the brain's reward processes directly, by itself being reinforcing, but also modulates the rewarding effects of other drugs and of food (Solinas, Goldberg, and Piomelli, 2008). Although identification of these underlying mechanisms might help explain how one substance—THC—could influence consumption of a wide range of other substances, we do not think that the neuroscience literature yet provides actionable insights relevant to the policy decision Vermont faces, so we attempted to be comprehensive in our review only of the econometric and epidemiological literatures.

Evidence Concerning Alcohol

A moderately large economics literature explores whether alcohol and marijuana are complements or substitutes, but it has not reached consensus. Although the studies and data have

improved over time, at each point in time, the weight of evidence pointing in either direction has remained roughly balanced.

Some early studies examined the effects of marijuana decriminalization but also factored in variation in the minimum legal drinking age (MLDA) and state alcohol taxes. Two using data from the Monitoring the Future study on high school students found evidence that marijuana and alcohol were substitutes. DiNardo and Lemieux (2001) found that raising the MLDA appeared to increase marijuana use, and Chaloupka and Laixuthai (1997) found that decriminalizing marijuana reduced alcohol use. Two other studies reached the opposite conclusion, finding evidence of complementarity using data from the U.S. household survey—in particular, that higher alcohol prices lead to lower rates of marijuana use (Farrelly, Bray, Zarkin, Wendling, and Pacula, 1999; Saffer and Chaloupka, 1999a).

Two other of these early studies reached ambiguous conclusions. The Thies (1993) analysis of data from the National Longitudinal Survey of Youth (NLSY) found that marijuana decriminalization was associated with greater alcohol participation rates, which might suggest a complementary relationship, but there was no effect on heavy alcohol use and no effect on marijuana use, which makes the effect on alcohol use suspect. Cameron and Williams (2001) found substitution with respect to changes in price, but decriminalization was associated with greater use of alcohol, which would be consistent with complementarity.

A subsequent wave of studies sought to improve on the earlier studies' methods, notably by including evidence concerning marijuana's prices (not just its decriminalization status). These studies found evidence of complementarity (e.g., Pacula, 1998b; Pacula, Grossman, et al., 2001; J. Williams, Pacula, et al., 2004).

There next followed a spate—or perhaps a spat—of papers that looked at discontinuities in amounts of marijuana use just above versus just below the MLDA. Yörük and Yörük (2011) reported that turning 21 was associated with a sharp increase in marijuana use in NLSY data, suggesting that, when young adults started drinking more, they also increased their marijuana use. However, Crost and Guerrero (2012) found the opposite result in household survey data, and Crost and Rees (2013) criticized the Yörük and Yörük (2011) conclusions because they applied only when conditioning on there being some marijuana use since the last survey. When Crost and Rees reproduced the analysis with the full sample, they found no relationship between the MLDA and marijuana use. Then Yörük and Yörük (2013) reproduced the analysis and concluded that, although there was no relationship with parametric regression discontinuity models, there was one with certain nonparametric specifications.

The latest round of studies, this time using evidence from passage of medical-marijuana laws rather than decriminalization, has been similarly divided. D. Anderson, Hansen, and Rees (2013) found that, in the first year after medical-marijuana laws took effect, there were sharp declines in not only alcohol use but also in traffic fatalities involving alcohol. Pacula, Powell, et al. (2015) countered that medical-marijuana laws cannot be adequately modeled with a simple dichotomous variable because their provisions vary so much by state and that, when factoring in the characteristics of particular laws, the presence of brick-and-mortar medical dispensaries increased alcohol use and traffic fatalities, whereas strict rules about eligibility reduced them, both findings suggestive of complementarity. For more on this matter, see the point-counterpoint debate published in *Journal of Policy Analysis and Management* (D. Anderson and Rees, 2014a, 2014b; Pacula, Powell, et al., 2015; Pacula and Sevigny, 2014a).

Subsequently, Wen, Hockenberry, and Cummings (2014) found in an analysis of medical-marijuana laws in seven states that these laws led to an increase among adults in binge drinking

by 6 to 9 percent and in simultaneous use of alcohol and marijuana, as reported in household survey data, with no corresponding increase in underage drinking.

