

**Standardized Regulatory Impact Assessment (SRIA)
Proposed Regulations for Manufacturers of Medical Cannabis**

Prepared for the California Department of Public Health

by the Humboldt Institute for Interdisciplinary Marijuana Research



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Summary

Proposed regulations on medical cannabis manufacturers by the California Department of Public Health under the Medical Cannabis Regulation and Safety Act of 2015 (MCRSA) are expected to increase annual industry costs by \$39.1 million or 17.2 percent of manufacturer sales to dispensaries starting in 2019. In 2018, the first year of regulation, industry costs are estimated to be \$51.9 million for medical cannabis manufacturers. Currently, manufactured medical cannabis sales at dispensaries are estimated to be \$650 million, which is one-fifth of all manufactured cannabis sales. We predict there will be a noticeable fall in the risk premium after manufactured medical cannabis is regulated, which will increase supply, offset regulatory costs, and keep prices for manufactured medical cannabis from rising with regulations. We estimate that the benefits of the proposed regulations outweigh the costs. The expected impact of the proposed MCRSA regulations on manufactured medical cannabis is an increase in California Gross State Product by \$26 million annually. This analysis was made expecting that in January 2018, manufactured cannabis will be regulated under both MCRSA and the Adult Use of Marijuana Act of 2016 (AUMA). Under the combined effects of MCRSA and AUMA, there will be a relatively greater price decline in the recreational market and the production of manufactured medical cannabis is expected to decline by about 34 percent from baseline.

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Introduction

Medical Cannabis Regulation and Safety Act (MCRSA) and Regulatory Authority

This Standardized Regulatory Impact Analysis (SRIA) is written by faculty affiliated with the Humboldt Institute for Interdisciplinary Marijuana Research (HIIMR) and analyzes the economic impact of regulations proposed by the California Department of Public Health (CDPH) for the manufacture of medical cannabis. HIIMR began work for this impact analysis in August 2016, and completed an initial draft in early December 2016. The final draft was completed in January 2017.

The authority to regulate medical cannabis was granted in Assembly Bill (AB) 243 (Chapter 688, Statutes of 2015), AB 266 (Chapter 689, Statutes of 2015 and Senate Bill (SB) 643 (Chapter 719, Statutes of 2015), which are collectively known as the Medical Cannabis Regulation and Safety Act of 2015 (MCRSA). Among other things, AB 243 instructs CDPH to develop standards for the production and labeling of edible and manufactured medical cannabis products.

AB 266 defines the various terms and concepts within medical cannabis including “manufactured cannabis,” which is “raw cannabis that has undergone a process whereby the raw agricultural product has been transformed into a concentrate, an edible product, or a topical product.” Additionally, a “manufacturer” is “a person that conducts the production, preparation, propagation, or compounding of manufactured medical cannabis...or medical cannabis products either directly or indirectly or by extraction methods, or independently by means of chemical synthesis or by a combination of extraction and chemical synthesis at a fixed location that packages or repackages medical cannabis or medical cannabis products or labels or relabels its container.” It also defines the two license types of cannabis manufacturers. “Manufacturing level 1” (Type 6 license) refers to manufacturing sites that produce medical cannabis products using nonvolatile solvents, while “Manufacturing level 2” (Type 7 license) represents manufacturing sites that produce medical cannabis products using volatile solvents. AB 266 instructs CDPH to limit the number of licenses of this latter type. Also, manufacturers may cultivate cannabis or dispense cannabis, but they cannot do both. Through 2026, this restriction does not apply to businesses that have been operating in a local jurisdiction that requires “vertical integration” of cannabis businesses.¹ Finally, AB 266 lists specific labeling and packaging requirements for manufacturers.

¹ “Vertical integration” refers to a cannabis business that cultivates, manufactures, *and* dispenses cannabis products.

SB 643 requires CDPH to incorporate certain provisions for the licensing of manufactured medical cannabis products, such as requiring the licensee to describe the extraction and infusion methods and submitting criminal background checks, among other provisions.

SB 837, Chapter 32, Statutes of 2016, replaces “marijuana” with “cannabis” in the names of the newly created state agencies and laws, and moves authority to regulate cannabis testing labs from CDPH to the Bureau of Medical Cannabis Regulation (BMCR), as originally written in AB 243, AB 266, and SB 643. SB 837 would also authorize CDPH to issue fines and order production abatements, recalls, or embargos when it has evidence that a medical cannabis product is adulterated or misbranded.

Scope of Work and Relationship to Proposition 64

This SRIA looks at manufacturers of medical cannabis that are legal under California State law. The three current markets for cannabis are: (1) legal medical sales under Proposition 215 (medical market), (2) illegal domestic sales within California (underground or illegal market), and (3) illegal exports to other states (export market).² During the writing of this SRIA, California voters approved Proposition 64, the Adult Use of Marijuana Act (AUMA), which made it legal to grow, manufacture, transport, sell, and consume small amounts of cannabis without obtaining a physician recommendation as required under Proposition 215. The passage of Proposition 64 creates a fourth market: recreational sales and legal adult use (recreational market). We believe that consumers of cannabis will generally purchase cannabis from the market that offers the lowest price. If the price of legal medical cannabis rises due to regulatory costs, the medical market will quickly shrink. This analysis addresses the question, “What will MCRSA regulations do to the price of medical cannabis relative to the recreational market and to the illegal domestic market?”

The passage of Proposition 64 poses challenges for the baseline numbers of this SRIA, and for estimating the impact of MCRSA regulations. It is difficult to separate the effects of MCRSA and AUMA, because (1) both laws will be implemented at the same time (January 1, 2018), and (2) because adding a recreational use market will impact the medical market. The baseline numbers provided in this analysis focus only on the medical use market. This report attempts to answer the question, “What will be the impact of new MCRSA regulations on medical, recreational, and illegal cannabis manufacturing and the California economy given the anticipated regulations and effects from AUMA?” We assume that a functioning and regulated recreational cannabis market will coexist when MCRSA regulations go into effect. This SRIA estimates the impact of MCRSA regulations, not the impacts of AUMA regulations, but we believe that the recreational market will face similar regulatory costs as the regulated medical market.

² We limit our analysis to production of cannabis in the medical, recreational, and illegal markets and ignore home production. Additionally, we do not believe the consumer considers cannabis purchased out of state to be a close substitute for in-state cannabis.

Manufactured cannabis products usually include a process of extracting compounds from the raw flower and cannabis plant or infusing extracting compounds into other products. Cannabis that is simply dried and packaged is not considered a manufactured product. In addition to manufactured products, MCRSA grants authority to the State to regulate cannabis cultivation, distribution, transportation, testing, and dispensary sales. While this report considers those areas in the supply chain, it is beyond the scope of this work to explicitly detail regulations in those areas.³

Public Input Description

CDPH, along with BMCR, conducted preregulatory stakeholders meetings to provide the public with an opportunity to participate in discussions on specific topics regarding dispensaries, distributors, manufacturers, testing laboratories, and transporters. The meetings were held in Redding, Sacramento, Santa Rosa, Oakland, Fresno, Los Angeles, San Diego, and Santa Ana during September and October 2016. Members of HIIMR attended over half of the meetings to solicit input from stakeholders and to compile a contact list for our survey.

Description of Medical Cannabis Manufacturing and Products

Cannabis Manufacturing Methods

There are a variety of processing methods used in cannabis extractions: Distillation, Pressing, Pressurized Solvent-Based Extraction, Tumbling, and Dry Sifting.⁴

Distillation – This method uses cold water, dry ice, or alcohol to extract the oils and terpenes from cannabis flower or trim.⁵ It is also used as a method to remove unwanted compounds from existing cannabis oil.

Pressing - Cannabis flowers and/or kief are pressed between heated metal plates protected by parchment paper, forcing the oils, cannabinoids, and terpenes to leave the plant.⁶

Pressurized Solvent-Based Extraction – Home and commercial grade extraction machines commonly used to produce food and medical grade essential oils and flavors use butane, CO₂, hexane, water, and/or propane that bonds to cannabinoids and terpenes. The resulting oil is

³ In addition to CDPH, MCRSA grants regulation authority for medical cannabis to the BMCR under the Department of Consumer Affairs and to the California Department of Food and Agriculture (CDFA). CDPH, BMCR, and CDFA contracted economists to perform the three SRIAs as required for MCRSA. BMCR is responsible for regulations on testing labs, dispensaries, transporters, and wholesalers. CDFA is responsible for regulations on cultivators. The three economic teams produced independent SRIAs; however, they held regular conference calls to share data, surveys, and methodologies.

⁴ See <https://blackrockog.com/blogs/learn/78049414-what-are-cannabis-concentrates-a-guide-to-extraction-techniques>

⁵ “Trim” is the industry term for trimming materials that are removed from the cannabis flower before sale.

⁶ Kief is a grade of dry sift that contains a mixture of trichome heads, stalks, and cannabis plant matter.

purified through evaporation or distillation.

Tumbling - Cannabis flower and/or trim is placed in a perforated chamber and spun to allow *tetrahydrocannabinol* (THC)-rich trichomes, called kief, to fall onto a collection tray. Kief is used to make tinctures, rosin, and hash.⁷

Dry Sift – A series of mesh silk screens or sieves are used to separate the trichomes from the cannabis flower or leaf.

