

Feasibility of Alternative Cannabis Tax Schemes:

A Legislative Report & Recommendation for Massachusetts

July 2020

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Purpose

This report, *Feasibility of Alternative Cannabis Tax Schemes: A Legislative Report & Recommendation for Massachusetts*, supplemented by the study, *Assessment of Alternative Tax Models for Adult-Use Cannabis in Massachusetts*, has been prepared in response to the enabling legislation, Chapter 55 of the Acts of 2017 section 63:

“The Massachusetts cannabis control commission, in collaboration with the department of revenue, shall study the feasibility of alternative tax bases for calculating taxes on marijuana and marijuana products, including by weight, volume or tetrahydrocannabinol potency. The commission shall file the results of this study together with any recommendations for changes to marijuana tax policy with the clerks of the senate and the house of representatives, who shall forward the recommendations to the senate and house chairs of the joint committee on marijuana policy and the senate and house chairs of the joint committee on revenue not later than July 1, 2020.”



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Executive Summary

This legislative report has been prepared in response to the enabling legislation, Section 63 of Chapter 55 of the Acts of 2017, to assess feasibility in implementing varying adult-use cannabis market tax schemes. A comprehensive assessment on varying price, weight, and potency-based schemes was contracted and conducted by KPMG LLP (KPMG).

All of the varying tax schemes assessed could feasibly be implemented in Massachusetts [See [KPMG study for all schemes assessed \(page 19\)](#)]; However, analyses suggest that the current 20% tax rate, including a 6.25% sales tax, 10.75% excise tax, and $\leq 3\%$ local tax, is within the optimal range for revenue and feasibility in Massachusetts. Keeping the current 20% tax rate, the study's forecasted analyses show that annual cannabis sales in Massachusetts have the potential to reach \$1 billion by June 2021 (i.e., July 2020 through June 2021), which will generate annual tax revenue of approximately \$200 million. Any change to the current tax structure is projected to result in marginal tax revenue changes and could cause disruption to the still new and maturing market.

The Massachusetts Cannabis Control Commission ("Commission") recommend that no changes be made to the current taxation rate at this time. However, a re-assessment of tax schemes may be warranted as the market matures in the future. Both the Commission and the Massachusetts Department of Revenue (DOR) defer to the Legislature to determine tax rates. DOR's contributions to this report are limited to evaluation of alternative tax schemes for feasibility of implementation.

I. Tax Study Overview

This legislative report, *Feasibility of Alternative Cannabis Tax Schemes: A Legislative Report & Recommendation for Massachusetts* (“report”), supplemented by study, *Assessment of Alternative Tax Models for Adult-Use Cannabis in Massachusetts* (“study”), has been prepared in response to the enabling legislation, Section 63 of Chapter 55 of the Acts of 2017, to assess feasibility in implementing varying tax schemes by weight, volume, and tetrahydrocannabinol (THC) potency. For these purposes, the Cannabis Control Commission (“Commission), in collaboration with the Massachusetts Department of Revenue (“DOR”), released a request for proposals to conduct an econometric study of varying cannabis tax schemes. This contract was awarded to KPMG LLP (KPMG), an independent public accounting firm with expertise in both the Massachusetts policy landscape and economic theory and methodologies.

This study’s primary objective was to forecast future cannabis sales and tax revenue under different cannabis tax schemes, which included: two price-based, four weight-based, and two potency-based schemes. This study found that all alternative tax schemes, except for one weight-based tax scheme, are estimated to generate more tax revenue, compared with the current price-based tax of $\leq 20\%$; However, these changes would be relatively small, potentially short-term in nature, and may disrupt the still nascent cannabis industry in Massachusetts.

This report provides the Massachusetts Legislature with an assessment of the feasibility of alternative cannabis tax schemes and concludes with recommendations based on study results. [See KPMG study in Appendix (pages 12-40), *Assessment of Alternative Tax Models for Adult-Use Cannabis in Massachusetts*]

II. Current System

While cannabis is not new, the legal marketplace for adult-use cannabis has only recently emerged in the United States (U.S.). In 2012, Colorado and Washington made history as the first states to legalize adult-use cannabis with Colorado's retail stores opening for business in 2014. Additional states followed suit with a range of heterogeneous policies and regulations. The result has been a legal industry with distinct differences from other industries and between states.

Massachusetts enacted and implemented non-medical adult-use cannabis legalization in 2016 with Question 4, "*Massachusetts Legalization, Regulation and Taxation of Marijuana Initiative.*" The ballot measure outlined a tax scheme at 12%, which would have been the lowest tax rate of all legalized states. In 2017, the Legislature revised the effective rate to 20% where it stands today. There was concern that the proposed excise tax in the original measure was too low, as other legalized states had higher rates at this time [CO (29%), WA (37%), and OR and AK (25%)]. Revisions in Massachusetts included a change in excise tax from 3.75% to 10.75% and local tax from $\leq 2\%$ to $\leq 3\%$. Massachusetts currently has a price-based tax scheme, including a 6.25% sales tax, 10.75% excise tax, and $\leq 3\%$ local tax.

Similar to the heterogeneity inherent in adult-use cannabis policy and regulation, states also implement varying tax designs ("schemes"). [See [KPMG study Appendix 4: Adult-Use Cannabis Tax Scheme by State](#) for a comprehensive table of legalized state tax schemes (page 40)]

III. Feasibility

Cannabis tax schemes vary across states with adult-use cannabis legalization. Section 63 of Chapter 55 of the Acts of 2017 requires an assessment of alternative tax schemes, including by weight, volume, and potency. A summary of the schemes is below with feasibility assessments. [See KPMG study Appendix 4: Adult-Use Cannabis Tax Scheme by State for a comprehensive table of legalized cannabis state tax schemes (page 40)]

While the alternative tax schemes assessed may result in changes to sales and tax revenue and would be feasible to implement, none are recommended by the Commission. By maintaining the current 20% price-based tax rate, the study shows that annual cannabis sales in Massachusetts have the potential to reach \$1 billion by June 2021 (i.e., July 2020 through June 2021), which would generate annual tax revenue of approximately \$200 million. A change from the current tax scheme to a weight-based, potency-based, or hybrid model may cause disruptions and costs to the Commonwealth, including but not limited to:

- Increases in the administrative and compliance burden on state tax authorities and taxpayers (e.g., reprogramming of DOR tax systems and retraining of both Commission and DOR staff to implement new file returns from Marijuana Establishments with estimated up-front costs for DOR in a range of \$650,000 to \$1,200,000);
- Restructuring within the Commission, particularly for licensing and enforcement regulations and staffing;
- Increases in the administrative and compliance costs on licensed Marijuana Establishments (MEs) (e.g., to the extent that a new model would require cultivators as well as retailers to file returns, these costs would fall on the cannabis industry for compliance), which could threaten some operations' viability; and
- Encouraging consumers to purchase cannabis from the illicit market(s) if additional taxes were passed onto consumers. This could result in the illicit market(s) continuing to operate with associated risks and costs to public safety, compliance and enforcement agencies, and ultimately, taxpayers.

The Massachusetts adult-use cannabis industry is in a nascent stage. A large-scale change in taxation scheme would cause disruptions that are not worth the potential short-term revenue gain, especially in a market with currently stable prices and inelasticity. Indeed, each scheme presents challenges for implementation and regulation, both in industry and government, that may not be worth the marginal gain. The Commission recommends the near-term focus remain on efficiency and market growth with potential for re-evaluation as the market matures.

Price-Based Scheme

i. Price-Based Scheme Results Summary

Massachusetts currently has a price-based tax scheme, including a 6.25% sales tax, 10.75% excise tax, and $\leq 3\%$ local tax. The study projected two alternative price-based tax rates: (1) 15% and (2) 25%. The 15% tax rate will increase sales and decrease tax revenue and conversely, the 25% tax rate would decrease sales and increase tax revenue, albeit only marginally. [See Chart III. A. Price- Based Tax Scheme Projections below and KPMG study for additional information (pages 27-28)]

Chart III. A. Price-Based Tax Scheme Projections



***Note:** This chart was taken from study [Exhibit 6. Projected Annual Cannabis Sales and Tax Revenue by Different Price-Based Tax Rates (Page 28)]

ii. Price-Based Scheme Feasibility Assessment

Price-based tax schemes, as currently implemented in Massachusetts, are most effective in providing efficiency and certainty. These schemes leave less room for error, since all products are taxed the same regardless of product type, weight, and THC levels, allowing for simple tax collection and filing processes.

Results of the study suggest that prices in the current market are stable. An increase to a 25% tax would decrease sales and increase tax revenue marginally. With any increase in the price-based tax structure, the retail tax burden would likely be transferred to consumers, potentially creating a short-term increase in tax revenue (23%) and a potential change to the current price elasticity, resulting in price instability. A higher tax rate may create more elasticity as seen in other states with legal adult-use markets, which may push some consumers to the illicit market. A tax rate change to the current price-based tax scheme could be implemented; However, it *would not* create a significant change in tax revenue, particularly over the long-term. Further, it could

disrupt the industry, causing some consumers to purchase from the illegal market and threaten the viability of licensed Marijuana Establishments.