There are some other windows on the issue. For example, although it was not an academic study, Boyle (2014) reported that a Sanford C. Bernstein business analyst concluded that “legalization of medical marijuana has helped beer sales.”

Evidence Concerning Tobacco

The literature on interactions between marijuana and tobacco is large and diverse methodologically. For example, brain-imaging studies suggest that the endocannabinoid (eCB) system plays a role in nicotine addiction (Jansma et al., 2013), and the epidemiological literature has found very high rates of co-occurrence of marijuana and tobacco; Agrawal, Budney, and Lynskey (2012) provided an excellent review.

Traditionally, the focus was on tobacco serving as a gateway to marijuana use (e.g., Kandel, Yamaguchi, and Chen, 1992), but, as tobacco control has become more stringent and marijuana policy has become more liberal, there is now equal concern about reverse-gateway effects in which marijuana use leads to tobacco use. Although some studies observed that the correlations could still simply reflect variation across people in some common vulnerability to abuse all sorts of drugs (e.g., Lynskey, Fergusson, and Horwood, 1998), others are not so dismissive. For example, Patton et al. (2005) found that, in a large community sample followed over time, frequent cannabis use at baseline predicts subsequent initiation of tobacco use and progression to nicotine dependence, prompting their comment that, “If this effect is causal, it may be that a heightened risk of nicotine dependence is the most important health consequence of early frequent cannabis use” (p. 1518). Other studies finding suggestive evidence of reverse-gateway effects range from individual interviews and focus groups (e.g., Amos et al., 2004) up through longitudinal analyses of large data sets, such as the National Longitudinal Study of Adolescent Health (Timberlake et al., 2007).

Causality is as hard to ascertain with reverse-gateway as with forward-gateway associations, so there have been efforts to investigate this possibility with animal studies that allow for randomization and manipulation of the THC exposure variables. For example, Panlilio et al. (2013) found that, when rats were exposed to THC for three days, 94 percent subsequently self-administered nicotine, whereas only 64 percent of control rats did so. Furthermore, when the “price” of nicotine was increased (meaning rats had to work harder to get the self-administered nicotine), the THC-exposed rats were more willing than control rats to persist in self-administration.

Likewise, there has been considerable interest in twin studies, in which one twin initiated cannabis use and the other did not. The twin studies show that both tobacco and cannabis use are heritable to an important degree, and there could even be a common heritable basis for both, but there are suggestions that genetic factors might not be the only mechanism driving the co-occurrence (Agrawal, Silberg, et al., 2010). For example, Agrawal, Madden, et al. (2008) found that twins who smoked cannabis were at substantially elevated risk of both transitioning from abstinence to regular (tobacco) smoking and from regular smoking to nicotine dependence. Likewise, Korhonen et al. (2010) found, in a study of Finnish twins, that cigarette smoking is predictive of subsequent initiation into use of cannabis and other illegal drugs. Agrawal, Silberg, et al. (2010) found evidence suggestive of causality in both directions, with

cannabis initiation potentially contributing (causally) to tobacco initiation in adolescence and then, after tobacco use has expanded to nicotine dependence, that regular cigarette use could influence cannabis use in young adulthood.

This segues into another potential causal pathway, which pertains to cessation not initiation—specifically, that the use of either marijuana or tobacco interferes with the ability to quit use of the other substance. For example, D. Ford, Vu, and Anthony (2002) found that marijuana users who smoked tobacco were less successful at quitting tobacco use than tobacco smokers who did not also use marijuana were.¹ Haney et al. (2013) found that cigarette smoking increases the risk of relapse back into marijuana use, and Ream et al. (2008) found that tobacco smoking exacerbates the symptoms of cannabis dependence. However, not all studies in this genre found such effects (see, e.g., Humfleet et al., 1999), and some found them in only in one direction not both (e.g., Peters, Budney, and Carroll, 2012).

The literature that speaks most directly to the question of interest here is the economics literature assessing how changes in the price or supply of one of these drugs (marijuana or tobacco) affects use of the other. That literature is nearly unanimous in finding that the substances are complements.

The principal exception is Goel (2009), who observed that, in cross-sectional data for the United States, locations with high tobacco prices also tended to have higher rates of use of illegal drugs, including cannabis. However, cross-sectional analyses are not strong at teasing out causal relationships; it would not be hard to imagine third variables causing both, e.g., liberal states might both enact higher tobacco taxes and be more tolerant of illegal drug use.