Cannabis Manufacturing Products

Edibles - Cannabis can be used in nearly every food product commonly available in stores such as candies, cookies, pretzels, pasta, butter, soda, infused juices, salad dressing, beer, wine, barbecue sauce, and corn chips. Large-scale manufacturers often use steam distillers and/or supercritical CO₂ extractors to produce oil for edibles. Small- and medium-scale producers of edibles, especially bakers, often infuse butter, coconut oil, olive oil, or other typical cooking fats with cannabis.⁸

Tinctures -Tinctures are made from cannabis trim, leaf, and/or bud that are soaked in alcohol and/or glycol or vegetable glycerin. Carbon filters are often used to remove chlorophyll from the finished product. Home and commercial grade distillation units use water or alcohol to remove cannabinoids, which produces concentrated cannabis oil. Many tinctures are infused with common herbs like lavender, basil, rose petals, and mint, and are sold in small bottles.

Butane Hash Oil (BHO) - Sold in liquid or hardened form, it is also known as shatter, wax, crumble, and BHO. Pressurized butane is forced through a vessel containing cannabis buds, trim, and/or kief. Cannabinoids, terpenes, and flavonoids adhere to the butane, forming oil. The butane-rich oil is then left exposed to evaporate or is placed in a vacuum oven where the butane is forced to evaporate. The consistency of BHO products varies depending on cannabis quality, strain, and post-extraction processes. BHO is often mixed with glycol to enhance viscosity for use in vaporizer cartridges.

CO₂ Oil - Liquid CO₂ is heated and pressurized to a supercritical state that hovers between liquid and gas, which is forced through a vessel containing cannabis. Finely ground cannabis trim is most often used, but buds, leaf, and kief are also popular. CO₂ extraction allows manufacturers to separate terpenes from cannabinoids. The oil is sold raw or decarboxylated (heated to 110°C for approximately two hours) in gel caps, syringes, and vaporizer cartridges. Most large-scale manufacturers add glycol (propylene and ethylene) to CO₂ oil in order to maintain a level of viscosity amenable for use in vaporizer cartridges. CO₂ oil is the most

⁷ Rosin tech is a solvent less hash oil that utilizes heat and pressure to extract oil from cannabis flower.

⁸ One large-scale manufacturer of chocolate-based candies melts finely ground hashish into their products.

common medium for low-THC, **cannabidiol** (CBD⁹)-rich oils popular among patients with epilepsy, Crohn's disease, cancer, and chronic pain.

Rosin Tech - Cannabis flowers and/or kief are pressed between heated metal plates protected by parchment paper forcing the oils, cannabinoids, and terpenes to leave the plant.¹⁰ The rosin that is collected hardens into a gum-like consistency.

Topicals - Topicals are cannabis infused lotions, salves, sprays, balms, and oils that are applied to the skin.

Baseline

Data Sources

Reliable and current data on this industry are difficult to find “off the shelf.” Therefore, we relied to a large degree on primary data collected through our own surveys.¹¹ In fall 2016, we surveyed manufacturers through an online survey that was advertised to hundreds of manufacturers that we had identified through the pre-regulatory process, and by other means. We also spoke with individual industry business representatives. In summer 2016, we surveyed dispensaries. Finally, we used preliminary data from an ongoing survey of dispensary patients. We made every effort to use data from peer-reviewed or official sources, but at times we have had to rely on the popular press or other non-refereed published sources. All of these online data sources are referenced and described below.

Current Market Estimates

Calculating the baseline for this analysis is challenging given the lack of uniform, reliable data for cannabis manufacturing and the medical cannabis market. The California Board of Equalization (BOE) collects sales tax, and dispensaries of medical cannabis are required to obtain a seller's permit with BOE.¹² Manufacturers and cultivators are also asked to obtain a seller's permit, and in our survey of manufacturers all respondents held a seller's permit. However, the BOE does not know precisely which companies with seller's permits are in the cannabis industry because businesses are asked to provide their North American Industry Classification System (NAICS) code, and there is no NAICS code for the cannabis industry. The BOE also states on the seller's permit registration site that cannabis businesses are not required to disclose what they sell. BOE has partnered with HdL Companies to use publicly available information to identify cannabis businesses. BOE estimated that in 2015 publicly

⁹ CBD or cannabidiol is a chemical in extracted cannabis oil.

¹⁰ See <https://errlax.com/2015/03/24/rosin-tech-explained/>

¹¹ We tried to get as many businesses as possible to respond, but it is difficult to know if our respondents are representative of businesses in California.

¹² See https://www.boe.ca.gov/industry/medical_cannabis.html#Started

disclosed medical cannabis sellers registered with BOE filed returns and remitted sales and use tax in the amount of \$58,012,269. For the first six months of 2016, remitted sales and use taxes totaled \$50,507,006. We attribute the increased revenue to greater compliance by dispensaries due to the desire to have proper documentation in anticipation of permitting. This makes it difficult to compare 2015 to 2016 (first six months) tax receipts, so we averaged annualized collections to arrive at \$79,513,141.¹³ We take this as the official number upon which we base our medical cannabis market estimate.

California sales tax is 7.25 percent, but districts can set an additional rate, up to ten percent total sales tax. Using the most recent BOE data, they report an average sales tax rate of 8.8 percent that dispensaries collect.¹⁴ We make two adjustments. First, we assume that 40 percent of sales are not reported.¹⁵ Second, we assume that on average four percent of sales are for items other than cannabis, such as t-shirts.¹⁶ After making these two adjustments, we arrive at an estimate of total medical cannabis dispensary dollar sales in 2016 of \$2.2 billion.

We can compare our estimates to others' estimates. New Frontier Data and ArcView Market Research estimate the California 2016 medical cannabis market to be \$2.81 billion.¹⁷ We also consider Washington, which legalized medical cannabis in 1998, soon after California. The U.S. Census estimates Washington's population in 2015 to be 7.2 million, while California's population to be 39.1 million.¹⁸ Kleiman, Davenport, and Rowe, et al., (2015) estimate the size of the medical marijuana market in Washington to be \$480 million.¹⁹ California's population is 5.4 times that of Washington, which implies a California medical cannabis market to be \$2.6 billion, if cannabis sales are proportional to population.

We next work backward from our estimate of dispensary sales to total medical cannabis manufactured products sales. We assign 30 percent of dispensary sales to manufactured products and 70 percent of sales to cannabis flower sales. This number is similar to what we have been told when talking with dispensaries, although some report manufactured products sales of 40 to 50 percent. The Marijuana Business Factbook, 2016, estimates the percent of manufactured cannabis sales to be 30 percent.²⁰ Preliminary survey data of dispensary patients finds that 50 percent of dispensary patients bought a manufactured product on their last visit, while 25 percent bought both a manufactured product and flower cannabis.²¹ Using the 30 percent share of manufactured products, our estimate of total manufactured medical cannabis sales in 2016 is \$650,562,058. Sales from manufacturers to dispensaries are equal to

¹³ 2016 annualized sales are \$101,014,012.

¹⁴ See <https://www.boe.ca.gov/news/marijuana.htm>

¹⁵ Based on comments by BOE Chairwoman Fiona Ma. See

<http://www.sfchronicle.com/bayarea/article/State-pot-measure-may-cost-millions-before-it-10596009.php>

¹⁶ This result comes from our summer 2016 dispensary survey.

¹⁷ ArcView (2016) "2016 Legal Cannabis Market: California State Profile."

¹⁸ See <http://www.census.gov/quickfacts/>

¹⁹ See <http://www.lcb.wa.gov/publications/Marijuana/BOTEC%20reports/BOTEC-MMJ-Report.pdf>

²⁰ See <https://mjbizdaily.com/wp-content/uploads/2016/03/Factbook2016ExecutiveSummary.pdf>

²¹ See Eschker and Gold (2016), "Medical Marijuana Patient Survey," preliminary findings.

dispensary manufactured product sales minus the dispensary marketing margin, which we take to be 65 percent.²² Thus, if retail manufactured product sales are \$650,562,058, then manufacturer sales to dispensaries are 35 percent of this amount, or \$227,696,721.

There is no direct count of the number of medical cannabis manufacturers in the state, and estimating this number is difficult. While there are multiple ways to arrive at the number of manufacturers, the estimates often generate implausible values for employees per business or output per employee. In summer 2016, CDFA conducted a widespread survey of the cannabis industry and found that 1,971 people said they intend to apply for either a Type 6 or Type 7 manufacturer license. This number represents respondents' future intent and is not necessarily equal to the total number of current medical cannabis manufacturers. In Colorado, there are currently 248 licensed "medical marijuana infused products manufacturers." Colorado's medical cannabis sales in 2015 were \$408,350,569, which yields \$1,646,575 per manufacturer. Using the same ratio to our estimate of California retail sales, there would be 1,317 manufacturers in California as long as there are not significant differences between the Colorado and California medical markets. However, both of these estimates for the number of California manufacturers are inconsistent with our survey results and discussions with industry business people regarding average employees per firm and sales per firm. Using industry ratios, we estimate there are 1,000 manufacturing businesses in the medical market and 4,140 employees in California.

We assume that manufactured sales in the medical cannabis market are 35 percent edibles, 60 percent concentrates, and 5 percent topicals. This breakdown of the manufactured sector is based on conversations with dispensaries and manufacturers. For fiscal year 2015-16, Washington reports a similar breakdown.²³ We can convert total sales into sales in these three categories using these percentages. However, we also want a quantity number for "total manufactured sales," but manufactured products are an extremely heterogeneous group. To simplify the analysis, rather than looking at three separate markets, we attempt to combine all manufactured products using a common measure. Since extracted oil is common to all concentrates, we use "oil grams" as the standard measure and ask, "How many units are made with one gram of oil?" We then use the average price per unit to calculate the price for one oil gram production equivalents. For example, we find that edibles are typically priced at \$3 per 10mg THC content.²⁴ Oil typically has 60 percent THC content, which means that one gram of oil will make 600mg of THC content, or the equivalent of 60 10mg edibles. Thus, one oil gram is found in \$180 of edibles on average, and we use \$180 as the price of edibles.²⁵

²² This estimate comes from our survey and discussions with BMCR and CDFA economists. Marketing margin is (Retail Price-Wholesale Cost)/Retail Price.