Weight-Based Scheme

i. Weight-Based Scheme Results Summary

With support from the Commission and DOR, KPMG assessed the current 20% tax rate and four additional weight/price-based hybrid tax schemes. One hybrid tax scheme projected lower tax revenue, while the additional three projected higher tax revenue. [See Chart III. B. Weight-Based Tax Scheme Projections below and KPMG study for additional information (pages 28-29)]

Chart III. B. Weight-Based Tax Scheme Projections



***Note:** This chart was taken from KPMG study [Exhibit 7. Projected Annual Cannabis Sales and Tax Revenue by Different Weight-Based Tax Rates (Page 29)]

ii. Weight-Based Scheme Feasibility Assessment

In contrast to a retail-sale tax scheme model, the weight-based method would require cannabis sales and tax returns to be broken down by product type and tax amount per gram. Some states that use this tax model have a different tax rate for flower, trim, seedlings, leaves, and/or seeds. These taxes are imposed on the cultivator, not the retailer. Depending on the model, there may be an additional retail sales tax. Given these differences, training would be necessary to educate administrators about the differences among the taxed products and to educate cultivators on filing proper returns. There may also be complexity in product measurement as cannabis loses weight as it dries after harvest. Systems would need to be put in place to ensure that product is

weighed consistently at the proper point in its preparation. This structure may also encourage consumption of higher potency products, adding potential adverse public health and safety effects.

THC (“Potency”)-Based Scheme

i. THC (“Potency”)-Based Scheme Results Summary

Two potency or tetrahydrocannabinol (THC)-based tax schemes were assessed using a higher tax scheme than the current 20% rate, and both projected increases in tax revenue. [See Chart III. C. THC- Based Tax Scheme Projections below and KPMG study for additional information (pages 29-30)]

Chart III. C. THC (“Potency”)- Based Tax Scheme Projections



***Note:** This chart was taken from KPMG study [Exhibit 8. Projected Annual Cannabis Sales and Tax Revenue by Different THC-Based Tax Rates (Page 30)]

ii. THC (“Potency”)-Based Scheme Feasibility Assessment

Similar to price and weight-based tax schemes, a THC (“potency”)-based tax scheme could also be feasibly implemented; However, it would add varying logistical complexities and costs *without* creating a projected significant increase in tax revenue. The potency-based method would require the tax return to be broken down by the THC levels of the cannabis product, with various tax rates applicable to products of different potency. Like the weight-based model, this is a tax imposed on cultivators and product manufacturers, and depending upon the model, an additional retail sales tax may apply. Potency-based taxation would require implementation of systems by cultivators, product manufacturers, and by the Commonwealth to test product to ensure that its potency is correctly stated and that the correct tax rate is applied.

Additionally, in a new industry where the science continues to evolve and with limited testing facilities, implementing a potency-based tax scheme would add to testing costs and require additional laboratory monitoring to ensure consistency across laboratories and products. Further, it could result in a reduction in product availability as producers wait for tests or make lower-potency products to avoid higher taxes. Additionally, this could also affect the medical market and higher potency product availability for medical patients. In a more mature market with additional licensed testing facilities and as the science of cannabis testing and cultivation develops, a potency-based tax structure could have benefits such as product selection among a potency continuum, unlike a weight-based tax scheme, and has the potential for public health harm reduction by incentivizing low THC products (e.g., reduce consumer consumption of higher potency products due to higher cost of purchase). On the other hand, it could turn consumers who seek high-potency cannabis to the illegal market or home growing/manufacturing, which would have a negative effect on tax revenue. At this point, however, changing to a potency-based tax scheme would introduce complexities for both the Commonwealth and the cannabis industry that outweigh the potential benefit.

IV. Conclusion

Looking beyond solely the tax revenue that may be generated by different tax schemes, the Commission and DOR recognize that changing the current tax regime would involve price disruptions, costly complexities in administration and enforcement, and costs to the new cannabis industry. Among the administrative advantages of the current retail sales model: the same tax rate applies to sales of all cannabis products; only cannabis retailers are required to file returns; and the tax return itself is relatively simple. Most importantly, a retail tax by its nature would automatically adjust for the weight and potency of products sold, given that quantity and potency of the cannabis will be reflected in its retail sales price. In essence, in a retail sales model, the task of assessing the weight and potency of a product would fall on the retailers, not the Commonwealth.

In conclusion, any of the assessed tax schemes *could be* implemented in Massachusetts. However, implementing any of the alternative schemes would *not* provide a significant change in tax revenue. Furthermore, change at this point would likely result in disruption to the nascent market and would require significant changes and costs to how the Commonwealth ensures compliance with tax and cannabis regulations. The Commission and DOR defer to Legislature on setting a tax rate.

As the market matures, surrounding states implement adult-use cannabis policies, and other unforeseen changes occur, a re-assessment of tax schemes may be warranted.

V. Recommendation

After a thorough assessment of different cannabis tax schemes included in the study and careful consideration of potential affects, the Commission believes the current 20% tax rate, including a 6.25% sales tax, 10.75% excise tax, and $\leq 3\%$ local tax, is the preferred rate for revenue and feasibility in Massachusetts. However, both the Commission and DOR defer to the Legislature to determine tax rates. The study's analyses indicate that any changes in tax structure would *not* result in a significant change in tax revenue and the implementation of any alternative scheme may cause disruption to the still new and maturing market. The Commission recommends that no changes be made to the current taxation rate and scheme at this time; However, a re-assessment may be warranted as the market matures in the future.

VI. Appendix: KPMG Study, *Assessment of Alternative Tax Models for Adult-Use Cannabis in Massachusetts* (pages 12-40)



Commonwealth of Massachusetts

Cannabis Control Commission (CCC)

Assessment of Alternative Tax Models for Adult-Use Cannabis in
Massachusetts

Final Report

June 2020



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Executive summary

Adult-use cannabis sales have experienced significant growth in Massachusetts since the first sales in November 2018. While Massachusetts currently uses a price-based tax for cannabis sales with a total tax of 20%, other states have experimented with other tax schemes, including based on weight and potency. To assess potential alternative cannabis tax schemes for Massachusetts, as requested by the Cannabis Control Commission (CCC), we conducted two types of analyses.

First, we conducted a regression analysis to project future cannabis sales and tax revenue in the next fiscal year (July 2020 through June 2021) under different alternative tax schemes. Second, based on an environmental scan, we summarized other states' experiences with various tax schemes.

Annual adult-use cannabis sales in Massachusetts have the potential to reach \$1 billion by June 2021 with the current tax rate of 20%, which will generate an annual tax revenue of about \$200 million. The significant growth in cannabis sales and tax revenue is primarily driven by the planned increase in new retail stores in the coming year.

We considered several alternative tax schemes: two price based, four weight based, and two potency based. All alternative tax schemes, except for one weight-based tax scheme, are projected to generate more tax revenue compared with the current price-based tax of 20%. That being said, the changes in tax revenue under the weight-based and potency-based tax schemes are relatively small. Additionally, these changes in tax revenue may be short term in nature. It is unclear whether higher tax revenues from higher tax rates would persist in the long run, especially in a more mature and competitive market in the future. A higher tax rate may also lead to a potential move of consumers from the legal to the black market.

In short, we found that alternative schemes—based on weight or potency—may result in changes in sales and tax revenue. Increasing the current rate may result in slightly higher revenue in the short term but in the long term may lead to a potential move of consumers to the illegal market. The legal cannabis industry in Massachusetts is in an infant stage, and a large-scale change to taxation could cause unpredictable market disruption.

We also assessed the potential advantages and disadvantages of alternative tax schemes qualitatively. A price-based tax is straightforward and has a lower administrative and compliance burden for both state tax authorities and taxpayers. A weight-based tax may be less vulnerable to a price reduction in the long term and could contribute to a more stable tax revenue. A weight-based tax, however, may inadvertently encourage the cultivation and consumption of more potent cannabis products and the associated public health impacts. A potency-based tax, in contrast, may discourage the use of more potent cannabis products.

Furthermore, both potency-based and weight-based taxes may increase the administrative and compliance burden on state tax authorities and taxpayers. Decisions about tax scheme changes require careful consideration of their revenue and nonrevenue impacts.

The results of this study should be interpreted with careful consideration of its assumptions and limitations. Our tax revenue projection may change significantly when any of the critical assumptions change, such as the black-market competition, growth in the number of retail stores, the pass-through rate of the tax burden, and the price elasticity of legal cannabis demand in a more mature market.

Any projection of future tax revenue is inherently uncertain. Our projection is further complicated by the significant uncertainties around the impact of the COVID-19 on the economy and, more specifically, on the legal adult-use cannabis market in Massachusetts. Additionally, due to the relatively short history of adult-use cannabis sales and alternative cannabis tax schemes, evidence about the potential advantages and disadvantages of alternative tax schemes from the environmental scan may be based on anecdotal experience instead of empirical studies.

All estimates developed in this study are based on data supplied by CCC and from public sources. All alternative tax schemes, including tax rates, are based on the specifications of the existing alternative tax schemes in other states, supplemented by inputs from the CCC. The potential advantages and disadvantages summarized in this study are based on public sources. KPMG has not designed or provided any inputs to the alternative tax schemes considered in this study and has not hypothesized or tested any advantages and disadvantages of alternative tax schemes. In doing so, KPMG does not make recommendations regarding the feasibility of implementing alternative tax schemes.

