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MARIJUANA TAXATION AND BLACK MARKET CROWD-OUT

by Geoff Lawrence and Spence Purnell

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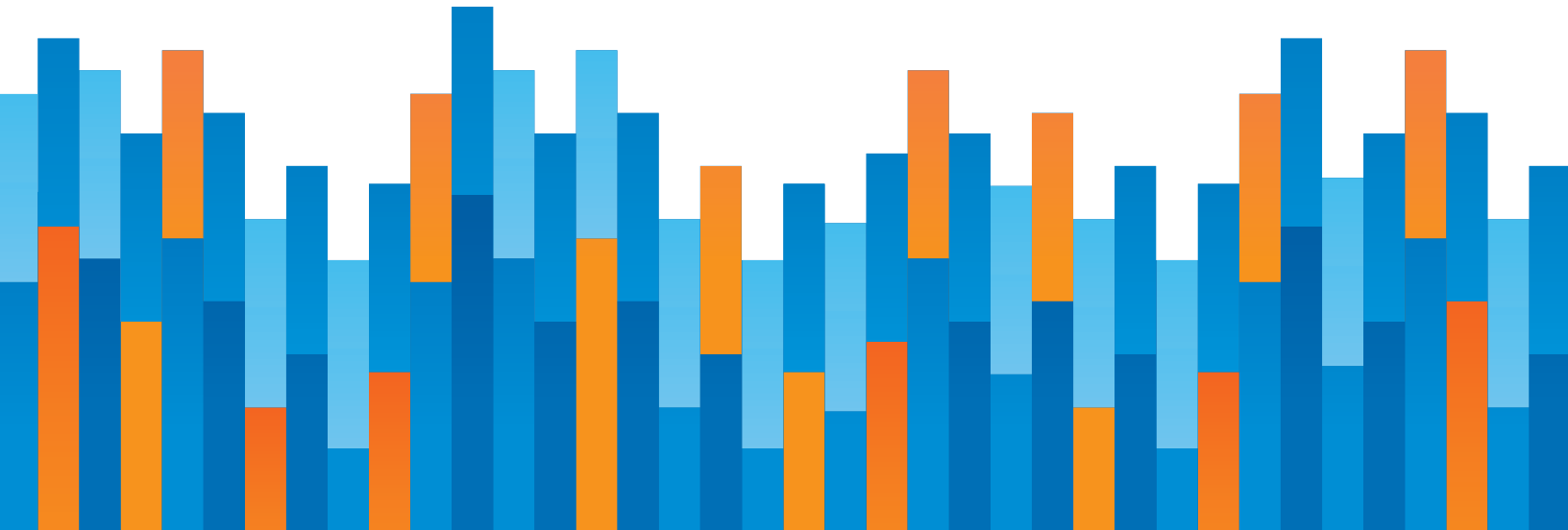

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EXECUTIVE SUMMARY

Many view marijuana legalization as a potential windfall for state budgets. Accordingly, states have sought to identify tax rates, licensing rates and other fees that extract the maximum revenue from the industry to fund unrelated government projects ranging from education to infrastructure improvement. But by raising the price of marijuana for consumers, these costs undermine a major competing purpose of legalization: elimination of the black market. As demonstrated by alcohol and cigarettes, excessive taxation can influence consumers' decisions to patronize the black market.

A key limitation to measuring the effectiveness of various tax regimes is the difficulty of estimating the volume of transactions that flee to the black market in legal states. Notably, the literature on consumer responsiveness to price in both legal and illegal markets indicates consumers in legal markets tend to be more price-sensitive than consumers in illegal markets. This observation carries important implications for the appropriate level of taxation.

Black markets will continue to operate so long as high taxes in the legal market create a large price disparity. Such high tax rates may not only sustain illicit market suppliers, but also result in few tax receipts as fewer and fewer transactions take place on the legal market. A central question is the degree to which marijuana excise taxes approach or exceed the risk premium necessary to compensate producers and consumers for their decision to participate in black market transactions. Policymakers looking to minimize illicit markets must determine the level of taxation that would discourage consumers and

producers alike from seeking black market alternatives, while still ensuring that tax rates cover the costs of regulatory enforcement.

Standard regression analyses cannot determine this tax rate with any certainty because data regarding the experience of existing legal marijuana markets are not yet sufficiently voluminous to produce statistically significant results. In addition, estimating the size of the black market is a highly speculative exercise, and so any data source used to approximate black market transaction volume may be spurious. Instead, we consider here a cost-of-production model to examine the supply-side effects of taxation.

Exclusive of the costs associated with regulatory compliance and taxes, black market and legal market producers may face substantially similar production costs. A cost-of-production model can be used to estimate the supply-side effects of taxation, informing the debate over the appropriate rates of marijuana taxation. Table ES1 provides cost estimates for each stage of producing marijuana flower in a 10,000 square-foot industrial warehouse as both an illegal and licensed operator.

Beyond these similar costs of production for licit and illicit marijuana, both consumers and producers of black market marijuana assume risk by engaging in black market transactions—they could be arrested, robbed by their counter-party, physically harmed, delivered tainted or adulterated products, or any number of possible negative outcomes. At least theoretically then, both consumers and producers should seek a risk premium for engaging in a black market transaction, particularly when there is an alternative legal market for similar products. These risk premiums should be expected to have different effects for consumers and producers. Consumers should expect to receive additional value for their money, which is to say they seek cheaper prices on the black market. Producers, on the other hand, should expect additional compensation in the form of a higher profit margin. In the absence of an alternative legal market, these countervailing tendencies likely negate each other to at least some degree.

TABLE ES1: ESTIMATED PRODUCTION COSTS FOR MARIJUANA

	Indoor Illegal Grow (Based on Caulkins 1500 ft^2 indoor model)	Indoor Legal Grow
Production Intensity (lbs/ft^2/year)	0.42	0.42
Square feet cultivated	10,000	10,000
Annual production (lbs)	4,200	4,200
Costs per pound – Cultivation		
Materials (exclusive of lighting)	$100	$100
Lighting	$75	$75
Labor	$40	$80**
Rent or Depreciation on Building	$100	$100
Costs per pound – Harvest		
Harvesting*	$8	$16**
Manicuring*	$130	$130
Drying/Curing*	$5	$10**
Overhead		
Amortization of License*** ($25,000/ Annual production)	N/A	$6
Compliance software licensing* ($500 month*12/Annual production)	N/A	$1.43
Insurance* ($25,000 annual policy/Annual production)	N/A	$6
Testing* ($200 per 5 lbs)	N/A	$40
Total Cost Per Pound Before Tax	**$458**	**$564.43**
Tax Expense		
Cultivation tax		Varies
Retail tax		Varies

*Cost estimates supplied by Lawrence. Manicuring services are available in California at a flat rate per pound by outside vendors. Other costs are estimated based on real-world experience.

**Labor-intensive processes are estimated to cost roughly double for a legal grow because of the time-intensity involved in tagging each plant with RFID tags, logging nutrients given, and logging measurements at various stages of the growing and harvesting cycles.

***Licensing costs vary significantly by jurisdiction. We believe a $25,000 cultivation license fairly represents the median cost for a 10,000 square foot grow.

However, when a legal market exists, such as in those states that have passed legalization statutes, producers face a trade-off between seeking a risk premium for participating in the black market or facing higher tax expense and regulatory costs in the legal market. All else equal, a producer should be expected to remain in the black market if their profit margin exceeds the profit margin that would be available in the legal market plus their required risk premium for participating in the black market. By contrast, a consumer should be expected to remain in the black market only if the cost savings available from lower prices on that market exceed the consumer's risk premium for participating in it.

Individuals have different levels of risk tolerance, which means the premiums required by producers and consumers to compensate for risky activity are subjective and vary even across similarly situated individuals. Further, levels of risk tolerance are not directly observable, so a dynamic, statistical modeling of risk tolerance is not possible. Therefore, we examine the tangible costs that marijuana producers likely face in both legal and illegal markets. We find production costs are higher in legal markets and attempt to quantify the effects of both regulatory compliance and taxation. Producers will select to operate in black markets if these costs combined exceed the risk premium sought by each producer. Similarly, consumers will seek illegal marijuana if the cost structure allows black market producers to sell at lower prices than are available on the legal market.