²³ See <http://lcb.wa.gov/publications/Marijuana/MJ-Dashboard/FY%202016%20Dashboard%20Data.xlsx>. The amounts calculated from this report are 46 percent edibles, 53 percent concentrates, and about 1 percent topicals.

²⁴ THC stands for Tetrahydrocannabinol and is the main psychoactive compound in cannabis.

²⁵ There is an incredible range in the price of all manufactured products, but we tried to find the typical or average price. For example, bulk concentrates tend to be much cheaper than individually packaged products. Perceived quality also has a large effect on price.

We use the same one gram of oil per \$180 for topicals as well, although it is particularly challenging to find a typical unit of measure or price for topicals. One gram of oil goes into producing one gram of concentrates, and we use as the price of concentrates \$60 per oil gram. With these oil production conversions, we estimate the amount of cannabis extracted oil used in the manufacture of medical cannabis sales in 2016 to be 7,871,801 oil grams [or 7.9 metric tons]. We can also estimate, on average, a manufactured product made with one gram of oil sells at wholesale for \$28.93 and at retail for \$82.64.²⁶ The current California medical cannabis market baseline is shown in Table 1.

Table 1: “Current Baseline” for California Medical Cannabis Manufacturing, 2016

Manufactured Products Dispensary Retail Sales	\$650,562,058
Manufacturer Sales to Dispensaries	\$227,696,721
Number of Businesses	1,000
Number of Employees	4,140 (includes part-time, seasonal, and owner-operators)
Amount of Cannabis Oil Used in Production	7,871,801 oil grams [or 7.9 metric tons]

Major Regulatory Status Determination

An initial calculation was performed, and it was determined that it was likely that proposed CDPH regulations on medical cannabis manufacturers would reach the \$50 million threshold for an economic impact within a 12-month period. We have refined the additional cost and impact calculations and estimate that in 2018, the year of initial implementation, increased direct costs to medical cannabis manufacturers will be \$51,856,163.

Regulation Summary

License Types

MCRSA creates two license types for manufacturers: Type 6 manufacturers extract using nonvolatile solvents, and Type 7 manufacturers extract using volatile solvents. CDPH is creating two additional license categories: Type N for manufacturers that produce edible products, topical products, or other types of cannabis products (infusion), and that do not extract oils and Type P for manufacturers that do not manufacture the actual product, but only package and label those products. Under the proposed regulations, a Type 7 licensee may also conduct extractions using nonvolatile solvents or mechanical methods on the licensed premises, provided the extraction process is noted on the application form, and the relevant information is

²⁶ \$28.93 per oil gram equivalent is equal to \$227,696,721 worth of wholesale divided by 7,871,801 grams of oil produced.

provided to CDPH. A Type 6 or Type 7 licensee may also conduct infusion operations and/or packaging on the licensed premises without needing an additional license.

MCRSA also places limits on the number of different license types that a manufacturer may possess, as well as the types of additional licenses. No manufacturers can hold a Type 8 (testing facility) or Type 11 (distributor) license.

Regulation Description

The proposed regulation covers labeling, packaging, background checks, license fees, BOE seller's permits, bonding, local permitting requirements, infrastructure standards, closed loop extraction systems, standard operating procedures, general licensing requirements, limits on additives, and the Track and Trace requirement. The costs of these requirements are discussed below.

Regulatory Impacts

Overview

MCRSA moves the medical cannabis industry in California from an unregulated industry with uncertain legal status to an industry with regulations typical of an industry that uses a federally controlled substance. For manufacturers, this move toward regulation is particularly impactful since there was essentially no statewide or local regulation because cannabis manufacturing was illegal under state law.

AB 2679, Chapter 828, was signed on September 29, 2016, and clarifies for local governments the types of manufacturing of medical cannabis allowed during the interim period before MCRSA is fully implemented. This is important for cannabis manufacturers, because they generally are considered to have the least secure legal status of any segment in the supply chain, and have been subject to continued law enforcement scrutiny. Accidents surrounding some extraction processes have caused fires and explosions, which have led to injury and property loss. As a result, as of October 2016, at least 14 cities have enacted restrictions on butane sales, which is a key input in the pressurized solvent-based extraction process. These cities are Anderson, Biggs, Chico, Corning, Eureka, Gridley, Los Angeles, Ontario, Orland, Oroville, Red Bluff, Redding, Shasta, and Willows. Most of the restrictions limit the sale of refined butane to no more than 600ml per month to a single customer, and require retailers to record customer identification.

Costs

CDPH gave HIIMR an initial draft version of the proposed regulations to support the SRIA in October 2016, and the rest of this section provides cost categories from the most current

working version of the regulations that was available. There are 14 categories of key new requirements. We estimated the additional industry costs of implementing the specific regulatory requirements. However, for general licensing requirements, we combined them into a broad category and made an overall estimate of their costs.

Labeling

Proposed regulations require a primary and informational panel that: identifies the product as cannabis-infused; has a “cannabis product symbol;” lists THC and CBD content in milligrams; identifies manufacture dates; lists warnings, such as “For medical use only”, ingredients, allergens; and identifies the “best by” date of the product, among other requirements. Label font size is also specified and there is a list of label restrictions. We contacted a number of label makers to find the cost of a label, and we assume that one label can contain both primary and informational panels. Common label sizes were 2”x3” and 4”x6,” and we discovered the average cost per label in bulk. Averaging between the two label sizes gave an estimated cost of 11.3 cents per label. Many oils and concentrates sold in bulk currently have no label, but many manufactured products currently have labels already, including most edibles and topicals. We estimate that on average, one-half of manufactured units currently sold by the manufacturer have labels and manufacturers must begin adding labels to the other half of the units they produce.

Cannabinoid Content Testing

In order to properly label their products with accurate THC and/or CBD content, we assume that manufacturers will submit their products for testing. We contacted testing labs and a large manufacturer about the costs involved. Bulk discounts lowered laboratory charges to about \$50, and indicated that manufacturers typically tested each batch they produce. It is also possible to conduct testing in-house, if the manufacturer is willing to purchase the machinery and train employees, and these costs could run over \$100,000. We assumed a testing cost per batch of between \$25 for in-house testing and \$50 for lab testing. We also assumed a mix of “full-time” large (25 percent), “full-time” small (25 percent), and “part-time” small (50 percent) manufacturers. The full-time producers test about 16 batches a month and the part-time producers test about two per month. Our estimated average cost per firm in the industry is \$4,225 per year.

This testing to determine cannabinoid content does not replace the required testing for product safety that is required to be performed by an independent, licensed laboratory.

Packaging

Proposed regulations require tamper and child-resistant packaging. We assume that all edible and topical makers already package their products, and that half of the concentrate makers use packaging. We contacted a number of packaging makers and obtained costs for both tamper and child-resistant packaging, and compared the cost to packaging that does not meet that requirement. We looked at a range of packaging that included pouches and bottles suitable for

solids and liquids, and prices ranged from seven cents to \$1.10 per unit. We wanted to know what the extra cost would be to purchase compliant packages. The extra cost was estimated to be 4.4 cents per package.

Live Scan and Background Checks

CDPH will require Live Scan background checks for “owners” of manufacturing businesses, where ownership is anyone that participates in the direction or control of the business or has a five percent financial interest or more, as well as “associated” owners that include spouses. We cannot find reliable data on how many current workers in the cannabis industry have prior criminal convictions, and we decided against asking for criminal backgrounds in our surveys because we were not convinced that respondents would be truthful. CDPH anticipates reviewing cases on an individual basis, and it may be that only serious felonies and assaults, or selling cannabis to minors, may disqualify someone from obtaining a license. Additionally, AUMA allows those with prior criminal convictions to be resentenced according to new sentencing standards and potentially have their records purged.²⁷ The combined effect of regulatory forbearance and record purging may mean that all would-be owners with all but the most egregious convictions will be allowed to participate in the industry. Nevertheless, we believe this regulation has the potential to limit the number of experienced owners and managers in the industry and that may lead to reduced efficiency as talented managers and owners are denied the opportunity to run a business. These effects are difficult to quantify, and we assume the cost of reduced talent in the industry at 0.2 percent of current sales.

Direct prices for Live Scan vary depending on where fingerprints need to be sent, but prices can be as high as \$87 and take as long as four to six weeks to be processed by the Department of Justice and sent to CDPH. Perhaps more important is the opportunity cost of the time to apply for the background check. We assume that cost to be equal to four hours of time valued at \$100 (at an hourly cost of \$25 per hour, which was reported as the hourly wage of a manager at a manufacturing site). Finally, we have no direct evidence of the average number of owners and associated owners per manufacturer and we assume this number to be two people.²⁸ We estimate industry costs to rise by \$187 per owner and associated owner.²⁹

License Fees

CDPH will require an initial non-refundable application processing fee of \$1,000 that is only charged once unless significant changes to the business occur, such as ownership change or license type change. There will also be an annual renewal fee according to the fee schedule in Table 2. These fees are intended to cover CDPH expenses of administering the licensing and regulatory requirements, developing and maintaining an information technology (IT) solution for

²⁷ See <http://www.lao.ca.gov/ballot/2016/Prop64-110816.pdf>

²⁸ Not all owners are actively engaged in business operations.