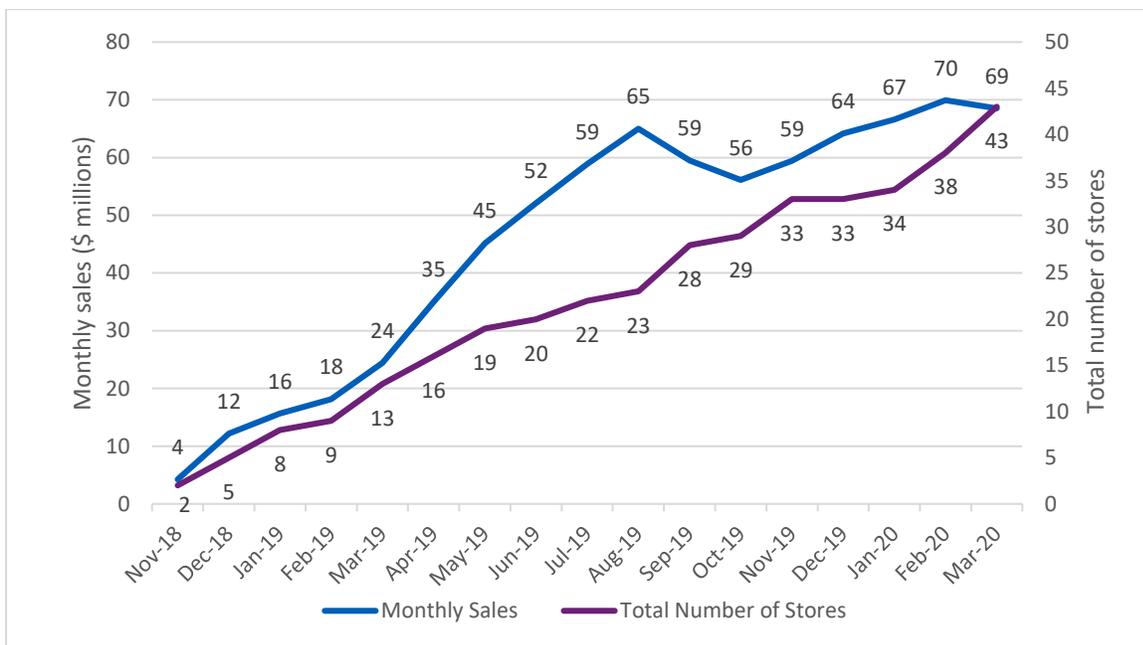
CCC should consider undertaking additional analyses to understand the potentially changing impacts of alternative tax schemes. First, the cannabis sales and tax revenue forecast model will require periodic re-estimation to reflect changing market and consumer behavior in a more mature market, especially in a post-COVID “regime.” How consumers respond to price and tax changes may evolve, which may affect the forecast of cannabis sales and tax revenues.

Second, an economic impact analysis can provide a more comprehensive understanding of the economic benefits of the adult-use cannabis market in Massachusetts. The economic benefits include not only cannabis tax revenues but also the job creation and contribution to the gross state product. An economic impact analysis can also help CCC estimate the additional tax revenues from industries in the cannabis supply chain that benefit from the legal cannabis market.

1. Introduction

Massachusetts was the first state on the East Coast to legalize the recreational sale of cannabis to adults. In November 2016, 53.6% of state residents voted “yes” on Question 4, the Massachusetts Legalization, Regulation, and Taxation of Marijuana Initiative. The first recreational sale of cannabis in the Commonwealth took place in November 2018, when two retail stores opened. In the following 16 months, a total of 43 recreational cannabis retailers began selling marijuana to adult consumers. Except for the period covering the vaping ban¹ and the mandatory store closures to contain COVID-19,² Massachusetts has seen steady growth in adult-use cannabis sales revenues since 2018, with monthly sales reaching about \$70 million in March 2020 (see Exhibit 1).

Exhibit 1. Growth in adult-use cannabis sales and retail stores in Massachusetts



Massachusetts applies a 20% tax on the retail sale of adult-use cannabis products, including a 6.25% state sales tax, a 10.75% excise tax, and a local cannabis tax of up to 3%. Nine other states also have a

¹ As a result of health concerns surrounding vaping products, a ban was enacted in Massachusetts for all vaping products in September 2019; it was lifted in December 2019.

² On March 24, 2020, to contain the spread of COVID-19, Massachusetts implemented a shutdown of nonessential businesses, which included recreational cannabis dispensaries. The shutdown was lifted in part on May 25, 2020 when curbside pickup of recreational cannabis was permitted. At the time of this study, the effect of COVID-19 on the cannabis industry (and the economy more generally) is unclear.

legal adult-use cannabis market. While a price-based tax on retail sales is the most common cannabis tax scheme, several states have experimented with alternative tax schemes, including weight-based and potency-based taxes. The impact of these alternative tax schemes on cannabis sales and tax revenue and nonrevenue outcomes (e.g., administrative and compliance costs and public health outcomes) is not well understood due to a lack of data and a relatively short history of adult-use cannabis sales in the United States.

This study aims to assess alternative cannabis tax schemes in Massachusetts. To this end, we conducted two analyses. First, we forecasted the future adult-use cannabis sales and tax revenue under the current cannabis tax structure in Massachusetts and under several alternative tax schemes experimented in other states. Second, we conducted an environmental scan to summarize other states' experiences when experimenting with alternative tax schemes. This analysis helps assess the nonrevenue outcomes associated with alternative tax schemes.

The adult-use cannabis market and alternative cannabis tax schemes are still recent phenomena. Thus, there is a lack of high-quality data and consistent empirical evidence to understand the full impacts of alternative tax schemes on the adult-use cannabis market. This study uses available information at the time of the analysis, and our results should be interpreted with careful consideration of our assumptions and limitations. As with any forecast study, any change in the key assumptions could impact the forecast considerably.

The rest of this report is structured as follows. We first provide a brief description of the alternative tax schemes considered in this study. Next, we describe the data sources and method to forecast future cannabis sales and tax revenue under the different tax schemes. We next present the findings of the study, including a list of study limitations, and conclude with a high-level summary of the results.

Alternative tax schemes

The primary objective of this study is to forecast future cannabis sales and tax revenue under different cannabis tax schemes. The baseline is the current cannabis tax structure in Massachusetts, which is a price-based tax with a total tax rate of 20%, including sales tax, excise tax, and local cannabis tax. The retailer collects these taxes at the time of the final sale. For this study, we estimate the impact of two alternative price-based rates (25% and 15%) on sales and tax revenue, based on input from the CCC.

Three states currently have a weight-based tax scheme for their legal adult-use cannabis market: Alaska, California, and Maine. Since Alaska does not levy a sales tax, we focus on the weight-based models from California and Maine, which are both essentially hybrid tax schemes that include both weight-based and price-based taxes. A hybrid weight-based scheme first taxes the cultivator's sales to the manufacturer, distributor, or retailer based on a fixed per-weight basis of the cured flower. This tax is then combined with a tax on the final sales to consumers as a percentage of the price.

California has a retail cannabis tax similar to Massachusetts; it ranges from 22.25% to 25.5%, depending on the local sales tax. A weight-based tax of \$9.65 per ounce of flowers, \$2.87 per ounce of cannabis leaves, and \$1.35 per ounce of fresh plant material is levied on California cultivators' sales. Both retail and cultivator taxes are collected by a distributor, who functions as a middle-man between the cultivator, manufacturer, and retailer. The distributor then submits the taxes collected to the tax authority. Maine follows a similar approach to California. The total retail tax for the sale of Maine cannabis is 15.5%, and the tax per ounce of the flower is \$20.94. Maine also taxes trim at \$5.86 per

ounce, seedlings at \$1.5 each, and seeds at \$0.30 each. At the time of this study, no sales of adult-use cannabis have been recorded in Maine because COVID-19 delayed its first store opening scheduled for 2020.

Illinois is the only state to have a potency-based tax scheme. It taxes cannabis based on delta-9-tetrahydrocannabinol (THC) levels. Lower THC products (those with 35% THC or less) are taxed at 10%, infused products at 20%, and products with more than 35% THC at 25%. State and local taxes in Illinois do not account for potency and are the same as taxes on other retail goods. The Illinois sales tax is 6.25%, and the local sales tax ranges between 0 and 4.75%. Illinois also taxes cultivator sales at a rate of 7% based on wholesale prices, not weight. Illinois also allows localities to tax cannabis at up to 3% of sales price. Thus, once the local cannabis taxes are included, the total cannabis tax in Illinois is between 16.25% and 39% at retail, with 7% at wholesale. In the first month of legal adult-use sale (January 2020), Illinois collected nearly \$10.5 million in taxes, exceeding the initial estimate.³

By using the tax schemes and rates from California, Maine, and Illinois, along with inputs from the CCC, we estimate the impact of these eight tax schemes:

- *Price-based* tax at 15% and 25% rates
- *Weight-based* tax based on California and Maine weight-based tax amounts with the following rates:⁴
 - \$9.65 per ounce weight-based tax and 17% price-based tax
 - \$9.65 per ounce weight-based tax and 20% price-based tax
 - \$20.94 per ounce weight-based tax and 17% price-based tax
 - \$20.94 per ounce weight-based tax and 20% price-based tax
- *Potency-based* tax based on Illinois's THC thresholds with the following rates:
 - 20% price-based tax for $\leq 35\%$ THC, 23% price-based tax for $> 35\%$ THC and infused products
 - 20% price-based tax for $\leq 35\%$ THC, 25% price-based tax for $> 35\%$ THC, and 23% price-based tax for infused products

³ Legal Marijuana Sales Created \$10.5 Million in Illinois Tax Revenue in January. CBS Chicago. Available at <https://chicago.cbslocal.com/2020/02/24/illinois-recreational-marijuana-revenue-legal-weed-cannabis-sales/>, retrieved on June 6, 2020.