In determining a rate of marijuana taxation, policymakers should account for consumer choice to participate in the black market and ensure the tax environment induces consumers to transition to the legal market. Given that black markets will continue to operate in an atmosphere of high taxes on the legal market, policymakers should keep the legal market vibrant by basing marijuana tax rates on as accurate a forecast as possible of the state's cost of regulating the legal marijuana industry, rather than solely attempting to maximize revenue.

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PART 1

INTRODUCTION

As states transition from illegal to legal marijuana markets, they face a choice of possible tax regimes for the newly legal industry. Amassing tax revenue expressly motivates many lawmakers and voters to consider legalizing marijuana, but marijuana consumers can respond by purchasing legal marijuana subject to these taxes or purchasing other goods—including illegal marijuana that is not subject to taxation. This choice highlights a potentially competing objective of legalization: the eradication of black markets. Marijuana remains widely available through the black market supply chains that have supplied this product with increasing sophistication since passage of the federal Marijuana Tax Act in 1937. Tax rates and regulatory restrictions that elevate the price of legal marijuana significantly above the prices that prevail on black markets may both prolong the presence of black market suppliers and reduce government tax receipts as consumers flee to illegal marijuana markets.

Marijuana remains widely available through the black market supply chains that have supplied this product with increasing sophistication since passage of the federal Marijuana Tax Act in 1937.

This study examines these competing factors to forge a new, more effective model for determining marijuana tax rates. Economic theory suggests that tax structures should be simple, transparent and non-distortive. Generally, this indicates that a simple excise tax at the point of final sale may be the best method for taxing marijuana. We further review the existing research on consumer responsiveness to changes in price for other goods subject to special excise taxation like alcohol and cigarettes and then marijuana specifically. A key limitation to measuring the effectiveness of various tax regimes is the difficulty of estimating the volume of transactions that flee to the black market in legal states, but the literature on consumer responsiveness to price in both legal and illegal markets indicates consumers on legal markets tend to be more price-sensitive than consumers on illegal markets. This observation carries important implications for the appropriate level of taxation.

We conclude with a cost-of-production model to estimate the supply-side effects of taxation. Exclusive of costs associated with regulatory compliance, black market producers may face substantially similar production costs, and so a key question is the degree to which marijuana excise taxes approach or exceed the risk premium necessary to compensate producers and consumers for their decision to participate in black market transactions. This supply-side analysis should inform the debate over the appropriate rates of marijuana taxation.

PART 2

EXISTING APPROACHES TO STATE TAXATION OF MARIJUANA

Early-adopting states of marijuana legalization uniformly target tax revenue from excise taxes on the newly legal good, but differ over the structure, nature and rate of those excise taxes. Some states have levied taxes on the wholesale transfer or sale of marijuana from growers to processors or dispensaries. Others have taxed the retail sale of marijuana products to end-use consumers. A handful of states have done both. States have also experimented with assessing taxes as a percentage of sales, as a fixed tax based on weight, or based on other factors like the total canopy space used by growers. Since each approach offers tradeoffs, it's important to focus on efficiency, effectiveness, and sound and sustainable policy. It's therefore helpful to examine tax structures capable of achieving these goals.

The Tax Foundation identifies four hallmarks of sound tax policy: simplicity, transparency, neutrality and stability. The simplicity of a tax structure reduces costs of compliance and enforcement because taxpayers can easily understand and calculate their tax liabilities and government auditors can easily review and identify errors. Transparency helps businesses and their customers understand the tax code's impact on them and makes it easy for courts

Principles of Sound Tax Policy:

- Simplicity
- Transparency
- Neutrality
- Stability

to adjudicate disputes. Neutrality ensures that a tax structure itself does not bias the decisions made by businesses and consumers. Decisions made in the absence of tax-induced distortions reflect the underlying desires of market participants and therefore tend to maximize utility by allowing the market to directly answer what businesses and consumers want. To the extent that tax policy alters these decisions, it introduces an overall loss of social utility. Finally, stability in the tax code ensures long-term predictability, and is therefore critical to the financial planning and investment decisions of market participants.[1]

Wholesale marijuana taxes generally fail the tests of simplicity, transparency and neutrality. Wholesale taxes are assessed upon the original sale or transfer of marijuana from a grower to a processor or dispensary. As such, this cost is factored into the final price that dispensaries must charge to consumers, but the effect of this taxation is not transparent to consumers.

> *Wholesale marijuana taxes generally fail the tests of simplicity, transparency and neutrality.*

Wholesale taxes have also created distortions in the production cycle, leading marijuana businesses to pursue inefficient levels of vertical integration in order to avoid these taxes. Following a consolidation of marijuana taxes in the state of Washington, which switched in 2015 from assessing a 25% tax on gross receipts at each level of cultivation, processing and retail to a single retail excise tax of 37%, the amount of marijuana produced by non-vertically integrated firms increased by 42%. The Tax Foundation has identified this response as *prima facie* evidence that the original tax regime created incentives for firms to vertically integrate in order to avoid higher taxation.[2]

The simplicity of wholesale taxes varies by jurisdiction depending on how it is implemented. Alaska, California and Maine tax wholesale marijuana at a flat rate per unit of weight. This approach is simple to calculate and administer but also introduces additional

distortionary effects. For instance, the effective rate of taxation becomes higher for low-quality marijuana that sells for lower prices per pound, whereas the effective tax rate is lower for high-quality marijuana. This effect can lead marijuana businesses to stop offering low-quality products, typically identified by a lower concentration of the inebriating cannabinoid tetrahydrocannabinol (THC), in favor of highly potent marijuana that consumers may not otherwise prefer.

Other states with wholesale taxes have assessed these taxes as a percentage of the total sales price. While this approach may sound simple, it can lead firms to vertically integrate, as seen in Washington, to avoid tax liabilities by changing the nature of the transaction from a sale to an intracompany transfer.

Colorado and Nevada responded to this vertical integration incentive by modifying the price-based tax into an effective weight-based tax. The regulatory agencies in each of these states conduct periodic surveys of wholesale transactions and use the survey responses to calculate what the agencies consider a "fair-market value" of wholesale marijuana. Taxes are then assessed as a percentage of this bureaucratically established "fair-market value" multiplied by the gross weight of the transaction. Although the intent behind this approach is to remove the market distortions and gamesmanship of licensees vertically integrating to avoid taxation, it produces the same distortion in favor of high-potency marijuana as other weight-based excise taxes. Plus, it burdens administration by tax authorities, which is a cost in itself.

> *Retail excise taxes that are assessed as a fixed percentage of a transaction are easy to calculate and audit, and the total amount of tax embedded in the product is fully transparent to the ultimate consumer.*

Some local governments in California have instituted cultivation taxes that are assessed as a flat fee per square foot of canopy space under cultivation. Governments often assess such canopy taxes for the fixed, stable and predictable stream of tax revenue they produce and the relative ease of administering them. However, this also taxes producers for space they may not be able to use over the course of a year. In late 2016, when Northern California wildfires destroyed marijuana crops along with whole towns and villages, for instance,

cultivators found themselves stuck with tax bills they were unable to pay because they had produced no revenue.[3]

By contrast, a retail tax satisfies the major tenets of good tax policy without producing significant unintended consequences. Retail excise taxes that are assessed as a fixed percentage of a transaction are easy to calculate and audit, and the total amount of tax embedded in the product is fully transparent to the ultimate consumer. Perhaps most importantly, taxes assessed only at retail do not distort the investment decisions of businesses, leading to inefficient levels of vertical integration or related problems.

By their nature, excise taxes are intended to be non-neutral to a certain extent. The rationale of an excise tax is partly to dissuade consumers from engaging in a certain activity or to finance compensation for potential externalities these activities create.[4] A truly non-neutral form of taxation would subject marijuana sales only to the same general sales tax to which most other consumer transactions are subject. However, given that revenue generation has been an explicit goal of most legalization efforts and that similar products like alcohol or tobacco are generally subject to special excise taxes as well, a simple retail excise tax for marijuana appears to meet the goals of legalization in the most efficient manner.