²⁹ Background checks are only required for new applicants or for material changes to the license. We assume that after the first year when companies obtain their initial license, Live Scan checks are required of only ten percent of existing owners each year.

medical cannabis licenses, repaying General Fund loan for program startup cost, and the costs of the Track and Trace program.

Table 2: Annual Fees by Tier and Projected Revenue

Tier Based on Gross Revenue	Annual Fee	Estimated Market Share	Estimated Number of Licensees	Projected Revenue Year 2019 and Beyond*
\$0 – 100,000	\$ 2,000	28%	280	\$ 588,000
\$100,000 – 500,000	\$ 7,500	32%	320	\$ 2,432,000
\$500,000 – \$2 million	\$ 15,000	23%	230	\$ 3,473,000
\$2 million- \$5 million	\$ 35,000	16%	160	\$ 5,616,000
\$5 million +	\$ 50,000	1%	10	\$ 501,000
Total		100%	1000	\$ 12,610,000

*Assumes that an amount equal to ten percent of existing firms must pay the application processing fee either due to a significant change to the business or due to new businesses replacing those that ceased operations.

Specifically, the fees were set as follows:

The number of FTEs (Full-Time Equivalent employees) was determined by calculating the number of hours it would take to complete a task (processing hours) multiplied by the number of licenses (1,000) divided by 1,800 (equivalent of one FTE annually). The total cost was derived by multiplying the annual classification salary by the FTEs needed to complete the task annually. The total annual salary cost (\$1,019,113) was divided by the number of licenses (1,000), which equals \$1,019 or rounded down to an application fee of \$1,000.

License Fee:

The license fees were determined by accounting for the cost of administering the manufactured cannabis safety program. These costs include operational staff, administrative staff, the IT system for licensing, Track and Trace fees, and reimbursement of the General Fund loan by Fiscal Year 2020-21.

The estimated market share is based on our survey of manufacturers. In 2018, we assume that one-half of the manufacturers purchase licenses and are fully processed. By 2019, we assume that all 1,000 firms are processed. We also assume there is turnover in the industry, and that ten percent new firms enter the market each year, while ten percent leave the market. In 2018, businesses in total pay \$6,755,000 in collected fees, and in later years we assume fees

collected from all manufacturers to total \$12,610,000. If in the future the fees generate significant fund balances, and if it is prudent to do so, the program will reduce fees.

We suspect there will be some degree of consolidation in the industry as manufacturer size grows to achieve economies of scale, although we have little way to guess what the distribution by size will look like. At the same time, however, larger firms will pay higher annual fees. The combined effect may be to leave total revenue largely unchanged. For example, we estimate that revenue is essentially unchanged if the number of firms falls to 850, while at the same time there are five percent fewer firms in the \$0-100,000 tier and five percent more firms in the \$5 million and above tier.

Seller's Permit from BOE

Medical cannabis manufacturers are currently required to obtain a seller's permit from BOE, and CDPH will require recordkeeping that substantiates a valid permit.³⁰ Our survey found that only about two-thirds reporting having a permit. However, BOE told us that there is no fee for a seller's permit and that no security deposit is required. We, therefore, only consider the value of time in obtaining a seller's permit and in recordkeeping in our cost estimates, and we assume this to be 0.5 percent of the value of a company manager's time.

Bonding Requirement

CDPH plans to require manufacturers to show proof of a \$5,000 bond in an amount suitable to cover the cost of destruction of a batch of manufactured cannabis product should testing require. We value the cost of the bond as the opportunity cost of the funds used to purchase the bond. We use a three percent interest rate to calculate ongoing costs at \$150 per firm.

Requiring Local Permitting Compliance

Local permitting by cities and counties may turn out to be very expensive for medical cannabis manufacturers, and some localities will likely place a ban on manufacturing activity altogether.³¹ MCRSA requires manufacturers to demonstrate they have obtained all relevant local licenses, permit or other authorization. Our statewide review of general business permitting indicates that annual costs are generally low, around \$300 annually, although there is some variation. However, we fully expect that permitting for medical cannabis manufacturers will cost considerably more since cities and counties are concerned about the hazards associated with oil concentrate extraction.³² Eureka is the only city we found that is about to implement specific cannabis manufacturing permits for an annual cost of \$9,000.³³ Without more examples, we take this as the typical cost of local permitting when such permitting exists. We believe that

³⁰ See https://www.boe.ca.gov/industry/medical_cannabis.html#Growers

³¹ Prior searches found that in 2015, 24 out of 58 California counties had no active medical cannabis dispensary. See <http://www2.humboldt.edu/hiimr/docs/california%20dispensaries.pdf>

³² <http://www.times-standard.com/article/NJ/20161101/NEWS/161109982>

³³ A permit fee this high is not extraordinary for an industry with perceived safety or health concerns. Sacramento had dispensary permitting fees that ranged between \$25,000 and \$34,000.

many localities will not have cannabis-specific permitting requirements.³⁴ We split the difference and assume that half of manufacturers face a cannabis specific permit, while the other half do not.

Our approach to monetizing a likely ban on manufacturing in some localities is to assume the manufacturer incurs the cost of moving operations to a nearby jurisdiction that allows permitting. We assume a cost of moving a modestly sized business at \$15,000 and assume that ten percent of businesses must move location.

Facility Compliance and Video Surveillance

Manufacturing will need to take place in facilities that meet sanitation, safety, and security standards. Sanitation standards include using food-grade equipment and surfaces, maintaining dressing and locker rooms, among others. Safety standards include complying with local and state requirements. Security standards include electronically secure records and maintaining a security alarm. Without hard data for guidance, we assume that half of existing manufacturers already meet these standards, and we assume the initial cost of complying with the standards is \$12,500.

Security cameras are required, and they must allow for remote access, high definition recordings, video capture in low light settings, and camera placement in a number of rooms, among other requirements. Surveillance recordings shall be kept for a minimum of 30 days on the licensee's recording device. We assume that half of existing manufacturers already have video equipment that meets these standards. We obtained prices for conforming video equipment online and we found that the initial cost of compliant equipment is approximately \$2,500 with an ongoing annual expense of about \$500.

Closed Loop Extraction System

Type 7 (volatile compounds) license holders will be required to extract cannabis oil from trim or flower using a closed loop system, which captures solvents during manufacturing. The closed loop system means that little flammable gas escapes during extraction, which greatly reduces the chance of explosion and fire. CDPH requirements are essentially: a) a licensed engineer certifies the system was commercially manufactured and the system was built to code; b) the manufacturer maintains approval from the local fire official for the closed loop system; and, c) the system meets required fire, safety, and building code requirements. This closed loop requirement is essentially a response to the fires from butane solvent extraction already mentioned. In terms of extra cost, we assume that b) and c) are already part of the local permitting fees. Washington currently requires extractors to use "I-502" compliant machines, which have very similar requirements to CDPH's proposed requirements, and we used I-502 machines as the basis for pricing.³⁵ Larger manufacturers may pay for larger capacity machines in order to have quicker run times and process more trim. There are, however, lower priced

³⁴ In that case, CDPH will simply require a letter confirming compliance with local ordinances.

³⁵ For a description of the requirements, see <http://apps.leg.wa.gov/wac/default.aspx?cite=314-55-104>

options. Online price searches obtain a range of approximately \$10,000 to over \$100,000. We use \$25,000 as the price of a “typical” compliant machine.

Our survey directly asks whether manufacturers use hydrocarbons in production, and 28 percent indicated they did.³⁶ While many of our survey respondents that produce with volatile hydrocarbons indicate they already use a closed loop system, it is likely that many existing systems will not meet CDPH guidelines. Overall, we estimate that 22 percent of manufacturers must acquire compliant closed loop systems.

Standard Operating Procedures

CDPH will require that manufacturers write Standard Operating Procedures (SOPs) and have those available for review. We categorize SOPs into the following six general categories: cannabis acquisition and tracking; employees; security; safety and sanitation; hazard and recalls; and manufacturing protocols. We do not know what percent of manufacturers currently have SOPs in these areas, but we suspect most do not, and we assume that three-quarters will need to write SOPs.³⁷ We use \$20,000 as our estimate of cost for writing the SOPs.

General Licensing Requirements

CDPH will require sound recordkeeping and making documents available, such as employee records, shipments, etc. Additionally, manufacturers must also provide a list of employees, site plans, estimated gross revenue, etc., for the annual renewal application. Firms must receive and document landlord approval for their cannabis production. CDPH will conduct onsite inspections. All of this requires labor effort in the areas of bookkeeping and compliance. These are common costs that are not specific to cannabis manufacturers, and are usually part of most businesses and certainly part of industries that require statewide licensing or permitting. We value effort at general licensing requirements to be equal to 15 percent of the time of a manager who earns \$40,000 per year. It is difficult to say how many firms will need to devote more manager time in these areas, but we believe that most firms are currently devoting very little time toward compliance and bookkeeping, and we assume that 80 percent of firms will be affected by general licensing requirements.

Adulterated and Potentially Hazardous Products Prohibited and THC Limits

CDPH will prohibit additives, such as nicotine, alcohol, caffeine, and chemicals that “increase carcinogenicity or cardiac effects” from being combined into cannabis products. There already

³⁶ These are not adjusted for sales level.