⁴ We used the projected sales quantity and associated product weights from the retail transactions to estimate the tax revenue under the weight-based schemes. See Appendix 1.

2. Data and approaches

Data sources

To forecast future adult-use cannabis sales and tax revenue, we used data obtained from CCC and public sources. Exhibit 2 summarizes the data sources and how these data are used in our analysis. The primary data used in this study are the store sales transactions and store openings data provided by the CCC from the Metrc and Socrata databases.

Exhibit 2: Study data sources

Data	Data Use	Source
Daily adult-use sales data by granular product type from November 2018 to March 2020	Calculate adult-use cannabis sales (revenue, weights, units) and obtain prices in Massachusetts	CCC/Metrc database
Adult-use license application (dates for application, provisional license, and final license; information to identify expedited applicants)	Estimate the future number of new retail stores	CCC/Socrata database
Black-market prices from November 2018 through March 2020 ⁵	Quantify the impact of the black-market prices on legal market sales	Price of Weed and Budzu

We also used black-market data for the state of Massachusetts in the analysis. The black-market prices were pulled from two websites: Budzu⁶ and Price of Weed,⁷ using the Internet Archive Wayback Machine.⁸ Data were pulled for the period corresponding with the Metrc data: November 2018 through March 2020.

In addition to these data sources, we leveraged the experience from the Massachusetts Department of Revenue (DOR) and the Massachusetts Gaming Commission. The DOR provided valuable inputs on its high-level projection for cannabis revenues in Massachusetts. The Gaming Commission shared lessons

⁵ Prices for one ounce or greater were removed from the analysis due to bulk discounting that is not comparable with the legal market. Prices were normalized to one gram for consistency with Metrc data conversions. While data are available by city in Massachusetts through the websites, data points are limited. Therefore, while area-specific data would have been a useful addition, the black-market data were sparse. As a result, statewide data were aggregated on a monthly basis from the two sources.

⁶ <http://budzu.com/prices/usa/massachusetts>

⁷ <http://www.priceofweed.com/prices/United-States/Massachusetts.html>

⁸ <http://archive.org/web/web.php>

learned from its experience with the gaming revenue forecast. These inputs have been considered throughout the study.

Approach

In this section, we describe the methodology used to forecast cannabis sales under different tax schemes and an alternative scenario of cannabis price decline. We started with a regression-based econometric model that estimates the relationship between cannabis sales and several independent (predictive) variables. We then generated the future value of the independent variables and used the regression coefficients to estimate future cannabis sales.

Econometric model

We used a multiple variable regression model to estimate the empirical relationship between the dependent variable (i.e., cannabis sales) and independent variables (e.g., cannabis price) using historical data. Forecasts of future cannabis sales can be generated by applying the same empirical relationship to the future values of the independent variables. Specifically, we used an ordinary least square (OLS) regression model, with the log-transformed cannabis sales (quantity sold) as the dependent variable.⁹ The independent variables in the regression model include:

- Adult-use cannabis price (log-transformed)
- Black-market cannabis price (log-transformed)
- Product group indicators (i.e., raw cannabis, infused products, and concentrates)¹⁰
- Number of operating licensed adult-use retailers in operation
- Store age (number of months in operation) and its squared term
- Vape ban indicator (September–December 2019) (interacted with product group indicators)
- Indicators for each retail store.

We estimated this regression model using daily sales data by cannabis product group for each store from the inception of adult-use sales in November 2018 to March 2020. Both the dependent variable (cannabis sales) and the price variables in the regression were log-transformed so that the coefficients of the price variables can be interpreted as the price elasticities of demand for cannabis. The price elasticity of demand is a measure of how much consumer demand changes in response to a price change. That is, it is a measure of how sensitive consumers are to changes in the price. For example, a price elasticity of demand of -0.5 indicates that for a 1 percent increase in the price of cannabis, there is a 0.5 percent decrease in demand.

⁹ To estimate tax revenue under the weight-based and THC-based tax schemes, we converted the projected quantity sold into grams and THC levels using the method described in Appendix 1, Weight and Potency Conversion.

¹⁰ We grouped granular product categories from the Metrc system into three major product groups: concentrate, infused, and raw cannabis. Concentrate products include concentrate, concentrate (each), kief, and vape product. Infused products include infused (edible), infused (nonedible), infused pre-rolls, and suppository. Raw cannabis includes buds, raw pre-rolls, shake/trim, and shake/trim (by strain).

Product group indicators control for group-specific effects, such as the variation in product preferences over time. The number of retailers controls for product availability and market competition. Store operation history may affect cannabis sales, and thus the number of months a store has been in operation was included in the regression, with a squared term to control for the quadratic effect. In this way, we can estimate both the impact of operational history on sales and how this impact changes over time.

Massachusetts declared a public health emergency related to vaping in September 2019 and issued a four-month ban on all vaping products. An indicator for the four months was included in the regression to control for the sales decline associated with this temporary ban. Finally, we included indicators for each retail store control for the unobserved, store-specific effects that do not vary over time. The retail store indicators capture the unique location, ownership, and operational characteristics of each store, along with other unobserved effects.

We considered additional independent variables, including socioeconomic and demographic variables, such as the percent of the population in the labor force, the unemployment rate, percent of the population that is male, and household income. However, we decided not to include these independent variables in the regression analysis due to their infrequent data refresh (e.g., quarterly and annually), which leads to a lack of variability in these variables.

Appendix 2 presents the coefficients of the regression model. As expected, adult-use cannabis sales decrease as the legal cannabis price increases. Specifically, a 1 percent increase in the legal cannabis price was associated with a 0.44 percent decrease in adult-use cannabis sales. This result indicates that the demand for cannabis in the current market in Massachusetts is inelastic; that is, the demand does not change as much as the price. On the other hand, adult-use cannabis sales increase as the black-market price increases, which suggests that price increases in the black market may push some consumers to the legal market (i.e., a substitution effect) and vice versa. Adult-use cannabis sales also increase with the length of time stores have been in operation, although at a decreasing rate. As a whole, changes in the explanatory variables explain 91% of the variations in adult-use cannabis sales.

Projection of future values of independent variables

The econometric model estimates how adult-use cannabis sales adjust with changes in the values of the independent variables. Before we can forecast adult-use cannabis sales in our forecast period, July 2020 through June 2021, we need first to project the future values of the independent variables. The key variables to the forecast are future cannabis prices (in both legal and black markets) and the future number of retail stores. To assess the impact of future uncertainties, we projected the future values of independent variables under two scenarios: the main scenario and an alternative scenario with a retail price drop. The sections below describe the projections under the main and price drop scenarios.

Cannabis price

A descriptive analysis shows that both legal adult-use and black-market cannabis prices were relatively stable over time in Massachusetts. We projected the future legal adult-use price using a three-month moving average (i.e., the current month's price is the average price of the previous three months). We used a six-month moving average to project the future black-market price since we do not have as many data points on the black-market price as in the legal market.

Number of new retail stores

Using the historical data on adult-use retail license applications, we conducted a survival analysis to estimate: (1) the percent of applicants that eventually open a new store and (2) the median duration between application or provisional license approval and store opening. Since Massachusetts provides expedited application reviews to applicants with a disadvantaged background, we conducted a separate analysis for expedited and nonexpedited applicants.¹¹ Exhibit 3 shows the duration between retail license application and store opening for each cohort. Using these estimates, we projected that a total of 55 new stores would open during our forecast period of July 2020 through June 2021.

Exhibit 3: Estimated duration between retail license application and store opening

Cohort	% of Applicants that Open a New Store		Median Duration to Store Opening (days)	
	Application Submission	Provisional License	Application Submission	Provisional License
Expedited Applicants	44.6%	50.0%	297	162
Nonexpedited Applicants	10.9%	14.3%	406	241

Permanent store closure due to COVID-19

The COVID-19 in 2020 caused many businesses in Massachusetts and throughout the country to close. In Massachusetts, from March 24 through May 25, adult-use cannabis retailers closed, as did other businesses considered nonessential and were then allowed to open for curbside order pickup. All adult-use cannabis retail stores that were operating before the COVID-19 reopened in May 2020. We assumed no permanent cannabis retail store closure in Massachusetts during our projection period of July 2020 to June 2021.

Alternative scenario – price drop

We also projected the future value of independent variables under an alternative price drop scenario.¹² In this scenario, we assumed the same three-month moving average for the future legal adult-use retail price through November 2020, and the price will then decrease by 20% starting in December 2020 (the start of the third year of the legal adult-use sale) through June 2021.¹³

¹¹ The following types of retail license applicants receive an expedited application review: (1) eligible for the Economic Empowerment Priority review, (2) eligible for the Social Equity Programs, (3) have a Disadvantaged Business Enterprise status, and (4) have an existing medical use facility.

¹² The sales and tax revenue under the alternative price drop scenario was projected using the current 20% tax rate. The alternative price drop scenario was not used to project sales and tax revenue under the alternative tax schemes.

¹³ Although there is no consistent evidence that retail cannabis prices decrease significantly in new legal cannabis markets, an Oregon study suggests that retail prices could decrease by 10-20% in a year. We used a 20% price decrease as a conservative estimate. Source: Josh Lehner. February 8, 2018. Marijuana: Falling Prices and Retailer Saturation? Oregon Office of Economic Analysis. Available at <https://oregoneconomicanalysis.com/2018/02/08/marijuana-falling-prices-and-retailer-saturation/>, retrieved June 7, 2020.