TABLE 1: COMMON TYPES OF MARIJUANA EXCISE TAXES AND THEIR EFFECTS

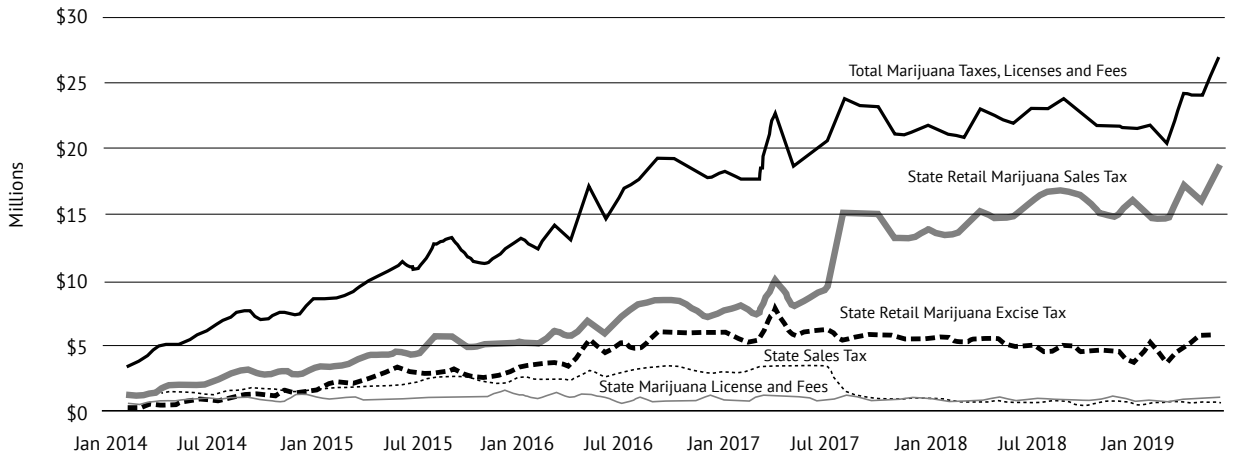
Types	Effects
Wholesale, price-based	Non-transparent to ultimate consumer; Leads to inefficient levels of vertical integration so licensees can avoid tax liabilities; Can be difficult to audit or administer when regulators must determine "fair market value"
Wholesale, weight-based	Non-transparent to ultimate consumer; Taxes lower potency marijuana at higher effective rates, leading to sales of more potent products
Canopy Tax	Stable and simple; May, however, tax cultivators for space they are unable to use throughout the course of a year; Non-transparent to ultimate consumer
Retail	Transparent, simple and stable; Meets most principles of sound tax policy except that all excise taxes are non-neutral by nature

2.1 MARIJUANA TAX REVENUES IN LEGAL STATES

States that have legalized marijuana for recreational use have generally been successful at increasing public revenues from the excise taxes assessed on marijuana products. One exception is California, where state revenues declined in the first year of recreational sales relative to the year previous, when marijuana was permitted for medical use only.[5] California has been a clear outlier among states with recreational markets in this regard and we dedicate special consideration to the possible reasons for this.

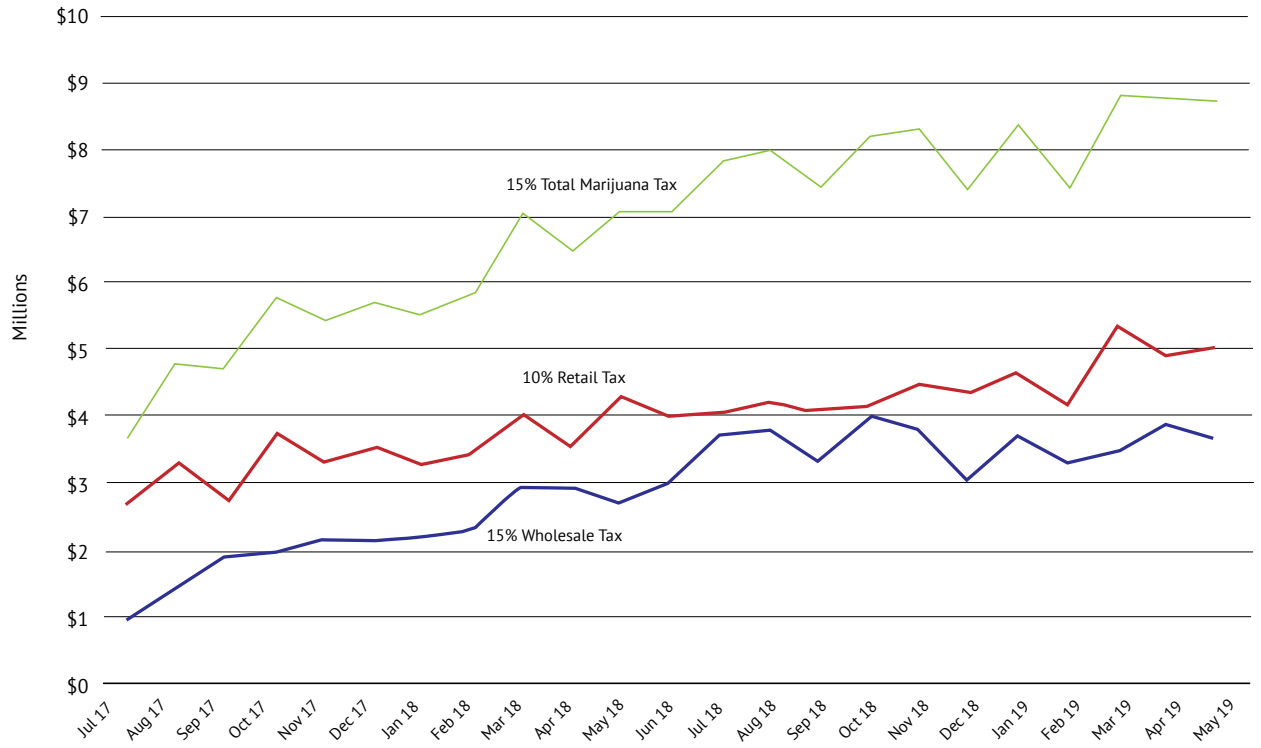
Not all states publish marijuana tax revenue data at a detailed level, but among states that do, the data show steady growth of these revenues over time as more licensees have opened shop and consumers have engaged in the legal market. The following charts illustrate the monthly growth of marijuana tax revenues in Colorado, Nevada and Oregon. Monthly tax, licensing and fee revenue in Colorado has grown from $5 million in January 2014 to more than $25 million in early 2019. In Nevada, monthly tax revenues amounted to less than $4 million in July 2017, but have grown to almost $9 million. Likewise, Oregon has seen its monthly tax revenues grow from just over $2 million in early 2016 to more than $10 million in early 2019.

FIGURE 1: STATE OF COLORADO MARIJUANA TAX REVENUE



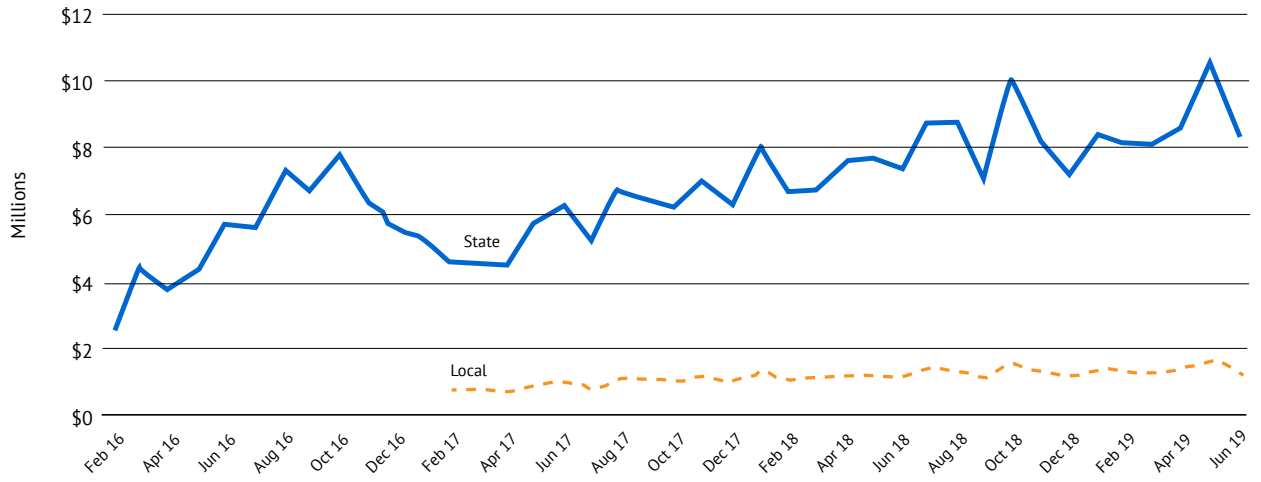
Source: Revenue collected monthly as posted in the Colorado state accounting system.
Prepared by Colorado Department of Revenue, Office of Research and Analysis, dior_ora@state.co.us. Published July 2019.