The other studies of this genre conclude that marijuana and tobacco are complements (Chaloupka, Pacula, et al., 1999; Farrelly, Bray, Zarkin, Wendling, and Pacula, 1999; Farrelly, Bray, Zarkin, and Wendling, 2001; Cameron and Williams, 2001), and, when Clements, Lan, and Zhao (2010) reviewed this literature to inform their simulation studies, they concluded that it supports the belief that marijuana and tobacco are complements.

One of the few studies that might give pause to this conclusion is the Kelly et al. (1990) experimental manipulation with eight people with a history of smoking both marijuana and tobacco in a ten- to 15-day residential study. Participants were given joints of varying potency, or placebos, and access to tobacco cigarettes. Active marijuana smoking decreased the number of instances of tobacco smoking. However, in a broadly similar study by Nemeth-Coslett et al. (1986), marijuana smoking had no significant effect on tobacco smoking, and, even if marijuana and tobacco were substitutes hour by hour, they could still be complements over longer time spans.

As a final point, marijuana legalization could also increase tobacco use not only because of demand-side complementarity but also because of strategic intervention by tobacco firms. Informed by their analysis of tobacco industry documents from the 1970s, when marijuana legalization was last on the table, Barry, Hiilamo, and Glantz (2014) worried that the tobacco industry is waiting to pounce on this opportunity. Given that combining tobacco and cannabis into a single cigarette is common in Europe, contemplating the strategic response of tobacco firms would seem to have a place in any estimation of how marijuana legalization might affect tobacco use.

¹ Indeed, they suggest, “Difficulty in tobacco cessation might be considered one of the most important adverse effects of marijuana use” (p. 243).

Evidence Concerning Opiates

Vermont has a particular concern with opiate abuse. Opiates are used for a range of reasons, but one is pain management. One scenario of particular interest to Vermont is that legalization might lead people to substitute marijuana for opiates in medically supervised and unsupervised management of pain.

The primary reason for optimism in this regard is a recent *Journal of the American Medical Association* paper by Bachhuber et al. (2014). They conducted a panel data analysis at the state level over time, from 1999 to 2010, and concluded that states with medical-marijuana laws in effect had 25-percent lower average rates of mortality due to opioid overdose. There are some reasons for caution with this study. For one, states' rates of reporting of specific substances in National Vital Statistics System (NVSS) data on drug-related deaths are highly variable for some years (Warner et al., 2013).

Medical-marijuana programs could reduce opioid-related deaths and addiction to opioids for at least two reasons. One is that opioids and cannabinoids are complementary ways of alleviating pain, so access to medical marijuana allows for successful management of pain with a lower, safer dose of opioids. The Abrams, Couey, et al. (2011) clinical study with 21 people supported that possibility, although the pathways are not independent. THC's analgesic effects are reduced in mice made dependent on morphine as compared with controls; conversely, the analgesic effects of morphine are attenuated in mice that are first made tolerant to THC (Thorat and Bhargava, 1994).

A second possibility is that the availability of medical marijuana might reduce the recreational use of (diverted) prescription opioids. (A significant proportion of those who die of prescription-opiate abuse are not themselves the ones who suffer from pain but rather recreationally use prescription opiates that were diverted to the black market.) This could happen because of demand-side substitution if users substitute recreational use of marijuana for recreational use of more-dangerous opioids (Hayes and Brown, 2014). It could also happen on the demand side if greater availability of medical marijuana shrinks the prescription-opiate market and thereby shrinks diversion of medical opiates into the recreational market.

Even if we take Bachhuber et al. (2014) at face value, it is not clear what it says about how legalization might affect opioid deaths in Vermont. The Bachhuber et al. study measured the effects of implementing a medical-cannabis law, which Vermont has already done, so it might already be receiving any benefit of this 25-percent reduction, and legalization would not necessarily have any additional effect. Clearly, more research is needed, in Vermont and in other states.

Evidence Concerning Other Illegal Drugs

Somewhat confusingly, the question of whether marijuana is a complement or a substitute for hard drugs is conceptually distinct from the question of whether marijuana is a gateway to hard-drug use. Unfortunately, in terms of quantitative estimates of the extent to which marijuana is a complement or substitute for other illegal drugs, the literature is quite thin.