Projected future cannabis tax revenue by tax scheme

To assess the impact of tax schemes on cannabis tax revenue, we first forecasted the total annual cannabis sales revenue. The projection uses the main scenario described above, with the current price-based tax rate of 20%. We then estimated the cannabis sales revenue from other tax schemes, including price-based taxes at different rates as well as weight-based and THC-based taxes, using the following approach:

1. Assume that any change in tax burden under the alternative tax schemes is 100% passed through to consumers. For example, if the tax rate is increased by 5 percentage points, consumers will pay the entire additional 5% tax. This approach is consistent with the State of Washington experience, where the legal cannabis industry has high market power and was able to pass through additional costs to the consumers.¹⁴
2. Estimate the impact of a change in the tax burden on cannabis sales by applying the additional costs to the consumer by the estimated price elasticity of demand (-0.44), assuming everything else remains the same. The price elasticity is the relationship between the change in price (in this case, caused by the tax change) and the change in demand. For example, if the taxes increase by 5%, some customers will purchase less, as some are no longer willing to buy the product. The price elasticity determines whether the demand decreases by less than 5%, 5%, or more than 5%.
3. Assume that increases in the legal adult-use cannabis taxes do not lead to consumers switching to the black market. We were unable to estimate the potential demand movement between the legal and black markets due to a lack of sales data for the black market.

Data and approach limitations

It is critically important to interpret the study results in light of several significant limitations:

- The number of new retail stores is the primary driver of growth in our projected future sales and tax revenue. The projected tax revenue will be impacted significantly if the number of new retail stores either falls short or exceeds our expectation, which is possible with any change in licensing policies or practices.
- The impact of alternative tax schemes on sales and tax revenue was calculated through the price elasticity of demand. The impact of alternative tax schemes on sales and tax revenue could change significantly if the price elasticity changes.
- Sales and tax revenue estimates assume a constant price elasticity of demand at different tax rates. This might not be true since the elasticity is a local measure that may not work well to estimate sales and tax revenue changes associated with a large change in the tax rate or price.
- Sales and tax revenue estimates do not take into account competition from the black market due to a lack of black-market demand data in Massachusetts. If the black market in

¹⁴ Hollenbeck B, Uetake K. October 2018. Taxation and Market Power in the Legal Marijuana Industry. UCLA Working Paper.

Massachusetts continues to flourish as it did in California, our projection could overestimate future sales and tax revenue.

- Sales and tax revenue estimates assume that retailers can pass all additional tax burden to the consumer, which is reasonable in a market where retailers have high market power. The ability of retailers to pass costs onto consumers may change in the future, especially if the market becomes more competitive.
- The impact of COVID-19 on the economy is mostly unknown. The sales and tax revenue estimates may be different if the economic impact of COVID-19 is more or less severe than expected.
- Although the qualitative experiences from other states provide useful insights, it is important to recognize that some of these experiences may reflect the unique markets in those states. Also, legal adult-use cannabis is still a relatively new phenomenon with limited data and history. It is unclear whether these early experiences will persist in the long term.

3. Findings

This section presents the findings of our study. We first show the impact of alternative cannabis tax schemes on future cannabis tax revenue in the next fiscal year. Next, we provide a summary of other states' experiences with alternative cannabis tax schemes.

Impact of alternative tax schemes on cannabis tax revenue

Exhibit 4 shows that the monthly cannabis sales projected by our regression model are close to the actual sales for January 2019¹⁵ through March 2020. It also shows the forecasted monthly sales revenue from July 2020 through June 2021,¹⁶ under both the main scenario and alternative price drop scenario in which prices drop by 20% starting in December 2020.

Exhibit 4. Actual and estimated monthly cannabis sales

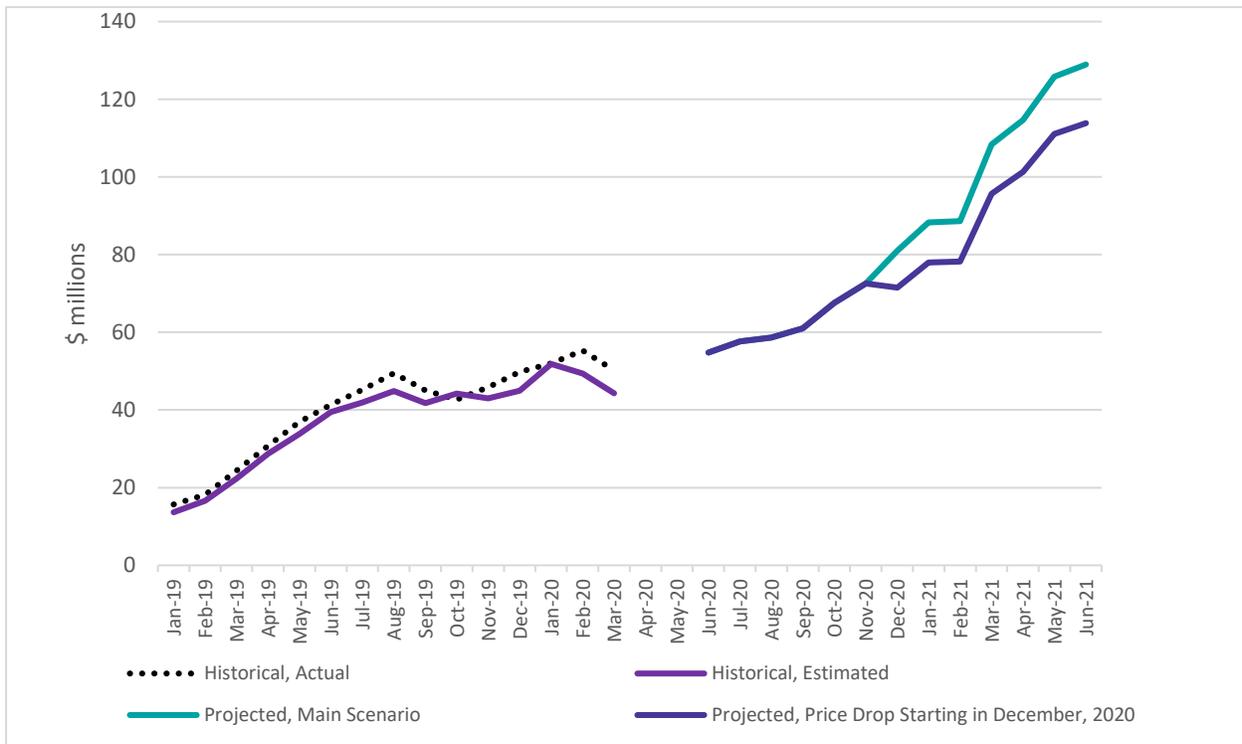


Exhibit 5 shows the projected annual cannabis sales from July 2020 through June 2021 under different price scenarios. Under the main scenario, annual cannabis sales are expected to reach \$1,053 million, with an estimated cannabis tax revenue of \$211 million under the current tax structure. This represents a 94% increase in both cannabis sales revenue and tax from the 12 months of April 2019 through March 2020. This growth in both sales and tax revenue is driven primarily by the number of new retail stores projected to open next year.

¹⁵ The first two months of legal adult-use cannabis sales, November and December 2018, are not shown since early months of sales could be different from subsequent months when the sales become more stable. Actual and estimated sales from April 2020 through June 2020 are not included due to the closure of cannabis stores related to COVID-19.

A scenario where there is a 20% retail price drop starting in the third year of legal adult-use sale (an alternative scenario with the same 20% tax rate) leads to lower cannabis sales (\$967 million) and lower tax revenue (\$193 million).

Exhibit 5. Projected annual cannabis sales and tax revenue under current tax structure (for the year starting on July 1, 2020)