³⁷ We contacted a handful of cannabis industry consultants that are able to write SOPs. The typical cost is about \$30,000 for six SOP categories. This amount seems very large to us, and we expect that business owners that write their own SOPs will face a smaller opportunity cost. Additionally, we expect a number of consultants to enter the market to provide standardized SOPs at a lower cost.

exists a market for cannabis infused energy drinks and alcohol.³⁸ Prohibiting these additives reduces future sales, and this leads to the standard loss of consumer and producer surplus when choices are limited because the gains from trade are reduced. Prohibition also reduces industry innovation, but this effect is difficult to quantify. CDPH will also prohibit potentially hazardous food, which largely means the product has an unstable shelf life, which limits the size and scope of products manufactured. Without concrete data on the potential size of adulterated products or those with unstable shelf lives, we estimate lost sales to be one percent of current medical cannabis sales, and we use this amount to capture the impact of prohibiting these types of products.

CDPH may place THC concentration or per-serving limits on some forms of manufactured medical cannabis edibles. We believe that these limits will not be very costly for manufacturers, who, due to labeling requirements described earlier, will already have to determine product THC content. The nature of the costs will be to restrict the supply somewhat of products, and we assume that THC limits costs one tenth of a percent of sales.

Track and Trace

MCRSA requires that manufacturers purchase cannabis only from licensed cultivators that use the Track and Trace system to inventory cannabis throughout the supply chain. That means that manufacturers will only be allowed to purchase from licensed cultivators, and this is likely to reduce the supply of cannabis available, at least initially.³⁹ It will likely mean that manufacturers will have fewer choices between cultivators than they do at present. It is difficult to assign a dollar value to the supply restriction, but we assume that the uncertainty and reduction in suppliers is one percent of sales.

Cost Summary

Table 3 lists the additional industry costs for each category in 2018 (the first year of costs), and in 2019 and future years. CDPH plans to have regulations fully implemented by January 1, 2018, with no phase-in period.⁴⁰ Manufacturers will obtain a license and immediately face the ongoing costs. All costs and calculations are in 2016 dollars. These costs are extra expenses for each category due to the new regulations as described above, not the total cost in each category. For example, in 2018, we anticipate the labeling requirements will add \$376,227 in additional costs to the industry in the first year and each year ongoing. Facility compliance, the closed loop system, and SOP costs are one-time costs for each business, and we anticipate turnover, with ten percent of new firms that enter the industry each year having to pay these

³⁸ See <http://www.forbes.com/sites/julieweed/2015/05/31/catapult-wants-to-be-the-starbucks-of-marijuana-infused-coffee/#37c4409052fe> or <https://www.bloomberg.com/news/articles/2015-02-11/is-it-time-to-take-cannabis-cocktails-seriously->

³⁹ Washington had supply difficulties when recreational use cannabis was first legalized. See <http://www.newsweek.com/washington-supply-legal-weed-cant-meet-demand-257541>

⁴⁰ Some manufacturers will prepare for licensing in 2017 to some degree, but we place all first-year costs in 2018 in order to capture the full costs of regulatory implementation. We then model all costs to be fully incorporated into the market each year in 2019 and beyond.

costs. We estimate that as a result of regulation, total industry additional costs will be \$51.9 million in 2018 and then \$39.1 million each year thereafter. “Ongoing costs” are 17.2 percent of wholesale revenue. We assume that costs keep up with inflation and we use \$39.1 million as our “ongoing” value of lifetime annual costs.

Table 3: Year One and Ongoing Additional Costs in the Manufactured Medical Cannabis Market Due to Proposed MCRSA Regulations

Cost Category	Total Additional Industry Costs of Regulation, 2018	Total Additional Industry Costs of Regulation 2019 and Ongoing	Ongoing Costs as Percent of Manufacturer Wholesale Market
Labeling	\$376,227	\$376,227	0.2%
Testing for Labeling	\$4,225,000	\$4,225,000	1.9%
Packaging	\$948,892	\$948,892	0.4%
Live Scan Background Checks	\$2,976,248	\$2,639,648	1.2%
License Fees	\$6,755,000	\$12,610,000	5.5%
BOE Seller's Fee	\$200,000	\$200,000	0.1%
Bond for Destroyed Batches	\$150,000	\$150,000	0.1%
Local Permitting	\$6,150,000	\$6,150,000	2.7%
Facility Compliance and Video Surveillance	\$7,500,000	\$1,125,000	0.5%
Closed Loop System	\$5,493,164	\$549,316	0.2%
SOPs	\$7,500,000	\$750,000	0.3%
General Licensing Requirements	\$4,800,000	\$4,800,000	2.1%
Unadulterated Product and THC Limitations	\$2,504,664	\$2,276,967	1.0%
Track and Trace Supply Restrictions	\$2,276,967	\$2,276,967	1.0%
TOTAL Increased Cost to Industry*	\$51,856,163	\$39,078,019	17.2%

*Totals do not equal sum of costs due to rounding.

Methodology and Assumptions

Approach

Our approach is to determine how MCRSA and AUMA regulations affect prices in the manufactured medical and recreational markets. We then used those price changes in our model of demand in medical, recreational, and illegal markets in order to determine quantity changes in each market. In addition to the costs specified above, we describe below other cost and market impacts of the regulations, and we divide them into supply and demand side effects.⁴¹

Supply Side Considerations

Fall in the Risk Premium

Industry regulation typically has the impact of raising costs for industry, which leads to a reduction in the industry supply curve, an increase in costs, and a reduction in the quantity sold. In the case of medical cannabis regulation, MCRSA and AUMA will reduce the risk premium associated with cannabis manufacturing, which will offset the expected rise in price of medical cannabis. The risk premium is the extra amount that producers and workers must receive in order to be compensated for the risk of incarceration, asset forfeiture, and other losses that are associated with an illegal activity. Cannabis manufacturing is federally illegal and manufacturers have certainly been well aware that their activity may lead to criminal conviction.⁴² By some accounts, the risk premium in the cannabis industry has been substantial.⁴³ If MCRSA reduces the risks associated with medical cannabis production and AUMA reduces the risks associated with recreational cannabis production, then MCRSA and AUMA lower the risk premium and effectively lower costs to existing producers and encourage new producers to enter the markets.⁴⁴ This will increase market supply and lower the market price, which will increase the quantities sold. Manufacturers tell us they are already seeing an increase in the number of manufacturers in anticipation of licensing. In Washington, the ratio of sales revenue to weight (\$/gram) has fallen by over 50 percent in the first 21 months after recreational use was

⁴¹ We assume the manufacturers pass these extra costs along with appropriate markups to the retailers and consumers face increased prices.

⁴² At a preregulatory meeting, manufacturers remarked that many manufacturers are hesitant to share their business data since they are worried about law enforcement action.

⁴³ See Caulkins 2010

http://www.rand.org/content/dam/rand/pubs/working_papers/2010/RAND_WR764.pdf See Hawken and Prieger 2013

http://lcb.wa.gov/publications/Marijuana/BOTEC%20reports/5c_Economies_Scale_Production_Cannabis_Oct-22-2013.pdf

⁴⁴ The Cole Memorandum from the U.S. Department of Justice dated August 29, 2013, explains that the threat of federal marijuana enforcement should be low in states with robust regulatory and enforcement systems. See <https://www.justice.gov/iso/opa/resources/3052013829132756857467.pdf>

legalized, which we believe is partly due to a drop in the risk premium.⁴⁵ In discussions with BMCR and CDFA economists, we find that marketing margins are currently large at all points in the supply chain. Part of this is the risk premium, although part of it is due to inefficient production resulting from the illegal and uncertain status of the industry. We believe that MCRSA and AUMA will lower but not eliminate the risk premium, since access to traditional banking services and funding will continue to be limited due to the illegal federal status.

The key question is, “How much does the fall in the risk premium reduce the retail price, and will it compensate for the increases in regulatory costs?” We believe the evidence is clear that in states where legalization has occurred, there has been an increase in manufacturing suppliers and prices have been falling despite new taxes and the costs of regulation. In other words, after states legalized recreational cannabis use, the supply has increased and more than offsets the increase in regulatory costs. However, the degree to which the risk premium falls is a key source of uncertainty in this report. In our model, a reduction of about 17.5 percent in the marketing margin at the wholesale and retail levels has the effect of wiping out the effect of increased regulatory costs. We use this 17.5 percent margin reduction as our preferred impact of the risk premium drop on the medical manufactured cannabis market, and 25 percent reduction for the recreational market.⁴⁶

Improved Efficiency in the Recreational Market

We anticipate the price in the recreational market will be relatively lower than the price in the medical market because the recreational market may become more efficient. The same agencies that have been granted regulatory authority under MCRSA will largely have the same authority under AUMA. Although draft regulations under AUMA do not exist, at the time of writing we anticipate that MCRSA and AUMA will be amended or adapted to have more similar provisions. At the time of writing, we are uncertain what those changes will be. As things stand now, the differences between MCRSA and AUMA will lower the relative price of recreational cannabis compared to the price of medical cannabis. First, AUMA allows for more vertical integration between cultivators, manufacturers, distributors, and retailers (dispensaries). This may lead to more efficiency and reduced costs in the adult use market. Second, AUMA allows for larger “Type 5” growers, which also may lead to more efficiency and reduced costs in the adult use market. Third, companies licensed under AUMA have a higher threshold for the definition of “owner,” which means one can have a larger ownership share of a company before becoming subject to residency requirements or potential background checks. Specifically, recreational use company owners have to meet at least a 20 percent financial interest in the business. This higher threshold for ownership means that more capital should flow to the recreational market and could lead to larger, more efficient companies and reduced costs. We assume that manufacturers collect payroll and other taxes and meet employer mandated costs in both the recreational and medical markets.