FIGURE 2: STATE OF NEVADA MARIJUANA EXCISE TAX REVENUES



Source data: Nevada Department of Taxation. "Marijuana Statistics and Reports." Accessed July 31, 2019 at: https://tax.nv.gov/Publications/Marijuana_Statistics_and_Reports/.

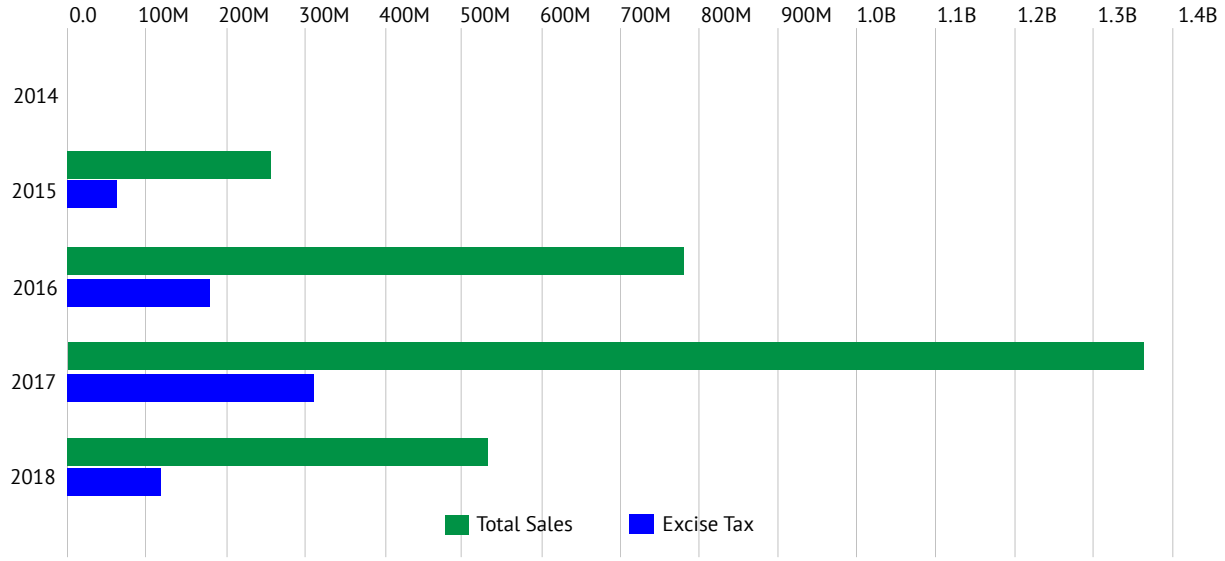
FIGURE 3: STATE OF OREGON MARIJUANA TAX RECEIPTS



Source: Oregon Department of Revenue
https://www.oregon.gov/DOR/programs/gov-research/Pages/research-marijuana.aspx

The state of Washington also makes marijuana tax revenue data available on its website on an annual basis, and Washington has experienced annual growth comparable to the states highlighted above, with revenues growing from about $65 million in 2015 to $315 million in 2017, the last full year for which data are available.

FIGURE 4: WASHINGTON STATE TOTAL SALES AND EXCISE TAX REVENUE



Source data: Washington State Liquor and Cannabis Control Board. "Marijuana Dashboard." Accessed July 31, 2019 at: https://data.lcb.wa.gov/stories/s/WSLCB-Marijuana-Dashboard/hbnp-ia6v/.

In total, the 11 states that permit marijuana for recreational use generated $1.1 billion in related tax revenue during fiscal year 2018.[6]

The case of California is curious because the total volume of legal sales actually declined during 2018, the first year in which recreational sales were permitted. According to market analytics firm BDS Analytics, total legal sales amounted to around $3 billion in 2017 when only medical marijuana was permitted, but fell to $2.5 billion in 2018.[7] Taxes on this volume of sales generated $345 million in 2018,[8] even though the nonpartisan Legislative Analyst's Office predicted in 2016 that Proposition 64, the ballot measure that ultimately authorized recreational sales within the state, could generate over $1 billion in annual tax revenue.[9] In response, Gov. Gavin Newsom's administration has reduced its revenue forecasts from marijuana taxation down to $288 million for fiscal year 2019 and $359 million for fiscal year 2020.[10]

Critics point to three main causes of the disappointing performance of California's new recreational market. First, at least two-thirds of California's local governments have banned all forms of marijuana businesses from their jurisdictions and about four-fifths have banned retail dispensaries where consumers could purchase legal marijuana.[11] This supply-side constraint has made legal marijuana difficult to access for many would-be legal consumers. As Hezekiah Allen, executive director of the California Growers' Association, says, "Most consumers in California probably have to drive 30 or 40 minutes compared to six months ago when they could have any product they wanted with the click of a button on an app. That market hasn't gone away."[12] In January 2019, California adopted final rules to implement Proposition 64 that explicitly permitted home deliveries, even to customers residing in jurisdictions that have banned marijuana businesses. This is expected to improve consumers' access to legal marijuana products, but California cities have responded with a lawsuit against the state, claiming that the provision violates the authority to regulate recreational marijuana given to local governments by Proposition 64.[13]

In 1996, California voters passed Proposition 215, which opened the first medical marijuana market in the nation.

Second, prior to the passage of Proposition 64, California already had an extensive and largely unregulated marijuana market. In 1996, California voters passed Proposition 215, which opened the first medical marijuana market in the nation. However, Proposition 215 established limited oversight for this market and allowed non-profit marijuana cooperatives to grow and distribute marijuana throughout the state. This structure may have also enshrined existing black market growers with new protections because they could seek status as a marijuana cooperative. Businesses that operated in this unregulated market never faced the compliance and licensing costs or the taxes faced by marijuana businesses newly licensed under Proposition 64. In December 2017, the California Department of Food and Agriculture estimated that Californians were already producing about 15.5 million pounds of marijuana annually, but only consuming 2.5 million pounds.[14] This glut of largely unregulated and untaxed marijuana supply would undoubtedly confound marijuana businesses licensed under Proposition 64. Further, the state government still has not been able to establish its track-and-trace system to enable regulators to ensure the production

and distribution of marijuana throughout the supply chain is restricted to licensed businesses.

Third, in the face of this large supply of mostly unregulated and untaxed marijuana, Proposition 64 levied a host of new taxes on newly licensed marijuana businesses and allowed local governments to do so as well. Legal recreational marijuana would become subject to a cultivation tax of $9.25 per ounce of harvested flower plus a 15% retail excise tax, a 7.5% base sales tax, and additional taxes levied by cities and counties that range from 7.75% to 9.75%. The result is a cumulative effective tax rate on legal marijuana of 45% or more, depending on location, provided the respective local government even allows licensed marijuana businesses at all.[15] Given the lower cost and greater availability of unlicensed marijuana in California, many consumers have simply chosen to stick with this alternative.[16]

2.2 FEDERAL TAX TREATMENT

In addition to excise taxes levied by state and local governments, legal marijuana businesses also face significant tax penalties at the federal level. Businesses that sell goods considered illegal by federal authorities are still required to pay taxes on the income. However, the standard rule of deductibility—that a deduction is allowed if an expense is both "ordinary and necessary" for the conduct of the business—does not apply to these businesses. Originally, the Internal Revenue Service argued that taxpayers trafficking in illegal goods must be taxed on all income without eligibility for deductions. However, the U.S. Tax Court ruled in *Edmondson vs. Commissioner* that a taxpayer who had sold cocaine and claimed an array of business deductions was entitled to them because they were not expressly excluded by the tax code. Congress responded to this ruling in 1982 with the passage of Section 280(E) of the Internal Revenue Code, which specifically excludes taxpayers trafficking in controlled substances from eligibility for deductions other than the cost of goods sold.

“In addition to excise taxes levied by state and local governments, legal marijuana businesses also face significant tax penalties at the federal level.”