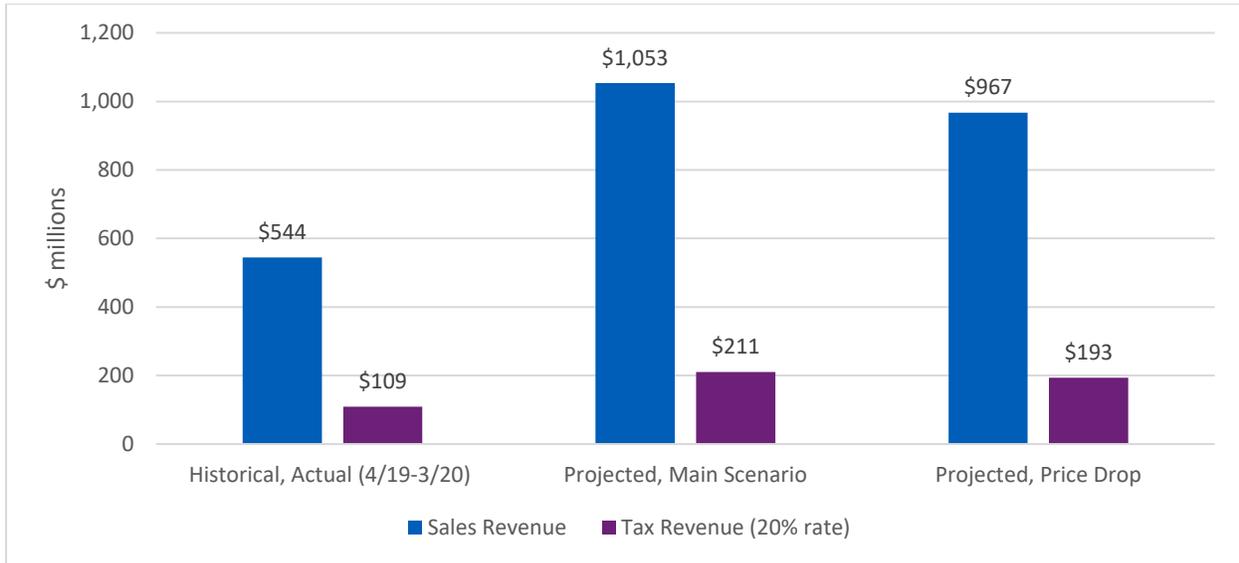


Exhibit 6 shows a comparison of projected annual sales and tax revenue with different tax rates under a price-based scheme. Compared with the current rate of 20%, an increase to 25% will reduce sales slightly to \$1,034 million (a 1.8% decrease) but increase the tax revenue to \$258 million (a 23% increase). In contrast, a reduction of the tax rate to 15% will increase sales by 1.8% and decrease the tax revenue by 23%. These effects are driven by the current inelastic legal adult-use demand in Massachusetts. Since demand does not adjust by as much as the tax rate change, the tax revenue will increase with a higher tax rate even though the demand will decline. It is worth noting that a higher tax rate may lead to lower tax revenue in the future if cannabis demand becomes elastic in Massachusetts.

Exhibit 6. Projected annual cannabis sales and tax revenue by different price-based tax rates (for the year starting on July 1, 2020)

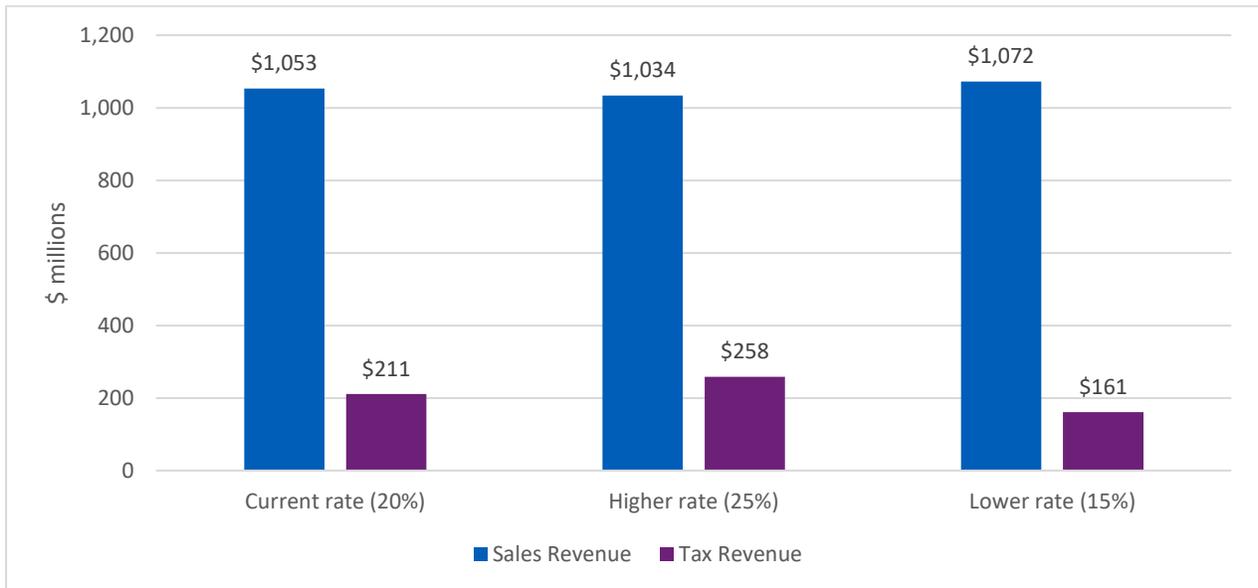


Exhibit 7 shows the estimated impact of weight-based tax schemes on projected tax revenues. Among the four weight-based tax schemes under consideration, only the first one, with a 34-cent per gram weight-based tax and a 17% price-based tax, is expected to have a combined tax rate lower than the current 20% rate. The other three weight-based tax schemes are expected to have a combined tax rate higher than the current 20% rate. With an inelastic demand, the projected tax revenue is lower under the first weight-based tax scheme than the current cannabis tax scheme. The projected tax revenue is higher under the other three weight-based tax schemes relative to the existing cannabis tax structure. A weight-based tax scheme with a 74-cent per gram weight-based tax and a 20% price-based tax produces the highest tax revenue among the four weight-based tax schemes.

Exhibit 7. Projected annual cannabis sales and tax revenue by different weight-based tax rates (for the year starting on July 1, 2020)

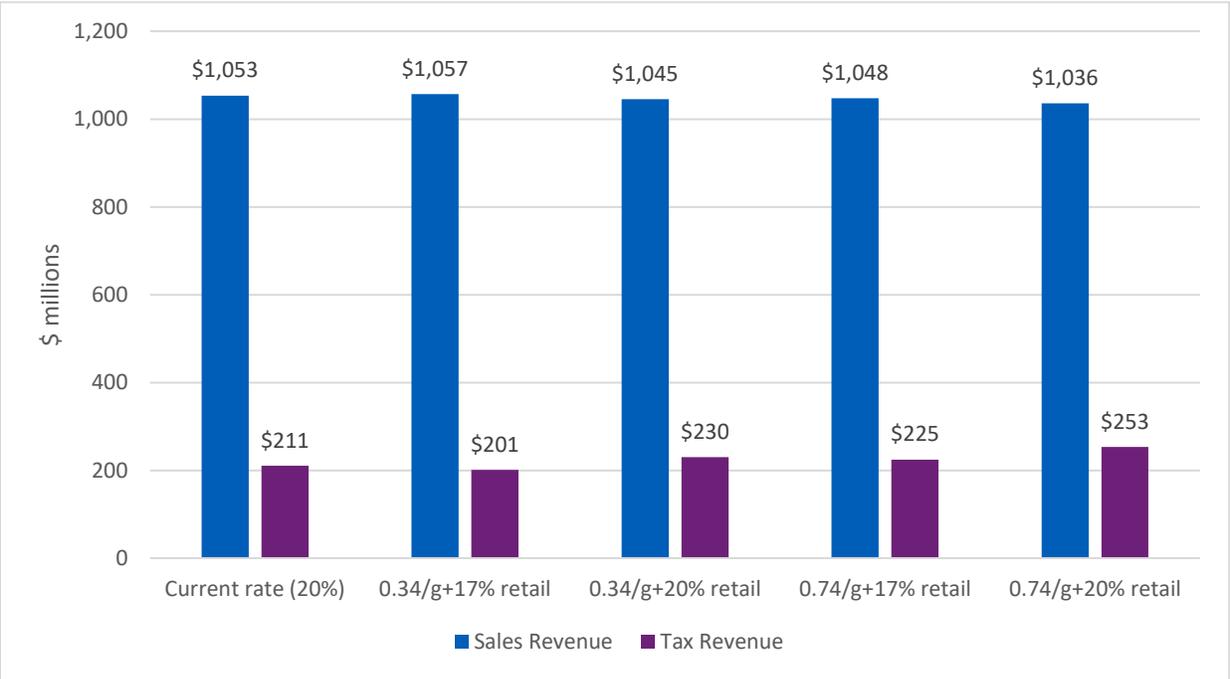
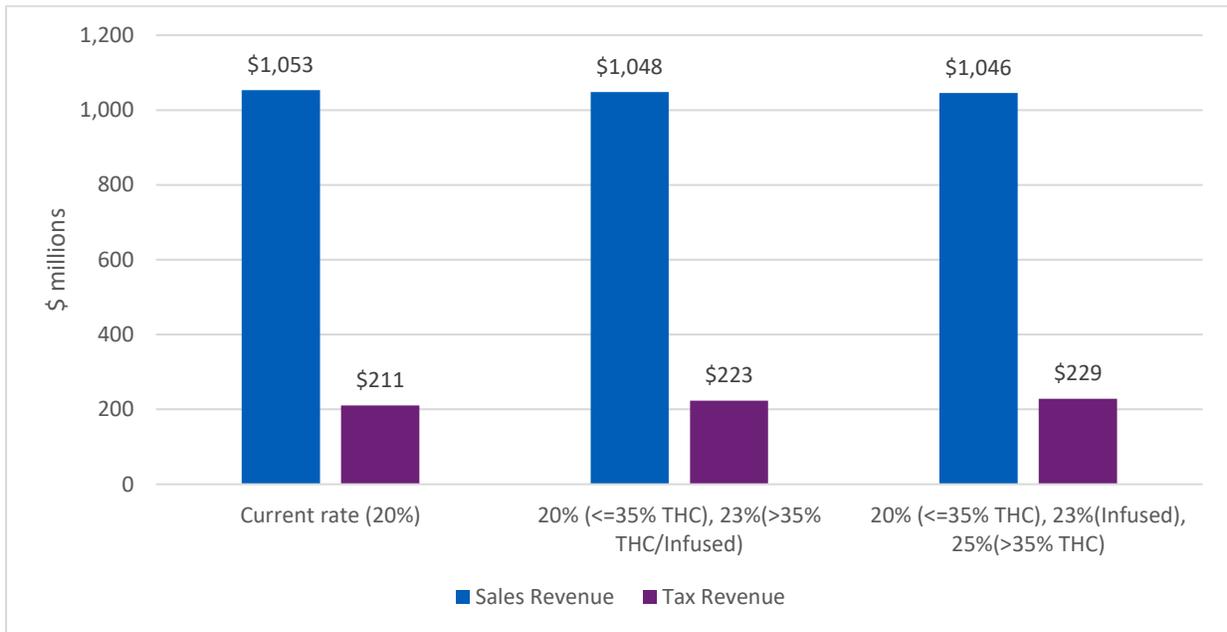


Exhibit 8 shows the estimated impact of potency-based tax schemes on projected tax revenues. Both THC-based tax schemes use a higher tax rate than the current 20% rate. Thus, both THC-based tax schemes are estimated to generate a higher tax revenue than the existing tax structure, given the current inelastic demand.