⁴⁵ See <https://www.washingtonpost.com/news/wonk/wp/2016/05/04/the-price-of-legal-pot-is-collapsing/>

⁴⁶ We allow the medical market to have a smaller decline in risk premium because that market has had a more solid legal foundation under the passage of Proposition 215 and, therefore, the effect of regulations in the medical market should be less than in the recreational market.

AUMA Taxes on Medical and Recreational Cannabis

With the passage of AUMA, both the medical and recreational manufactured markets face a new 15 percent retail excise tax and separate taxes on the production of cannabis flower and trim leaf. We calculate the flower and leaf tax as \$1.59 per gram of oil, which is a weighted average of the \$9.25 per ounce tax on cannabis flower and the \$2.75 per ounce tax on trim leaf.⁴⁷ These two taxes will raise the price of recreational and medical cannabis relative to the illegal market price and will increase the quantity demanded of illegal cannabis.⁴⁸ As described below, the recreational market is subject to sales tax, while the medical market is not.

Demand Side Considerations

Demand Change for Medical Cannabis

The demand for manufactured medical cannabis is likely to rise with the new MCRSA regulations because consumers are likely to perceive that, after regulations, manufactured cannabis is safer and there will be better and more uniform information on the labels. Consumers are willing to pay for these desirable features. There is little guidance for us on how big this impact will be, and we assume demand rises by five percent.

The demand for manufactured medical cannabis is also likely to fall after AUMA since customers are required under AUMA to present a medical identification card when purchasing medical cannabis.⁴⁹ Before AUMA, medical consumers only needed to obtain a physician's recommendation, and the online price was as low as \$60. We believe that it was fairly easy for someone aged 18 and older to receive a doctor's recommendation. After AUMA, medical patients need to obtain a state issued identification card from their local county health department, which has a cost capped at \$100. Additionally, since it is very possible that obtaining a doctor's recommendation will become more difficult, we assume it will rise in price to \$100.⁵⁰ Finally, there is the time opportunity cost of visiting the local county health department and doctor, which we assume to be four hours valued at minimum wage, which is equal to \$44.⁵¹ This means that the cost of obtaining a medical cannabis card is \$244. There is no similar identification card requirement for the recreational market. With the passing of AUMA, medical cannabis sales are not subject to sales tax, while recreational cannabis sales are subject to sales tax. We use an average sales tax rate of 8.8 percent to calculate that one would

⁴⁷ Our survey respondents tell us that one pound of trim produces one ounce of concentrate oil and one pound of flowers produces three ounces of concentrate oil. We also assume that ten percent of oil concentrates come from cannabis flowers and 90 percent from trim leaves.

⁴⁸ We note that in Colorado and Washington, medical and recreational cannabis have continued to expand in sales.

⁴⁹ After AUMA, medical dispensaries can continue to sell to anyone, including those under age 21, as long as they possess a state medical marijuana identification card. Recreational market sales are limited to those aged 21 years and older.

⁵⁰ These new regulations concerning doctor recommendations are to be determined.

⁵¹ The California minimum wage rises to \$11 on January 1, 2018. See https://www.gov.ca.gov/docs/Fact_Sheet_Boosting_Californias_Minimum_Wage.pdf

have to purchase more than \$2,773 worth of medical cannabis in order for sales tax savings to exceed the cost of obtaining an identification card.⁵² The medical market may thus come to be dominated by relatively heavy users of cannabis. We expect some medical customers to leave the market and purchase from the recreational market and the illegal market. If we raise the “price” of manufactured medical cannabis by \$244, our simulations show a reduction in quantity demanded of 22 percent. Thus, we assume that demand for manufactured medical cannabis falls by 22 percent after implementing the medical identification card requirement. Taken together, the effect of MCRSA regulations and AUMA requirements leads to a decrease in demand in the manufactured medical market of 17 percent (=5 percent - 22 percent). We expect these consumers to move to the recreational market and increase demand in that market.

Elasticity of Demand in the Medical Market

Demand for manufactured medical cannabis is a function of the price of medical cannabis and other factors, such as the price of cannabis in other markets and the relative ease of obtaining cannabis in these other markets. The other manufactured markets are the legal recreational market and the illegal market in California.⁵³ There is extensive literature that places the own price elasticity of demand for cannabis at -0.3 to -0.6, with much higher elasticities for some users.⁵⁴ However, we could not find estimates of the cross-price elasticity of medical cannabis with regard to other cannabis markets. It is reasonable to assume that manufactured recreational cannabis and illegal cannabis are very close substitutes for manufactured medical cannabis, and that a rise in the medical cannabis relative price will lead to a significant decline in the quantity demanded.⁵⁵ One reason is that after AUMA is implemented, retailers will be able to sell both medical and recreational use cannabis from a single location. Additionally, illegal cannabis is readily available within the state. We use -4.1 as our estimate of the price elasticity of demand for medical cannabis. This means that a one percent increase in the price of medical cannabis leads to about a four percent drop in the quantity demanded of medical cannabis.⁵⁶

⁵² In order to incorporate the cost of the identification card, we assume that, on average, a patient purchases one gram a week of medical manufactured cannabis and spreads the \$244 card cost over one gram per week, or \$4.69 per gram on average.

⁵³ Manufacturers also export to out-of-state customers, but the out-of-state price is likely not relevant to in-state medical cannabis demand.

⁵⁴ See <http://econpapers.repec.org/paper/unrwpaper/13-004.htm>. Orens et al., estimate the elasticity to be -3.0 for some users. See <http://mjpolicygroup.com/pubs/Alaska-Demand-and-Taxes.pdf>

⁵⁵ We thank the SRIA economic teams at the U.C. Davis Agricultural Issues Center and ERA Economics for helpful discussion about the size of the cross price elasticity.

⁵⁶ This elasticity is the retail demand elasticity. In our model, we apply dispensary retail margins to go from the wholesale price changes to the retail price impact.

Model

We use a three-market demand model where consumers switch between the medical, recreational, and illegal manufactured cannabis markets based on relative price changes.⁵⁷ A rise in the price in, say, the medical cannabis market will lead to a decrease in the quantity demanded in the medical market and an increase in quantity demanded in the recreational and illegal markets.⁵⁸ The model starts with assumed expenditure shares within the cannabis group and estimates changes in those spending shares when relative prices change. We initially assume the spending shares in the medical, recreational, and illegal markets are 20 percent, 40 percent, and 40 percent, respectively, but allow these to change within the model as MCRSA and AUMA changes relative prices. Additionally, we also allow the demand for manufactured medical cannabis to change as described above.

To summarize, new MCRSA regulations affect costs of manufactured medical cannabis, which in turn affects the supply of manufactured medical cannabis. At the same time, we determine how new AUMA regulations affect costs for medical and recreational cannabis manufacturers. We use the resulting price changes in the three markets to estimate the impacts on quantities sold of manufactured cannabis. We also include shifts in demand for manufactured medical cannabis. Medical market price changes depend on the new regulatory costs and the fall in the risk premium. The recreational market price change will depend on the same regulatory costs. However, prices should be lower compared to the medical price because the decline in the risk premium is greater and because manufacturers in the recreational market can become more efficient through vertical integration.

Regulatory Implementation

In this report we quantify the impact of MCRSA regulations by CDPH against a baseline. This is made difficult because AUMA regulations will be implemented in the same year.⁵⁹ The question is, “Does the baseline include AUMA?” We believe the answer is “yes,” since we know AUMA will be implemented by 2018. The challenge is that not only must we model the impact of MCRSA, but we must also model the impact of AUMA.⁶⁰

A key assumption is the beginning expenditure share of medical, recreational, and illegal cannabis. In 2016, we believe medical manufactured cannabis sales to be 20 percent of all manufactured cannabis sales, with the remaining 80 percent illegal manufactured cannabis

⁵⁷ We thank the U.C. Davis Agricultural Issues Center economists for sharing this model with us. The model incorporates a high degree of substitutability between the markets and an overall price elasticity of cannabis of -0.3. The supply elasticity is assumed to be infinite.

⁵⁸ We feel that interactions between the price of manufactured cannabis in the medical market and prices of manufactured cannabis in the recreational and illegal markets were most important for the impact of regulations. We do not consider substitution between manufactured and raw flower cannabis.

⁵⁹ Regulations are first implemented in 2018, and we expect regulations to be fully implemented by 2019.

⁶⁰ We note there are many reasonable ways to model the implementation of MCRSA and AUMA.

sales.⁶¹ In 2016, sales tax is paid on medical cannabis, but there are no regulations by CDPH on the market. The illegal market collects no sales tax and faces no regulations. At the beginning of 2018, just as MCRSA and AUMA regulations take effect, we consider that the illegal market splits evenly into a smaller illegal market (40 percent of overall manufactured cannabis) and a new recreational market (40 percent of overall manufactured cannabis).⁶² Once AUMA regulations take effect, the manufactured medical cannabis market collects no sales tax, pays the 15 percent excise tax and the tax on flowers and trim, and customers are required to pay for the state identification card. The manufactured recreational cannabis market collects the sales tax, pays the 15 percent excise tax and the tax on flowers and trim, pays the regulatory costs of complying with AUMA regulations, and faces lower costs due to greater efficiencies and a reduction in the risk premium. MCRSA regulations take effect at the same time, and the manufactured medical cannabis market pays the regulatory costs of complying with MCRSA and faces lower costs due to a reduction in the risk premium. This timeline is summarized in the Table 4.

⁶¹ This is our best guess estimate from talking with people in the industry.

⁶² In the absence of a compelling alternative, we simply split the original illegal market into half recreational use and half continued illegal.