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Essentially, Section 280(E) allows a marijuana dispensary to deduct only the costs of its wholesale purchases of marijuana products from growers and processors, as reflected on the associated invoices. The costs of employee compensation, utilities, legal, accounting, and other expenses may not be deducted by a marijuana dispensary, even though the "ordinary and necessary" standard makes these expenses deductible for other types of businesses. Marijuana growers and processors, by contrast, may deduct only the direct costs of producing their inventory, such as direct labor (trackable hours logged directly to given units of inventory and exclusive of management), power consumed specifically by lights or manufacturing equipment, packaging materials, depreciation of equipment, and rent or depreciation prorated to the amount of floor space used specifically for manufacture of specific inventory units. Other costs are not deductible.

The result is that marijuana businesses are taxed federally on amounts far in excess of their net income. For instance, if a marijuana dispensary is taxed as a corporation in the 21% tax bracket and operates at 40% gross margin but 10% net profit, the effect will be a federal tax penalty amounting to 6.3% of gross receipts. In other words, the federal penalty in excess of what a similarly situated business would pay is enough to eliminate 63% of net profits in this example.

TABLE 2: EXAMPLE INCOME STATEMENT

Gross Income	**100%**
Cost of Goods Sold	60%
Gross Margin	40%
Operating Expense	30%
Earnings Before Income Tax	10%
Income Tax Expense (21% * Gross Margin = 40%)	8.4%
Income Tax Penalty (Income Tax Expense – (Earnings Before Income Tax * 21%))	6.3%

*Income Tax Penalty is not a standard income statement line. It is a subcomponent of Income Tax Expense for marijuana companies shown separately here for demonstration purposes. Whereas Income Tax Expense is generally calculated as Earnings Before Income Tax times the applicable tax rates, the calculation for marijuana businesses is Gross Margin times the applicable tax rates.

As demonstrated by these hypothetical calculations, the federal tax penalty facing marijuana businesses may be several times larger than the total tax that a similarly situated business would pay. Furthermore, a marijuana business could operate in the red and still face significant federal tax penalties because the tax is based on gross margin rather than net income.

...the federal tax penalty facing marijuana businesses may be several times larger than the total tax that a similarly situated business would pay.

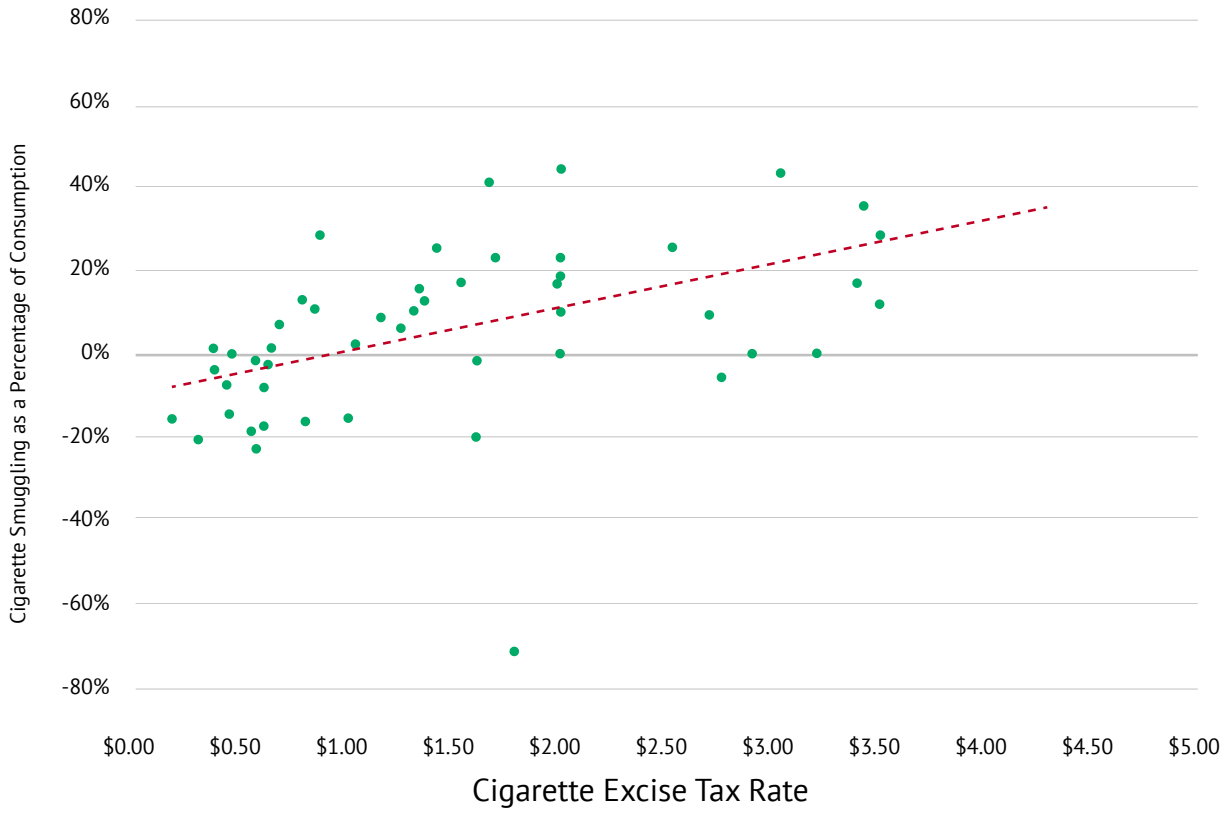
State and local policymakers must bear in mind this federal tax penalty when formulating tax policy for marijuana licensees. Just as marijuana businesses cannot deduct employee compensation and other "ordinary and necessary" expenses from their federal tax bill, they also cannot deduct the cost of state and local taxes and licensing fees. As a result, the tax burden facing marijuana companies can accumulate rapidly and they are forced to even pay taxes on taxes, since they are still taxed federally on income that was used to pay taxes assessed by state and local governments.

PART 3

PRICE ELASTICITY AND ILLEGAL MARKETS FOR GOODS SUBJECT TO SIN TAXES

Taxes on marijuana, just like those for alcohol and cigarettes, are special excise taxes on goods believed to impose social costs or other externalities. It is therefore useful to examine the literature on the price elasticity of these products. According to a Tax Foundation report, there is a causal relationship between high cigarette taxes and illegal smuggling. New York, with the highest cigarette taxes in the country at $5.85 per pack (including state and local taxes) also has the highest prevalence of illegal cigarettes, with illegal cigarettes comprising roughly 56.8% of all cigarettes smoked in the state. Since 2006, the tax rate has increased 190% while smuggling has increased 59%.[17] Other peer-reviewed research has confirmed this finding and concluded that in the Northeast, where taxes are generally the highest, roughly 30%-45% of all cigarettes have been illegally smuggled across state borders.[18]

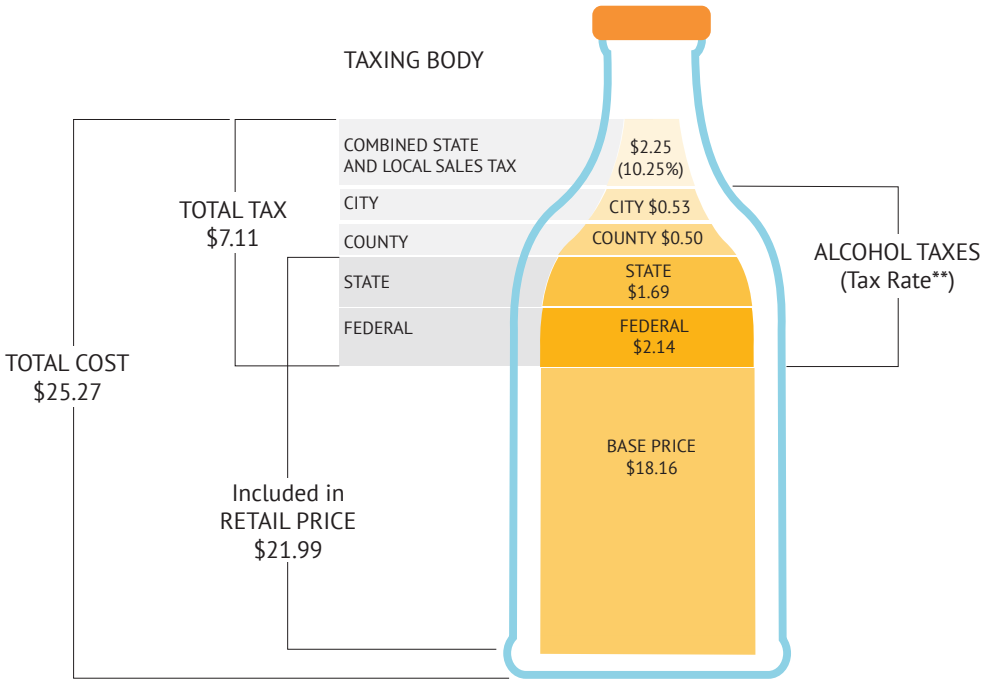
FIGURE 5: CIGARETTE SMUGGLING RISES WITH EXCISE TAX RATES: CIGARETTE SMUGGLING VS. CIGARETTE EXCISE TAX RATES, 2015