Across all the alternative tax schemes under consideration, a price-based tax rate at 25% is estimated to generate the highest tax revenue, with a tax revenue 23% higher than the current tax of 20%. All weight-based and potency-based schemes considered in this study result in relatively small changes in sales and tax revenue. Our estimates reflect the short-term change in sales and tax revenues under alternative tax schemes. The long-term changes remain uncertain, especially in a more mature market in the future. A higher tax rate may also lead to a potential move of consumers from the legal to the black market.

Exhibit 8. Projected annual cannabis sales and tax revenue by different THC-based tax rates (for the year starting on July 1, 2020)



As we have emphasized throughout this section, our projected tax revenue under alternative tax schemes relies on the current inelastic legal adult-use demand in Massachusetts. In a new market with a few retail stores, consumers may not be as sensitive to price changes. In a mature market with more stores and choices, a more elastic demand for adult-use cannabis is possible. For example, a recent study using three years (2014–2017) of adult-use cannabis sales data from the State of Washington estimated the price elasticity of cannabis sales at between -2.5 to -2.9, with 385 retailers in 2017.¹⁷

Appendix 3 shows the cannabis tax revenue estimates for a wide range of tax rates and price elasticities of demand.¹⁸ Under each price elasticity, the estimated tax revenue at each tax rate is expressed as a percent of the tax revenue at a 20% rate. For example, with a price elasticity of -0.44, the estimated tax revenue at a 25% tax rate is 23% higher than that at a 20% tax rate. The table also shows that with an inelastic demand (e.g., -0.44), a higher tax rate generates a higher tax revenue. When the demand becomes more elastic, a higher tax rate only leads to a higher tax revenue up to a certain tax rate, beyond which the tax revenue is estimated to decrease.

The numbers in Appendix 3 are estimated solely to demonstrate the potential impact of tax rates on tax revenue when the market becomes more elastic. The numbers should be interpreted with caution. Specifically, this table assumes a constant demand and consumer response to tax rate changes. In reality, market and consumer responses may change along with the tax rate changes. However, we do not have data to fully estimate the market and consumer responses in Massachusetts. Additionally, this

¹⁷ Hollenbeck B, Uetake K. October 2018. Taxation and Market Power in the Legal Marijuana Industry. UCLA Working Paper.

¹⁸ This analysis also assumes retailers pass through 100% of the additional tax burden to consumers across all price elasticity estimates.

table is likely to reflect short-term effects. It is uncertain whether these effects will persist in the long run, especially when the market becomes more mature and more competitive.

Other states' experience with alternative cannabis tax schemes

Nine other states have passed laws to allow adult-use cannabis sales. Appendix 4 provides a summary of the current cannabis tax structure in these states. While no two states have identical tax structures, five of the nine states have implemented a price-based tax scheme, making it the most common cannabis tax scheme. The popularity of a price-based tax scheme may be related to its ease of administration and enforcement. For example, a recent report from the California Legislative Analyst's Office noted that the state has an existing administrative structure for auditing and enforcing price-based tax payment, thus making it easier to enforce compliance.¹⁹ California does not require additional information from adult-use businesses, such as product weight and potency, which makes taxpayer compliance easier.²⁰

Three states have a weight-based tax scheme for adult-use cannabis sales: Alaska, California, and Maine. Alaska taxes cannabis cultivators based on product weight with no additional retail-based tax. California and Maine (scheduled to start in 2020) have a hybrid tax scheme that combines a weight-based tax on cultivators and a price-based retail tax. A weight-based tax scheme could be less vulnerable to revenue loss due to a cannabis price reduction.²¹ In other words, a weight-based tax scheme has the potential to generate cannabis tax revenue that is more stable than the price-based tax scheme.

However, a weight-based tax could incentivize the cultivation²² and consumption²³ of higher THC cannabis when cannabis products with the same weight but different potency are taxed at the same rate. Additionally, a weight-based tax scheme may increase administration and compliance burden. This is because state tax authorities may lack expertise in the weight of cannabis products, and states may not have a mechanism for consistent third-party verification of the weight of harvested plants.²⁴

Illinois is the only state that has a potency-based tax scheme, with a first legal adult-use sale in January 2020. Under a potency-based tax scheme, a higher tax rate is applied for higher potency cannabis products. A potency-based tax thus has the potential to discourage the harmful use of high-potency products, resulting in potential public health benefits.²⁵ Similar to a weight-based tax scheme, a potency-based tax scheme may also increase administration and compliance burden.

¹⁹ Petek G. December 2019. How High? Adjusting California's Cannabis Taxes. California Legislative Analyst's Office.

²⁰ *Ibid.*

²¹ Davis C, Hill ME, Philips R. January 2019. Taxing Cannabis. Institute on Taxation and Economic Policy.

²² *Ibid.*

²³ Opinion: There is a Better Way to Tax Legal Cannabis. April 12, 2019. Leafly. Available at <https://www.leafly.com/news/industry/opinion-theres-a-better-way-to-tax-legal-cannabis>, retrieved on June 6, 2020.

²⁴ Petek G. December 2019. How High? Adjusting California's Cannabis Taxes. California Legislative Analyst's Office.

²⁵ *Ibid.*

However, the cannabis industry has voiced the concern that, in addition to regulatory burden, it is difficult to measure the THC content accurately, which is critical for a potency-based tax.²⁶ Given a choice between a weight-based tax and a potency-based tax, the cannabis industry in Canada preferred the latter. The main reason was that it could potentially reduce auditing and accounting burdens, and it could ease pricing for low-potency products and potentially boost product availability, relative to a weight-based tax.²⁷

Regardless of the tax scheme, there are two potential threats to state cannabis tax revenue to consider, including black-market and cross-border competition. The impact of black-market competition on legal adult-use demand is not well understood, likely because of a lack of black-market sales data. Consumer surveys can be used to gauge black-market use. A report by the California Cannabis Advisory Committee noted that the black market continued to flourish due to the higher prices in the legal adult-use market and a lack of enforcement efforts to support licensed businesses.²⁸

A study of legal adult-use sales in Washington State shows that cannabis retailers passed all cost shocks to consumers. This suggests that consumers may be willing to absorb additional costs to stay in the legal market.²⁹ These conflicting observations could reflect the unique cannabis market in each state.

Cross-border competition poses another long-term risk to states with legal cannabis. When a state with legal cannabis borders states without it, it captures cannabis tourism revenues from the neighboring states. However, once a neighboring state legalizes cannabis sales, retail sales near the border can drop considerably. For example, retailers in Washington located along the border with Oregon experienced a 36% decline in sales immediately after Oregon started legal adult-use sales in 2015.³⁰

Market saturation

A challenge in a growing market is understanding the point of market saturation. When more stores enter the market, they may reduce the prices to capture diminishing market share. From the perspective of the tax authority, when the retail sales are taxed as a percent of sales, a decrease in prices can result in declining tax revenues. Therefore, it is important to understand the number of retail stores the market demand can support. Legal cannabis sales have a relatively short history in the United States, with states imposing different regulations. Thus, there is no exact answer as to the number of retail stores to reach market saturation.

Nevertheless, to shed light on this question, we look to the other three states that have a relatively long legal cannabis sales history: Colorado, Oregon, and Washington. By 2018 in Oregon, three years after

²⁶ The Stronger the Joint, the Higher the Tax? Report Weighs California Marijuana Tax Change. December 21, 2019. Anchorage Daily News. Available at <https://www.adn.com/nation-world/2019/12/21/the-stronger-the-joint-the-higher-the-tax-report-weighs-california-marijuana-tax-change/>, retrieved on June 6, 2020.

²⁷ Pot Sector Players Welcome Edibles Tax Change, Disappointed Medical Tax Remains. March 20, 2019. CBC. Available at <https://www.cbc.ca/news/business/pot-edibles-tax-change-1.5064871>, retrieved on June 6, 2020.

²⁸ California Bureau of Cannabis Control. 2018. California Cannabis Advisory Committee 2018 Annual Report.

²⁹ Hollenbeck B, Uetake K. October 2018. Taxation and Market Power in the Legal Marijuana Industry. UCLA Working Paper.

³⁰ Hansen B, Miller K, Weber C. February 2020. Federalism, Partial Prohibition, and Cross-Border Sales: Evidence from Recreational Marijuana. NBER Working Paper No. 23762.

the first legal adult-use sale, cannabis tax revenue has been unstable compared with Colorado and Washington.³¹ Oregon had significantly more stores per capita than Colorado and Washington, with 13.3 stores per 100,000 residents, compared to 9.0 and 1.3 in Colorado and Washington, respectively.³² Mapping the stores per capita onto Massachusetts's current population, Massachusetts is a long way from a possible saturation point, which may range from 627 to 921 stores, based on the experiences from Colorado, Oregon, and Washington.