Table 4: Features of the Medical and Recreational Markets in Four Periods

Period	Description	Medical	Recreational	Market Shares
<u>“CURRENT BASELINE”</u>	2016 <u>Baseline of current industry</u>	Pays sales tax	Does not exist	20% Medical, 80% Illegal
<u>“MODEL BASELINE”</u>	Beginning of 2018 <u>Assumes recreational market “splits” from illegal market. This is the Baseline for the economic model</u>	Pays sales tax	Created from illegal market	20% Medical, 40% Recreational, 40% Illegal
<u>“AUMA ONLY”</u>	2019 with AUMA regulations only <u>This is an intermediate step that helps to estimate the impact of MCRSA regulations</u>	Excise tax Flower tax No sales tax ID card required	Sales tax Excise tax Flower tax Risk premium falls Vertical integration efficiencies AUMA regulatory costs Demand up for regulated product	Determined in model; Overall market size held constant
<u>“MCRSA + AUMA”</u>	2019 with AUMA and MCRSA regulations <u>This is what the markets will look like in 2018</u>	Excise tax Flower tax No sales tax ID card required Risk premium falls, MCRSA regulatory costs, Demand up for regulated product; Demand down due to cost of obtaining card	Sales tax Excise tax Flower tax Risk premium falls Vertical integration efficiencies AUMA regulatory costs Demand up for regulated product	Determined in model; Overall market size held constant

We calculate the impact of MCRSA by estimating the impact of “MCRSA + AUMA” and then subtracting the impact of “AUMA.”⁶³ In other words, we ask, “What will manufacturing markets look like when MCRSA and AUMA are both in effect?” We then subtract what we believe the markets would look like if only AUMA were in effect. Of course, AUMA will not be in effect without MCRSA, but we construct this scenario to estimate the marginal impact of MCRSA.⁶⁴

IMPLAN

Overview

This analysis uses the IMPLAN Pro software and accompanying California state and county level data. IMPLAN is a widely accepted, economic input-output model that starts with the direct effect of business regulation (calculated independently), and then calculates the indirect impacts on other businesses, and the induced effects on employee spending. We used the analysis by parts method of inputting our estimated direct increase in manufacturer commodity spending and labor income earning in order to calculate the overall impacts on jobs and California Gross State Product along with the breakdown by industry.

IMPLAN does not have a cannabis manufacturers sector. IMPLAN uses data collected by the U.S. Bureau of Economic Analysis (BEA), among other sources, and currently the BEA does not track cannabis manufacturing. In fact, there is no NAICS code for cannabis manufacturing.

Forming the Medical Cannabis Industry

We customized a proxy sector within IMPLAN based on cost and other data obtained from an online survey and in-person survey of cannabis manufacturers. We asked for total manufactured cannabis sales, costs of manufacturing, wages and benefits paid to employees, and top ten costs of production. Additionally, we asked for total costs of manufacturing. Overall, there is great variety among cannabis manufacturers and their costs, given that manufactured cannabis includes edible products, topicals, and concentrates. Our strategy was to form a “typical” cannabis manufacturer that was a blend of the collected data. This allows our analysis to focus on an overall industry story, while also incorporating the heterogeneity of the market. We also focus on the top costs to manufacturers, since these are the factors that will impact the analysis the most. Our proxy industry was spice and extract manufacturing, which we felt was similar in terms of commodity use to cannabis manufacturing. We customized that sector based on 14 top commodity purchases by cannabis manufacturers as determined through our survey

⁶³ We keep the combined manufactured market size held constant when we begin adding the effects of AUMA and MCRSA. This means that for this report, we are not including increases in demand for manufactured recreational cannabis by new consumers of cannabis, since the focus of this report is the impact of MCRSA, and we do not need to estimate increased demand for recreational cannabis.

⁶⁴ Our model is best used to estimate the overall effect on demand of multiple price changes by considering all price changes at the same time, rather than in a two-step process. Since we wanted our model baseline to include AUMA’s regulations, we chose this strategy rather than just estimating the effect of MCRSA in isolation.

and a recent 2016 report.⁶⁵ Packaging was reported as a top ten cost 25 percent of the time. About one in five reported that marketing costs were in the top ten. The survey reports only one business that lists security or testing costs among their top ten. Two costs are particularly relevant. The cost of raw cannabis, which is flower and trim, was reported in the top ten costs by 57 percent of respondents. There is no raw cannabis commodity in IMPLAN, so we used the flower production sector as a substitute for that input. Solvents, such as butane, alcohol, and CO₂, were cited among the top ten costs by 29 percent of respondents. Other commodities that we selected represented the food production sectors in order to include costs important to edible manufacturers. We also used information from our survey to form estimates of the proportion of sales that goes to labor income and intermediate goods purchased.⁶⁶

Economic Impacts

Beginning Prices and Quantities

To make the analysis tractable, we consider an idealized manufactured cannabis product that is defined as a product that was produced using one gram of extracted cannabis oil. This allows us to think about market changes in one product called “manufactured cannabis” rather than many products. In describing the baseline in the medical manufactured cannabis market that is summarized in Table 1, we estimated a wholesale price of \$28.93 per gram and a retail price of \$82.64 per gram. We assume that recreational cannabis has the same price, and that the price of illegal manufactured cannabis is 80 percent of the price of medical cannabis, or \$66.11 per gram.⁶⁷ If medical manufactured cannabis is \$650,562,058 and 20 percent of all manufactured production, then retail sales of manufactured cannabis is \$1,301,051,269 in both the recreational market and the illegal markets. It follows from these prices that the initial quantity in the recreational market is 15,743,602 oil grams and 19,679,503 oil grams in the illegal market. Summing across all three markets, 43,294,906 oil grams of manufactured cannabis is produced in California. These amounts are reproduced in Table 5.

⁶⁵ See http://www.pacific.edu/Documents/school-business/BFC/CannabisStudy/Sacramento%20Area%20Legal%20Cannabis%20Sector%20Impact%20Study_2016_10_12.pdf

⁶⁶ We used the same IMPLAN parameters for recreational and illegal manufacturers as we do for medical manufacturers.

⁶⁷ The most recent data on California illegal versus medical retail prices that we could find states that illegal prices are 27 percent lower than dispensary prices. This strikes us as a large difference and it is more than twice the price difference of other markets. We use 20 percent as our preferred price differential. See <https://priceconomics.com/the-most-expensive-and-cheapest-cities-to-buy/>

Table 5: “Model Baseline” of Market Conditions at the Beginning of 2018 and Before MCRSA and AUMA Regulations in Effect

	Medical Market	Recreational Market	Illegal Market
Retail Price	\$82.64	\$82.64	\$66.11
Quantity Sold	7,871,801 oil grams	15,743,602 oil grams	19,679,503 oil grams
Retail Sales	\$650,562,058	\$1,301,051,269	\$1,301,051,269

Impact on Manufacturer Sales

We estimate that due to the combined effects of MCRSA and AUMA in 2019 and beyond, prices fall in the manufactured medical cannabis market by -0.3 percent and prices fall in the manufactured recreational market by 6.8 percent.⁶⁸ We assume that prices are unchanged in the illegal market. Table 6 shows the impact of these price changes in the three markets. In the medical market, there is an overall decrease in quantities sold of 34 percent and a decrease in total revenue of 34.3 percent.⁶⁹ Sales revenue in the recreational market rises by 29.7 percent and quantity sold rises by 36.5 percent.⁷⁰ The quantity sold in the illegal market falls by 18.3 percent and sales revenue falls by 18.3 percent. The medical market has the largest percentage drop in quantity, but the dollar amount is about the same as the fall in the illegal market, which starts bigger. The recreational market sees big gains in sales due to the relatively lower prices in that market.

Table 6: “MCRSA+AUMA” Impact on Manufactured Cannabis Markets in 2019 and Beyond

	Medical	Recreational	Illegal	Overall
Retail Price Change	-0.3%	-6.8%	0%	-2.8%
Retail Sales Change	-34.3%	29.7%	-18.3%	-2%
Percent Change in Quantity of Manufactured Cannabis	-34%	36.5%	-18.3%	0.8%

⁶⁸ We expect that AUMA and MCRSA will be fully implemented by 2019.

⁶⁹ Half of the decrease in quantities sold is due to the 17 percent drop in demand from the net effect from the required ID card and improved consumer safety described earlier. We assume these consumers will simply switch to the recreational market.

⁷⁰ Part of the increase in quantity manufactured in the recreational market comes from the consumers that left the medical market.

Overall, the combined price of all manufactured cannabis falls by 2.8 percent.⁷¹ This price drop leads to a combined increase in quantity demanded of 0.8 percent, given an overall cannabis demand elasticity of -0.3. Total retail expenditures on cannabis fall by two percent.

The medical cannabis market does not disappear even though manufactured medical cannabis has become more expensive relative to recreational cannabis. We assume a large elasticity of substitution between medical and recreational use cannabis, meaning that the price change in one market leads to a large change in quantity demanded in the other market. The two are not perfect substitutes, however. First, for frequent users that spend a lot on cannabis, the sales tax savings provide incentives to remain in the medical market. Second, adults aged 18-21 will not be able to purchase in the recreational market. Third, the concentration amounts per serving may be different for manufactured medical cannabis.⁷² Fourth, some people will have a preference to purchase cannabis from traditional medical retailers instead of a retailer selling for “recreational” use.

These findings are in line with what we expect from looking at the experience of Colorado and Washington after recreational consumption was legalized, with a large increase in manufactured products sales in the new recreational market.