Source: Mackinac Center for Public Policy; Tax Foundation

Similarly, mounting evidence suggests that recent increases in excise taxes and regulatory burdens on alcohol have pushed consumers to purchase millions of dollars in illegal alcohol smuggled across state lines to avoid taxes.[19] Illinois, for example, taxes distilled spirits at $8.55 per gallon, whereas neighboring Indiana only taxes at $2.68 per gallon. Some counties and cities within Illinois levy additional taxes to create a combined tax rate of nearly 30%.[20] There is reasonable evidence to suggest these tax rates have not slowed consumer demand but simply diverted it toward illegal alternatives, including alcohol smuggled from states with less aggressive excise taxes. This activity has become so prevalent that the Illinois Legislature is significantly increasing the penalty for alcohol smuggling.[21] There is also evidence that this phenomenon is mimicked internationally, with some estimates suggesting that nearly 20% of global alcohol consumption is from illegal sources.[22] This evidence serves to show that taxes add costs that raise prices, and if these costs become too high some consumers will shift demand to illegal markets.

FIGURE 6: TAXES ON THE PURCHASE OF A BOTTLE OF ALCOHOL* IN CHICAGO TAX AMOUNT BY TAXING BODY



* The taxes set forth in this chart are for a bottle of spirits and are based on 25.39 ounces per 750 milliliter bottle.

** City, county, state and federal alcohol taxes are levied at a flat rate

Source: Chicago Municipal Code, Cook County Code of Ordinances, Alcohol and Tobacco Tax and Trade Bureau, Illinois Compiled Statutes, @illinoispolicy

3.1 PRICE ELASTICITY OF DEMAND FOR MARIJUANA

As with tobacco and alcohol, marijuana consumers in states that have legalized the commercial production and sales of marijuana choose between procuring marijuana on those taxed and regulated markets or on illicit markets that escape these taxes and regulation. Policymakers looking to minimize illicit markets must determine the level of taxation that would discourage consumers and producers alike from seeking black market alternatives. The answer to this question will depend on how sensitive consumers are to changes in the after-tax price of legal marijuana. Economists have a way of measuring consumers' price sensitivity called the price elasticity of demand. In essence, price elasticity measures the extent to which consumers' demand for a product varies in response to a 1% change in price.

While economists have been measuring the price elasticities of various goods and services for decades, the ability to do this for marijuana has historically been hampered by the lack of quality data to perform the analyses. Marijuana and its derivatives have been federally illegal substances since passage of the Controlled Substances Act in 1970 and, prior to that, were taxed at prohibitive levels under the Marihuana Tax Act of 1937. As such, nearly all marijuana transactions between 1937 and 2012 took place on an illegal or quasi-legal market, rendering transaction data unavailable.

Nonetheless, economists have held interest in learning about the marijuana market for decades and have developed some techniques for approximating consumers' price elasticity. The first known attempt was made by UCLA professors Charles Nisbet and Firouz Vakil, who anonymously surveyed their students to determine how their marijuana-buying habits might change at various price points. The professors concluded that the price elasticity of these students was somewhere between −0.40 and −1.51 depending on the form of their statistical model.[23] This means that for every 1% increase in price, students would be expected to purchase somewhere between 0.40% and 1.51% less marijuana.

In the time since that 1972 paper, other economists have made additional efforts. In a 2001 paper, researchers used data from the Drug Enforcement Agency (DEA) detailing the prices paid by undercover agents for illegal marijuana to develop price elasticity estimates ranging from −0.002 to −0.69.[24] Australian researchers used an Australian equivalent of this data set in 2010 to estimate price elasticities ranging from −0.586 to −0.66.[25] More recently, researchers have availed themselves of large numbers of anonymous, self-reported transaction data that have been aggregated on a website at www.priceofweed.com. In separate efforts, economists at the University of Nevada[26] and California State University at Northridge[27] used these data to calculate price elasticities in the range of −0.3 to −0.6 and −0.418, respectively.

> *These studies generally indicate any excise tax that raises the final price of marijuana will result in fewer purchases of marijuana, although purchases appear to fall by a smaller degree than the amount of the price increase.*
>
> Geoff Lawrence and Spence Purnell

These studies generally indicate any excise tax that raises the final price of marijuana will result in fewer purchases of marijuana, although purchases appear to fall by a smaller degree than the amount of the price increase. It is worth noting that price elasticities are a derivative function and are therefore valid over only a narrow range of the demand curve for a product. So a price increase of 60% might yield very different results than simply multiplying the effects of a 1% price increase by 60.

3.2 SEGMENTING THE MARKET

A further complication for these estimates is that individual consumers may react differently to price changes depending on their frequency of use. Research in the market for alcohol has shown that the price elasticity of demand follows a U-shaped pattern across the distribution of users, with the lightest and heaviest drinkers generally unresponsive to changes in price. This reflects the behavioral attributes of those who consume alcohol on rare, special occasions and those who suffer from addiction, versus those in middle who moderate their consumption in response to price.[28]

A RAND Corporation study notes that the population of marijuana consumers should be thought of as four distinct groups each with different price sensitivities:

1. Light users and initiates;
2. Regular users;
3. Heavy users; and
4. Quitters.

The author notes that although many researchers have focused on the prevalence of marijuana use—primarily because survey data on prevalence are among the most easily available data—prevalence bears little relationship to the total amount of marijuana consumed. Total consumption is driven largely by the subgroup of heavy users, and so the price elasticity of this particular subgroup is likely to be determinative of the market as a whole.[29] Initiates and light users comprise the smallest group, both in number and volume consumed, while regular users represent the largest group but still do not account for a majority of the total volume consumed. The heavy user group is small but drives a majority of consumption in terms of total volume; correspondingly, this pattern is mimicked in other

intoxicant markets such as alcohol and tobacco, with most product sales coming from regular and heavy users.

This grouping is helpful in understanding the market because elasticity varies between the groups, with the heaviest users consuming a majority of marijuana and having a relatively low price elasticity.

3.3 COMPARING LEGAL MARKETS TO ILLEGAL MARKETS

While understanding how consumers may react to changes in the price of legal marijuana in isolation may be informative for tax policy, policymakers must recognize that consumers are also influenced by the availability of substitute goods they could purchase with their money, including black market marijuana.[30] That means that a tax-induced price increase for legal marijuana doesn't only inspire consumers to purchase less legal marijuana, but may actually induce them to purchase illegal marijuana instead.

While understanding how consumers may react to changes in the price of legal marijuana in isolation may be informative for tax policy, policymakers must recognize that consumers are also influenced by the availability of substitute goods they could purchase with their money, including black market marijuana.

The way economists measure this trade-off is through cross-price elasticity. Similar to own-price elasticity, this metric represents the additional amount of an alternative good consumers will purchase in response to a 1% change in the price of the good of interest. For example, a cross-price elasticity of 0.7 would mean that a 1% rise in the price of legal marijuana would lead to consumers purchasing 0.7% more illegal marijuana.

Unfortunately, the data necessary to conduct this type of analysis for the marijuana market either do not exist or have yet to be identified, but policymakers should note that

consumers do not make their consumption choices about marijuana in a vacuum—they have access to a substantially similar product in a different market and can easily substitute their method of consumption. Further, in states that have decriminalized the possession of small amounts of marijuana, consumers face minimal legal costs for shifting consumption to the black market even though sellers may still face legal penalties.