³¹ The Pew Charitable Trusts. August 2019. Forecasts Hazy for State Marijuana Revenue.

³² How Many Dispensaries Are In Each State? February 12, 2018. High Times. Available at: <https://hightimes.com/dispensaries/how-many-state/>, retrieved on June 16, 2020.

4. Conclusion

Annual cannabis sales in Massachusetts have the potential to reach \$1 billion by June 2021 (i.e., July 2020 through June 2021) with the current tax of 20%, which will generate annual tax revenue of about \$200 million. The significant growth in cannabis sales and tax revenue is primarily driven by the increase in new retail stores in the coming year.

All alternative tax schemes, except for one weight-based tax scheme, are estimated to generate more tax revenue, compared with the current price-based tax of 20%. That being said, the changes in tax revenue under the weight-based and potency-based tax schemes are relatively small. Additionally, these changes in tax revenue may be short term in nature. It is unclear whether these changes will persist in the long run, especially in a more mature and more competitive market. A higher tax rate may also lead to a potential move of consumers from the legal to the black market.

The cannabis demand may become more elastic in Massachusetts as the market matures. With a more elastic demand, a higher tax rate may still generate more tax revenue, but only up to a certain threshold.

We also qualitatively assessed the potential advantages and disadvantages of the alternative tax schemes. A price-based tax is straightforward and has a lower administration and compliance burden for both state tax authorities and taxpayers. A weight-based tax may be less vulnerable to a price reduction in the long term and could contribute to a more stable tax revenue. However, a weight-based tax may inadvertently encourage the cultivation and consumption of more potent cannabis products. In contrast, a potency-based tax may generate public health benefits by discouraging the use of more potent products. Both weight-based and potency-based taxes may increase the administrative and compliance burdens on state tax authorities and taxpayers. Decisions about tax scheme changes require careful consideration of their revenue and nonrevenue impacts.

Our results are based on several assumptions and have significant limitations. Any projection of future tax revenue is inherently uncertain. Our projection is further complicated by the considerable uncertainties around the impact of COVID-19 on the economy and, more specifically, on the legal adult-use cannabis market in Massachusetts. The results of this study should be interpreted with careful consideration of these assumptions and limitations.

In short, we found that alternative regimes—based on weight or potency—result in relatively small changes in sales and tax revenues. Increasing the current rate may result in higher revenues in the short term, but in the long term may lead to a potential move of consumers from the legal to the illegal market. The legal cannabis industry in Massachusetts is in an infant stage, and a large-scale change to taxation could cause unpredictable disruption to the market.

Future analyses

Future analyses are needed to understand the potentially changing impacts of alternative tax schemes. CCC should consider undertaking additional analyses to understand the possibly changing impacts of

alternative tax schemes. First, the cannabis sales and tax revenue forecast model will require periodic re-estimation to reflect changing market and consumer behavior in a more mature market, especially in a post-COVID “regime.” How consumers respond to price and tax changes may evolve, which may affect the forecast of cannabis sales and tax revenues.

Second, an economic impact analysis can provide a more comprehensive understanding of the economic benefits of the adult-use cannabis market in Massachusetts. The economic benefits include not only the cannabis tax revenues but also the job creation and contribution to the gross state product. An economic impact analysis can also help CCC estimate the additional tax revenues from industries in the cannabis supply chain that benefit from the legal cannabis market.

Appendix

- Appendix 1: Weight and potency conversion
- Appendix 2: Regression model output
- Appendix 3: Tax revenue by tax and price elasticity
- Appendix 4: Adult-use cannabis tax scheme by state

Appendix 1: Weight and potency conversion

To project tax revenue for weight-based and THC-based tax schemes, we impute the weight and potency for each cannabis product group based on the following approach:

Weight conversion

1. Raw cannabis products:
 - 1.1. If weight data were available for raw cannabis, no conversion was necessary.
 - 1.2. If weight data were not available, the price was divided by the average price of a gram of cannabis. This amount was then used as the weight.
 - 1.2.1. E.g., no known weight, the average price per gram = \$14 (calculated from the known set), price of a unit in a given row of data is \$49, $\$49/\$14 = 3.5$ grams.
2. Infused products:
 - 2.1. The average amount of THC in milligrams was calculated for each infused category by unit: 0.09 grams per infused (edible) and 0.22 grams per infused (nonedible).
 - 2.2. The THC milligram weight was multiplied by 5.2, the grams of raw cannabis that are used to manufacture one gram of an infused or concentrate product.³³
3. Concentrate products:
 - 3.1. If the weight data were available, the weight of the final product was multiplied by 5.2 to derive the source weight.
 - 3.2. If the weight data were not available, it was calculated at unit-to-gram on a 1-to-1 basis, then multiplied by 5.2.

Potency conversion

We grouped the product categories following Illinois's approach to segment cannabis products into three THC levels. Research and confirmation from the CCC indicate that raw cannabis products do not exceed 35% THC by volume.³⁴ Using the same data and with confirmation from the CCC, it was concluded that concentrate products nearly always exceed 35% THC. THC calculations and research were unnecessary for infused products as they are already aligned with the Illinois tax scheme.

³³ The conversion ratio was confirmed through conversations with subject matter experts at the CCC.

³⁴ Source <https://patriotcare.org/greenfield-menu/> and <https://www.cultivatemass.com/leicester-menu>, retrieved on April 13, 2020.

Appendix 2: Regression model output

The table below presents the factors that determine the quantity of cannabis sold in the Massachusetts legal market. The analysis is based on daily sales totals by store and product group. The data covers the period from November 2018 to March 2020, and a total of 30,224 observations.

The coefficient of the Ln (Price) reflects the percentage-point change in the daily sales of legal cannabis associated with a 1 percentage-point change in its price. Each 1-percentage-point increase in the price of legal cannabis is associated with a decrease in daily sales of legal cannabis of 0.44 percent. Similarly, the coefficient of the Ln (Black-market price) reflects the percentage-point change in the daily sales of legal cannabis associated with a 1 percentage-point change in the price of black-market cannabis.

Independent Variables	Ln (Quantity Sold)	
	Coefficient	Standard Error
Ln (Price)	-0.44***	(0.01)
Ln (Black-market price)	0.11***	(0.02)
Infused (base = Concentrate)	-1.33***	(0.02)
Raw (base = Concentrate)	1.63***	(0.02)
Number of Active Retailers	-0.001	(0.002)
Store Age	0.20***	(0.01)
Store Age Squared	-0.01***	(0.0004)
Vape Ban * Concentrate	-0.69***	(0.01)
Vape Ban * Infused	0.03*	(0.01)
Vape Ban * Raw	0.08***	(0.01)
Constant	6.45***	(0.07)
Sample Size (retailer/product group/day level)	30,224	
R-squared	0.91	

Note: *** p<0.01, ** p<0.05, * p<0.1. Coefficients of store fixed effects not shown.

Appendix 3: Tax revenue by tax rate and price elasticity

		Price Elasticity of Demand								
		-0.44	-0.5	-1	-1.5	-2	-2.5	-3	-3.5	-4
Tax Rate	10%	52%	52%	54%	56%	58%	60%	63%	65%	67%
	15%	76%	77%	78%	80%	81%	83%	84%	86%	88%
	20%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	25%	123%	122%	120%	117%	115%	112%	109%	107%	104%
	30%	145%	144%	138%	131%	125%	119%	113%	106%	100%

Note: Red cells indicate a lower tax revenue compared with the current 20% tax rate. Green cells indicate a higher tax revenue compared with the current 20% tax rate.

Appendix 4: Adult-use cannabis tax scheme by state

State	Taxed Transactions	State/(Local) Retail Tax	Cannabis Tax Rate(s)
Alaska	Cultivation	0%	\$50/ounce for flower \$15/ounce for trim \$25/ounce for immature flowers/buds \$1.00 per clone
California	Cultivation/Retail	7.25% + (0 to 3.25%)	15% – Retail sales \$9.65/ounce for flower \$2.87/ounce for leaves \$1.35/ounce for fresh plant material
Colorado	Cultivation/Retail	0% ³⁵ + (0 to 8.3%)	15% – Retail sales 15% – State cultivator excise tax
Illinois	Cultivation/Retail	6.25% + (0 to 4.75%)	7% – Sales to dispensaries 0 to 3% – Local tax [7/1/2020] 10% – Retail sales (THC<35%) 20% – Retail sales (Infused) 25% – Retail sales (THC>35%)
Maine	Cultivation/Retail	5.5%	10% – Retail sales \$20.94/ounce for flower \$5.86/ounce for trim \$1.50 per seedling \$0.30 per seed
Massachusetts	Retail	6.25%	10.75% – State retail sales 3% – Local retail sales
Michigan	Retail	6%	10% – Retail sales
Nevada	Cultivation/Retail	6.85% + (0 to 1.525%)	15% – Sales to dispensaries 10% – Retail sales
Oregon	Retail	0%	17% – State retail sales 3% – Local retail sales
Washington	Retail	6.5% + (0.5 to 4%)	37% – Retail sales

Note: Tax scheme at the time of this study.

³⁵ While Colorado has a statewide retail sales tax, it is not applied to cannabis sales.

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