Model (1993) found evidence of substitution inasmuch as ED mentions of other drugs fell in states that decriminalized marijuana relative to those that did not. Saffer and Chaloupka (1999b), by contrast, found primarily complementarity in an analysis of household survey data

that included the prices of alcohol, cocaine, and heroin, as well as decriminalization of marijuana, and Chaloupka, Grossman, and Tauras (1999) found that marijuana and cocaine are complements in data on youth from the Monitoring the Future survey. Rhodes et al. (2001) found that marijuana use by arrestees in the Drug Use Forecasting (DUF) program tends to fall when cocaine and heroin prices rise, although the authors note that complementarity is just one of several possible interpretations, and they found little effect of marijuana prices on cocaine use. Jofre-Bonet and Petry (2008) asked 81 heroin and cocaine addicts about hypothetical purchasing patterns under various price conditions. Their analysis suggested that, for heroin addicts, marijuana was a complement for heroin but a substitute for cocaine, while, for cocaine addicts, marijuana was a substitute for both cocaine and heroin.

Overall, this literature is simply insufficient to support strong statements about whether, on net, marijuana is a complement or a substitute for other illegal drugs.

Business Deductions and U.S. Code Title 26 Section 280E

An obscure Vermont tax law denies *some* tax deductions *only* to federally illegal drug businesses—in lock step with the federal government. A legal marijuana industry will likely want to change this law.

This is how the Vermont law works. Vermont, like most states, does not try to invent an income tax from scratch. Instead, Vermont conforms to the federal income tax: It follows the federal tax code word for word, except where the state legislature specifically and explicitly says not to (32 V.S.A. 5910). This federal conformity usually simplifies tax filing because taxpayers can start with the federal tax return and then turn to the state return with most of the work done.

For marijuana, Vermont happens to conform to an unusual federal rule: Sellers of federally illegal drugs can deduct only cost of goods sold¹—amounts paid to produce or buy inventory. (To get technical, Vermont conforms to federal tax code, 26 U.S.C. § 280E, which we explain next.)

U.S. Code Title 26 Section 280E came into the federal tax code in 1982, just after the U.S. Tax Court allowed a drug dealer to deduct all his business expenses. Congress did not like that result and amended the federal tax code to say that drug sellers can deduct *only* cost of goods sold—that is, what the taxpayer paid for the product—nothing else. That is the rule of Section 280E. Because of conformity, Vermont has the same rule. Because marijuana is still a federally illegal drug, Section 280E and Vermont’s conforming law treat it harshly.

Section 280E applies to any company in any stage of the marijuana business and works this way: Cost of goods sold, which is deductible, means only the cost of the product. So, many expenses of *growing* are deductible. For a grower, deductible cost of goods sold includes all the expenses of growing a plant, such as water, rent for growing space, salaries of *growing* personnel, and even electricity in a hothouse.

¹ Cost of goods sold, which marijuana businesses can deduct, is not an easy number to determine. And Section 280E creates distortions in taxpayer behavior. Section 280E “encourages . . . sellers to designate, for tax purposes, only a small portion of their stores as having anything to do with selling pot” (Fahey, 2014). So vertically integrated businesses, for instance, set aside a separate tiny room for the actual sales transaction (nondeductible) and reserve other, more-expansive areas for growing or preparing the product (deductible). Or, in a big room never used for actual transactions, they might have temporarily idle salespeople become artists creating individual packages, because packaging (without logos) goes into deductible cost of goods sold. Then taxpayers then divide up rent on the basis of square footage: They try to deduct all the rent for the big, cost-of-goods-sold area and say that very little rent was paid for the tiny sales area, so very little rent is nondeductible. And they allocate the expense of employee salaries to cost of goods sold on the basis of time spent in the expansive area (deductible). Employees spend as little time as practical in the small sales room (nondeductible). Whether these plays achieve the results taxpayers seek is not clear.

Expenses of *selling* are not deductible. A retailer can deduct the entire amount it pays a grower for product: That is cost of goods sold. But a retailer cannot deduct advertising, rent and utilities for retail space, salaries of *selling* personnel, point-of-sale displays, and so on. Growers, similarly, cannot deduct advertising or salaries of sales people, but those amounts might tend to be relatively small.