However, while most early studies examined the own-price elasticity of marijuana on illegal markets, at least one study has now estimated the own-price elasticity of marijuana on a legal market. Researchers from the University of Oregon examined the effects of a 2015 tax change in the state of Washington's recreational marijuana market and used transactional data from the state's seed-to-sale tracking software to measure the price elasticity, which they estimate at −0.85.[31] What's notable about this analysis is that the measured price elasticity on the legal market is significantly higher than what previous studies have estimated for the illegal market, indicating that consumers are more sensitive to changes in the price of legal marijuana. In fact, the authors note, "This is somewhat larger than most of the illegal or medical marijuana estimates. In the current legal recreational markets more substitutes are available."[32]

This point is significant even though the authors later conclude that states could raise additional revenue by increasing their marijuana excise taxes. They base this observation on the fact that the measured price elasticity is less than -1, which means that consumers slow their consumption at a lesser rate than the increase in price. The authors draw this conclusion based purely upon the goal of maximizing government tax revenues, but concede that this approach will likely cause states to fail at legalization's competing goal of eradicating the black market. As they mention in a footnote: "Raising taxes too high could also perpetuate the black markets legalized marijuana aims to supplant."[33]

PART 4

A COST-OF-PRODUCTION MODEL

The key question emanating from this research is what level of taxation will best allow policymakers to strike a balance between the competing goals of generating revenue and eliminating black market supply channels. Standard regression analyses cannot answer this question with any certainty because data regarding the experience of existing legal marijuana markets are not yet sufficiently voluminous to produce statistically significant results. In addition, estimating the size of the black market is a highly speculative exercise and so any data source used to approximate black market transaction volume may be spurious. Instead, we consider here a cost-of-production model to examine the supply-side effects of taxation.

> *However, when a legal market exists, such as in those states that have passed legalization statutes, producers face a trade-off between seeking a risk premium for participating in the black market or facing higher tax expense and production costs in the legal market.*

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Both consumers and producers of black market marijuana assume risk by engaging in black market transactions—they could be arrested, robbed by their counter-party, physically harmed, delivered tainted or adulterated products, or any number of possible negative outcomes. At least theoretically then, both consumers and producers should seek a risk premium for engaging in a black market transaction, particularly when there is an alternative legal market for similar products. These risk premiums should be expected to have different effects for consumers and producers. Consumers should expect to receive additional value for their money, which is to say they seek cheaper prices on the black market. Producers, on the other hand, should expect additional compensation in the form of a higher profit margin. In the absence of an alternative legal market, these countervailing tendencies likely negate each other to at least some degree.

However, when a legal market exists, such as in those states that have passed legalization statutes, producers face a trade-off between seeking a risk premium for participating in the black market or facing higher tax expense and production costs in the legal market. All else equal, a producer should be expected to remain in the black market if their profit margin exceeds the profit margin that would be available in the legal market plus their required risk premium for participating in the black market. By contrast, a consumer should be expected to remain in the black market only if the cost savings available from lower prices on that market exceed the consumer's risk premium for participating in it.

> *... consumers will seek illegal marijuana if the cost structure allows black market producers to sell at lower prices than are available on the legal market.*

Individuals have different levels of risk tolerance, which means the premiums required by producers and consumers to compensate for risky activity are subjective and vary even across similarly situated individuals. Further, levels of risk tolerance are not directly observable, so a dynamic, statistical modeling of risk tolerance is not possible. Therefore, we examine the tangible costs that marijuana producers likely face in both legal and illegal markets. We find production costs are higher in legal markets and attempt to quantify the effects of both regulatory compliance and taxation. Producers will select to operate in black markets if these costs combined exceed the risk premium sought by each producer.

Similarly, consumers will seek illegal marijuana if the cost structure allows black market producers to sell at lower prices than are available on the legal market.

To determine the production costs of marijuana, we begin with a 2010 cost model developed by Rand Corporation author Jonathon Caulkins.[34] That model was created before commercial marijuana production had become legal anywhere in the world, forcing Caulkins to rely on questionable sources to develop cost estimates, the accuracy of which he rightly questions. However, we supplement the Caulkins model with data points directly observed by one of our authors (Lawrence) who has acted as chief accountant for multiple licensed marijuana growers in California and Nevada.

Although Caulkins was attempting to estimate the cost of marijuana production under a legal regime, we consider his model to be more applicable to illegal marijuana production, since he doesn't consider any regulatory compliance, licensing or taxation costs. Instead, he attempts to calculate production costs based on the consumption of input materials using ratios and other estimates found in previous literature. In particular, he examines the costs of growing in four different environments—a small hydroponic grow, an indoor grow in a 1500 square-foot house, a greenhouse grow, and an outdoor, agricultural-scale grow. Although California is home to some greenhouse and outdoor grows, the legal marijuana industry is dominated by indoor grows conducted in large industrial warehouses. We therefore consider Caulkins' model of growing in a small house to be most relevant for the legal industry since space rental, labor and utility costs are similar in any indoor environment.

Once marijuana plants have been cultivated to maturation, they also must be harvested, dried, bucked, trimmed, cured, weighed and packaged, for which Caulkins provides best-guess estimates for most of these stages. However, Lawrence has recent experience paying contractors to perform many of these processes through arms-length transactions on an open, legal market, and so we substitute these directly observed data points for many of Caulkins' rough estimates.

> *Outside of these tangible costs for the physical production of marijuana, legal market participants also face licensing fees, compliance costs and taxes.*
>
> Geoff Lawrence and Spence Purnell

Outside of these tangible costs for the physical production of marijuana, legal market participants also face licensing fees, compliance costs and taxes. None of these are insignificant. Depending on jurisdiction, acquiring a license to cultivate marijuana can cost hundreds of thousands of dollars. All recreational marijuana programs also require licensees to participate in a seed-to-sale tracking system that adds substantially to labor costs by requiring constant measurement and logging of each individual plant that is associated with a unique identifier in regulatory software. Finally, excise taxes add costs proportional to the weight or sales price of marijuana sold. Although licensing costs and tax rates may be adjusted to make the legal market more or less competitive with participation in the black market, regulatory compliance costs are generally inflexible because federal prosecutorial discretion of marijuana businesses has hinged on states' implementation of "strong and effective regulatory enforcement systems," which has generally been interpreted to require seed-to-sale inventory tracking.[35]

Depending on jurisdiction, acquiring a license to cultivate marijuana can cost hundreds of thousands of dollars.

Table 3 provides cost estimates for each stage of producing marijuana flower in a 10,000 square-foot industrial warehouse as both an illegal and licensed operator. Most data are imported from the Caulkins model and supplemented, as noted, with the direct market knowledge of Lawrence. Table 3 only reflects the relative costs of generating inventory and not distributing or selling that inventory. While black market supply chains face distribution and selling costs, many of the licensing and compliance costs are compounded in the legal market because they are borne by retail dispensary businesses as well as wholesale growers. Still, production costs of wholesale marijuana flower are already estimated at over $100 per pound more when produced legally *before* even considering the effects of taxation.

TABLE 3: ESTIMATED PRODUCTION COSTS FOR MARIJUANA

	Indoor Illegal Grow (Based on Caulkins 1500 ft^2 indoor model)	Indoor Legal Grow
Production Intensity (lbs/ft^2/year)	0.42	0.42
Square feet cultivated	10,000	10,000
Annual production (lbs)	4,200	4,200
Costs per pound – Cultivation		
Materials (exclusive of lighting)	$100	$100
Lighting	$75	$75
Labor	$40	$80**
Rent or Depreciation on Building	$100	$100
Costs per pound – Harvest		
Harvesting*	$8	$16**
Manicuring*	$130	$130
Drying/Curing*	$5	$10**
Overhead		
Amortization of License*** ($25,000/ Annual production)	N/A	$6
Compliance software licensing* ($500 month*12/Annual production)	N/A	$1.43
Insurance* ($25,000 annual policy/Annual production)	N/A	$6
Testing* ($200 per 5 lbs)	N/A	$40
Total Cost Per Pound Before Tax	**$458**	**$564.43**
Tax Expense		
Cultivation tax		Varies
Retail tax		Varies

*Cost estimates supplied by Lawrence. Manicuring services are available in California at a flat rate per pound by outside vendors. Other costs are estimated based on real-world experience.

**Labor-intensive processes are estimated to cost roughly double for a legal grow because of the time-intensity involved in tagging each plant with RFID tags, logging nutrients given, and logging measurements at various stages of the growing and harvesting cycles.

***Licensing costs vary significantly by jurisdiction. We believe a $25,000 cultivation license fairly represents the median cost for a 10,000 square foot grow.

To move beyond this initial disparity in production costs and consider the effects of taxation, the following section examines the unique tax rates and current selling prices in various legal states.

4.1 STATE-BY-STATE TAX ANALYSIS

Although tax structures for legal marijuana vary significantly by state, they are primarily based either on the selling price or total weight of a transaction. Therefore, this tax analysis begins with data on the average selling price per pound of wholesale marijuana in each legal state. These data derive from states' seed-to-sale inventory tracking software by New Leaf Data Services.[36]

TABLE 4: MARIJUANA SPOT MARKET PRICES PER POUND, WEEK OF AUGUST 16, 2019

	Volume-Weighted Average ($/lb)	Simple Average ($/lb)	Average Deal Size (lbs)
U.S. Average	$1,328	$1,493	2.3
Alaska	$3,325	$3,480	0.9
California	$1,229	$1,519	6.5
Colorado	$1,169	$1,164	1.7
D.C.	$2,916	$2,971	1.2
Illinois	$3,087	$3,161	0.9
Maine	$2,733	$2,813	1.0
Massachusetts	$2,934	$2,979	1.1
Michigan	$2,120	$2,188	1.7
Nevada	$1,649	$1,718	2.3
Oregon	$1,000	$1,052	1.0
Vermont	$3,067	$3,122	1.0
Washington	$847	$996	2.1

Source: New Leaf Data Services

Table 5 compares the wholesale prices or weights of marijuana to the prevailing wholesale tax rates in each state to estimate the tax-inclusive production costs at the wholesale level. The estimated tax-inclusive wholesale production costs calculated in Table 5 should be compared against the estimated black market production costs determined in Table 3 of $458 per pound to determine the cost disparities between legal and illegal marijuana growers in each state. While this is an imperfect calculation, because electricity needs, facility rents, and other key inputs may vary significantly by region, the production costs tabulated in Table 3 are applied uniformly to generate a useful comparison of costs between legal and illegal marijuana growers generally.

TABLE 5: ESTIMATED TAX-INCLUSIVE WHOLESALE MARIJUANA PRODUCTION COSTS

	Volume-Weighted Avg. Price ($/lb)	Wholesale Tax Rate	Wholesale Tax ($/lb)	Tax-Inclusive Wholesale Production Cost ($564.43 + Tax)
Alaska	$3,325	$50 per ounce	$800	$1,364
California	$1,229	$9.25 per ounce	$148	$712
Colorado	$1,169	15%	$175	$740
D.C.*	$2,916	N/A*	N/A	$564
Illinois	$3,087	7%	$216	$781
Maine	$2,733	N/A	N/A	$564
Massachusetts	$2,934	N/A	N/A	$564
Michigan	$2,120	N/A	N/A	$564
Nevada	$1,649	15%	$247	$812
Oregon	$1,000	N/A	N/A	$564
Vermont*	$3,067	N/A*	N/A	$564
Washington	$847	N/A	N/A	$564

*State has legalized possession of recreational marijuana but has not yet established a regulated, commercial system.

Once marijuana inventory has been produced, it also must be distributed, marketed and sold to retail customers. Within the legal marijuana industry, this is accomplished by licensed dispensaries that purchase the wholesale inventory and make it available for retail sale. Dispensaries face their own costs in terms of transport, security, rents, depreciation on

tenant improvements and equipment, and compliance costs that vary substantially and are difficult to measure. Likewise, black market supply channels face their own costs for distribution, marketing and sales of marijuana inventory, and these costs are even more challenging to model due to their illicit and secretive nature.

However, we can at least approximate the costs imposed by taxation at the retail level with a number of assumptions. Dispensaries generally follow a rule of thumb of a 100% markup on pre-packaged inventory they purchase from their wholesale suppliers.[37] Retail sales may then be subject to both regular sales taxes and retail excise taxes, depending on jurisdiction. Using this assumption, Table 6 estimates the total retail price of marijuana in legal markets along with the portions of price attributable to taxes alone in each state.

TABLE 6: ESTIMATED RETAIL PRICE AND TAXES, TOTAL TAX PER POUND AT RETAIL

	Estimated Retail Price	Retail Excise Tax	Avg. Gen. Sales Tax**	Total Retail Price	Cost per lb. at Retail Attributable to State-Level Taxes Alone****
Alaska	$6,650	N/A	1.43%	$6,745	$895
California	$2,458	15%	8.56%	$3,037	$727
Colorado	$2,338	15%	Exempt	$2,689	$526
D.C.*	$5,832	N/A*	N/A*	$5,832	$0
Illinois	$6,174	10-25%***	8.74%	$7,331-8,257	$1,373-2,299
Maine	$5,466	10%	5.50%	$6,313	$847
Massachusetts	$5,868	10.75%	6.25%	$6,866	$998
Michigan	$4,240	10%	6.00%	$4,918	$678
Nevada	$3,298	10%	8.14%	$3,896	$846
Oregon	$2,000	17%	N/A	$2,340	$340
Vermont*	$6,134	N/A*	N/A*	$6,134	$0
Washington	$1,694	37%	9.17%	$2,476	$782

* State has legalized possession of recreational marijuana but has not yet established a commercial marijuana system.
**Average general sales tax rate figures are from the Tax Foundation.
***Illinois' retail excise tax rate varies depending on the type of marijuana product purchased.
****Includes taxes assessed at both the retail and wholesale levels.

The estimated tax cost in each state calculated in Table 6 excludes the roughly $108 per pound difference in manufacturing cost attributable to licensing and compliance costs faced by legal marijuana growers as tabulated in Table 3.

It is impossible to know the risk premiums required by each consumer or producer to engage in risky, black market transactions. However, we can surmise from the foregoing cost-of-production analysis that the combination of costs attributable to licensing, regulatory compliance and taxation add substantially to the prices of marijuana facing retail consumers. To whatever extent these additional costs exceed the risk premium required by consumers and producers to engage in black market activities, those actors will choose to remain in the black market.

In particular, among states that have created legal commercial systems for recreational marijuana, Oregon currently taxes at the lowest amount per pound. Coincidentally, recent media reports claim that Oregon's approach to marijuana legalization has been the most successful at eliminating the black market.[38] These accounts provide support for the theoretical notion of a trade-off between two of the major objectives of marijuana legalization: generating tax revenue and curtailing the black market. It therefore appears that a tax structure similar to Oregon's, which assesses a moderate excise tax at the retail level only, would be an optimal choice of tax regime for the legalized marijuana industry.

PART 5

CONCLUSION

A primary aim of legalization is to create a thriving legal market so that black market transactions cease to exist. Without legalization at the federal level, some degree of illicit activity is likely to continue. Nonetheless, as shown with alcohol and cigarettes, excessive taxation can influence consumers' decisions to patronize the black market. A competing goal of legalization, however, is the pursuit of tax revenue from legal marijuana, requiring a tax rate determination.

The economics of excise taxation is not an exact science, but consumer sensitivity to price changes is a response that can at least be approximated empirically. This consumer sensitivity may also vary based upon regional differences in demand, regulatory structures, market size and other factors.

> *California's approach of taxing at multiple levels with high rates has further enshrined black market activity while leaving the legal market flagging.*

The experience in California, with arguably the most burdensome combination of taxes and regulatory requirements in the nation, offers a particularly poignant example. California's approach of taxing at multiple levels with high rates has further enshrined black market activity while leaving the legal market flagging. Clearly, California's rough cumulative rate of 45% has been too high to divert consumers away from established black market supply chains. Illinois' alcohol tax of 30% was enough to initiate illegal interstate transfers and New York's roughly 50% cigarette tax has created a thriving underground market as well. These punitive tax rates far exceed what would be needed to provide financially for regulation of the respective industries.

Many observers have viewed legalization as a potential windfall for state budgets and tried to identify tax rates that could extract the maximum revenue from the industry in order to fund unrelated government projects ranging from education to infrastructure improvement. But these efforts detract from a major, competing purpose of legalization: elimination of the black market. Moreover, such Byzantine structures violate the four guiding principles of simplicity, transparency, neutrality and stability, threatening the sustainability of a vibrant and legal marijuana industry.

In determining a rate of marijuana taxation, policymakers should account for consumer choice to participate in the black market and ensure tax rates are likely to keep consumers in the legal market. Given that black markets will continue to operate in an atmosphere of high taxes in the legal market, policymakers should keep the legal market vibrant by basing marijuana tax rates on as accurate a forecast as possible of the state's cost of regulating the legal marijuana industry, rather than solely attempting to maximize revenue.

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Spence graduated from Stetson University with a bachelor's degree in political science and is working on an MPA at Florida State, where his research has focused on database infrastructure and analytics, economic development, and policy evaluation methods. Spence Purnell is based in Florida.

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