It might be good policy that marijuana businesses cannot deduct marijuana selling costs, such as costs for advertising, marketing, point-of-sale displays, and sales personnel—on their federal and Vermont income-tax returns. Governments and parents worry about advertising and marketing of tobacco and alcohol. Marijuana advertising is worrisome, too. Maybe advertising cannot be prohibited because of constitutional free-speech doctrine. But *tax deductions* for advertising are not protected by the U.S. Constitution.² Tax deductions are a legislative gift (Speiser and Outterson, 2012). So Section 280E *slows* advertising and marketing that the law might not be able to stop. That is, Vermont's conformity to Section 280E could keep a useful brake on marketing of marijuana—and on the marijuana industry generally.

At the same time, Section 280E denies deductions for permits, taxes, license fees, and other expenses that seem unobjectionable. That denial has no particular rationale—other than to raise revenue from a single industry, like the rationale for an excise tax. But that could be rationale enough. An *income-tax* penalty will be collected only from marijuana companies that do relatively well. But *excise* taxes apply even to companies that go bankrupt. If the choice of supply architecture (see Chapter Four) does not protect companies from failure, many companies might never show taxable profits, even with Section 280E boosting taxable incomes for all players. Ordinarily, new businesses fail more often than incumbent businesses, and, very generally, new industries are riskier than established industries. An ability-to-pay rationale tends to support the income tax as a revenue source. Section 280E might burden some companies that are not quite profitable, but it does not burden the very weakest companies.

So the state legislature's two extreme options are (1) repeal Section 280E conformity or (2) keep it. (When Colorado legalized marijuana, it quickly repealed state conformity with Section 280E. Colorado could not, of course, change federal treatment for its taxpayers. Washington did not face the issue: It has no state income tax.) Or the legislature could try to find a middle ground that would lose revenue but lose less than full repeal of Section 280E conformity would.

For example, Vermont could allow marijuana businesses to deduct, in addition to cost of goods sold, only listed and limited expenses, such as state license fees and taxes. This approach would keep advertising and marketing nondeductible. But trying to fine-tune further revisions to the state version of Section 280E might be difficult. Beyond the clear cases of amounts paid to the state and localities, attorneys and accountants might argue that fees paid to them should be deductible. But what if those professionals in fact provide general business advice—including marketing advice?³

² See *Graham v. Commissioner*, 83 T.C. 575, 581 (1984), cited in *Graham v. Commissioner*, 822 F.2d 844 (9th Cir. 1987). The legislature does not have to allow any deduction for any advertising or for anything, and it can single out industries for benefits, such as property-specific accelerated depreciation deductions, or burdens, such as Section 280E. Indeed, expenses for much advertising, as an economic matter, ought to be amortized—spread over a number of years—rather than deducted, because some images and jingles linger in customers' minds for years and years. So they are associated with income produced over long periods.

³ Other tinkering with the deduction for nontax and nondrug policy reasons is possible. For instance, to boost job creation, the legislature could allow deductions for salaries of retail personnel—though such an allowance might shift market-

Another way of planning for Section 280E is for taxpayers to combine marijuana and nonmarijuana businesses under one roof. Then taxpayers try to allocate expenses to nonmarijuana businesses, such as, as occurred in one early case (*Californians Helping to Alleviate Med. Problems, Inc. v. Comm'r*, 128 T.C. 173, 2007), education, counseling, social activities, and massage. Auditing gets confusing. Gaming happens. The legislature could prevent that kind of gaming by requiring separation of marijuana businesses from other businesses.⁴

ing efforts into the hiring of attractive and persuasive salespeople who would boost consumption. In any event, we do not suggest tightening Section 280E by denying the deduction for cost of goods sold. That would create a gross-receipts tax, that is, a percentage of price tax for all businesses in the supply chain, which would create huge distortions. Vertically integrated companies, if allowed to exist, would obtain a huge competitive advantage because their gross receipts would be smaller than the combined gross receipts of, say, a separate grower and retailer. Even without vertical integration, a lengthy supply chain, one with many intermediaries, would bear more tax than a short supply chain, with few.

⁴ Requiring separation also prevents bundling, a danger if and only if taxes are ad valorem, as described in Chapter Five.

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