We compare the economy with MCRSA regulations (Table 6) to the economy without MCRSA regulations while keeping AUMA regulations in place (Table 7). Without MCRSA, costs rise so high that the price in the medical market rises enough to make quantity demanded fall to zero.⁷³ This is because the risk premium in the medical market does not fall without MCRSA regulations, and the fall in the risk premium is responsible for countering the large rise in costs from both MCRSA and AUMA.

**Table 7: “AUMA ONLY” Impact on
Manufactured Cannabis Markets in 2019 and Beyond**

	Medical	Recreational	Illegal	Overall
Retail Price Change	22.9%	-6.8%	0%	1.9%
Percent Change in Quantity of Manufactured Cannabis	-100%	67.5%	-6%	-0.6%

⁷¹ This is derived from the average price change in each market weighted by the respective market shares.

⁷² There is a limit of 10mg THC content per serving for manufactured recreational cannabis products, while CDPH may not place similar limits on all manufactured medical cannabis products.

⁷³ The price rise actually predicts a drop in quantity demanded of 127 percent. This means that no manufactured medical cannabis would be sold once the price drop reaches 100 percent of the market.

Without MCRSA in place, the recreational market produces more cannabis (67.5 percent increase in Table 7 compared to a 36.5 percent increase in Table 6) and the illegal market gains (only six percent reduction compared to 18.3 percent reduction). Importantly, the overall economic gains from MCRSA regulations can be calculated by noting that the combined quantity in all markets falls by 0.6 percent with AUMA only, and rises by 0.8 percent with both AUMA and MCRSA, which is a difference of 1.4 percent. This means that the impact of adding MCRSA to AUMA is to increase the total quantity of manufactured cannabis in California by 1.4 percent. Additionally, the quantity of manufactured medical cannabis increases significantly by 66 percent, although it remains below baseline levels by 34 percent due to AUMA effects.⁷⁴ Table 8 presents the summary of the marginal impact of MCRSA regulations.

Table 8: “MCRSA ONLY” Impacts on Manufactured Cannabis Markets in 2019 and Beyond

	Medical	Recreational	Illegal	Overall
Retail Price Change	-23.2%	0%	0%	-4.7%
Percent Change in Quantity of Manufactured Cannabis	66%	-31%	-12.3%	1.4%

Adding MCRSA regulations to markets where AUMA regulations already exists decreases manufactured medical cannabis prices by 23.2 percent and raises the quantity sold by 66 percent. This is largely due to the fall in the risk premium. Since recreational and illegal market prices are not affected by MCRSA, their quantities sold fall by 31 percent and 12.3 percent, respectively. Overall, manufactured cannabis prices fall by 4.7 percent and the quantity sold increases by 1.4 percent.

The Creation or Elimination of Jobs within the State

The MCRSA regulatory changes have increased the quantity demanded for manufactured cannabis overall by 1.4 percent.⁷⁵ That will lead to more manufacturing and greater spending on intermediate goods by manufacturers, as well as more workers hired. The key input into IMPLAN is the value of the increased manufactured cannabis, which we estimate to be \$16

⁷⁴ Looking at tables 6 and 7, the retail price change of medical cannabis goes from 22.9% to -0.3%, or a drop of 23.2 percentage points. The overall quantity change goes from -100% to -34%, or an increase of 66 percentage points.

⁷⁵ We focus on the impact of MCRSA on overall manufactured cannabis production, rather than only medical cannabis production, because we want to report economy-wide impacts.

million.⁷⁶ IMPLAN calculates direct, indirect, and induced effects on the California economy. The direct effects stem from the spending by cannabis manufacturers to meet the increased 1.4 percent demand for their product. The indirect effects stem from spending by companies that must produce more intermediate goods to meet the demand from cannabis manufacturers. Induced effects originate with household spending due to the additional income that workers and proprietors receive. All three effects are combined into the total effect. Table 9 shows these effects. Looking at the Employment column, the direct effect of the new production is an additional 291 new workers. That number strikes us as very large, although it reflects our survey responses and calculated output per worker of \$55,000. We know there are many part-time and seasonal workers, especially in extraction, and perhaps most of these workers are not full time. If further data collection shows a greater average output per worker then we would revise the direct employment effect downward. Businesses that produce goods for cannabis manufacturers see an increase of 83 workers, and workers and proprietors earn extra income and their spending supports an additional 59 workers. The total effect is an extra 433 workers hired in California as a result of the greater demand due to the proposed regulations. This total effect on employment includes the part-time and seasonal workers already mentioned.

Table 9: Impacts from Increased Manufactured Cannabis Production in Medical, Recreational, and Illegal Markets Due to Proposed MCRSA Regulations in Year 2019 and Beyond*

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	291**	\$4,800,000	\$10,400,000	\$16,000,000
Indirect Effect	83	\$ 5,983,962	\$10,012,671	\$16,960,692
Induced Effect	59	\$ 3,170,273	\$ 5,612,570	\$9,436,150
Total Effect***	433**	\$13,954,235	\$26,025,241	\$42,396,842

*Estimated using IMPLAN software and data sets. See text for discussion.

**Includes a large number of part-time and seasonal jobs. See text for discussion.

***Total may not equal sum of effects due to rounding.

⁷⁶ IMPLAN assumes prices are fixed. We value the increase in manufactured cannabis by the average of the wholesale prices before and after the regulations and the wholesale prices in each of the three markets are first weighted by market share.

The Creation of New Businesses or the Elimination of Existing Businesses within the State

The initial increase in spending on manufactured medical cannabis is \$16 million which leads to indirect spending on suppliers of almost \$17 million. The workers and owners in manufactured medical cannabis and supplying firms earn greater incomes and this induces them to spend \$9 million additional in the economy. Additional spending across the economy sums to \$42 million. IMPLAN estimates the top ten industries affected by the increase in demand for manufactured cannabis are cannabis cultivators, wholesale trade, all other crop farming, owner-occupied dwellings, real estate, support activities for agriculture and forestry, management of companies and enterprises, food product machinery manufacturing, monetary authorities and depository credit intermediation, and hospitals.

Manufacturers we spoke with believe that in the next two to three years there will be an increase in demand, but also an increase in the number of manufacturers. We believe that small companies may be at a disadvantage as industry consolidation occurs. One factor mitigating the elimination of small manufacturers is the opportunity to produce for the illegal export market, where being a smaller, less visible business is often an advantage. Overall, we largely see the new regulations moving existing manufacturers in the illegal market to the recreational market.

The Competitive Advantages or Disadvantages for Businesses Currently Doing Business within the State

Cannabis manufacturers and their suppliers currently doing business within the state should continue to enjoy competitive advantages given their experience in the industry. Small businesses will find the new fixed costs of regulation challenging. In general, since the new regulations apply to all manufacturers, we do not see the proposed regulations as creating either competitive advantages or disadvantages for current businesses within the state.

The Increase or Decrease of Investment in the State

Table 9 shows that manufacturers will directly create \$10.4 million in additional value added to the economy, which is the increase in Gross State Product (GSP) as a result of the initial increase in sales. These direct effects will lead to more indirect spending by businesses that supply cannabis manufacturers. Workers that earn extra income, both in the cannabis manufacturing sector and in affected industries, will spend this income, which will create additional induced demand in the economy. Overall, we predict that California GSP, or Value Added, will permanently rise by \$26 million in 2019 and beyond as a result of the regulations. Labor income will rise by \$13,954,235.

The Incentives for Innovation in Products, Materials, or Processes

We believe the proposed regulations, by reducing the risk premium, will encourage new businesses to form, and this will lead to innovation. As an example, manufacturers we spoke with told us that the concentrate market is evolving. In the past, a failed harvest due to mold or mildew could not be sold. This failed harvest would sometimes be up to 30 percent of the total outdoor harvest. Cultivators are now producing oil concentrates since the mold can sometimes be removed in the manufacturing process. As another example, there is no industry standard for concentration and the industry will likely create new technology in order to sharpen delivery consistency.

Benefits of Regulations

Categories and Measurement

Proposed regulations improve health benefits through requirements regarding packaging and labeling, facility compliance, and adulterated cannabis product restriction.⁷⁷ Overall, the result should be a cleaner and safer product that results in minimizing the potential for overdoses, has the potential to reduce driving while impaired, and prevent foodborne illnesses. There is evidence that more cannabis consumption will lead to less alcohol consumption and, therefore, fewer alcohol-related driving accidents.⁷⁸ There is not much evidence of disease outbreaks associated with cannabis, although at least one outbreak has happened.⁷⁹ There is also evidence that recalls of manufactured products will not be a rare event, since there have been over 30 recalls of cannabis edibles in Denver since July 2015.⁸⁰ We believe the realized health benefits can be significant, but we are aware of no systematic measure of potential health benefits from cannabis regulation.

Regulations also improve public safety. Closed loop requirements for oil extractors can reduce fires and explosions from production accidents using volatile compounds. However, there is little statewide direct data on accidents related to cannabis oil extraction. A recent HIIMR survey of dispensary patients found that 20 out of 48 people responded “yes” to the question, “Have you or someone you know been injured while making dabs?”⁸¹ All but one of these people said that the injury was “got burned,” while a few other injuries were also indicated. At the same time, 14

⁷⁷ There is a long history of regulating the manufacture of products for human consumption. For example, the U.S. Food and Drug Administration regulates food manufacturing, dietary supplements manufacturing, and medicine manufacturing, among other products

⁷⁸ See http://legacy.iza.org/en/webcontent/publications/papers/viewAbstract?dp_id=6112

⁷⁹ See <http://www.nejm.org/doi/pdf/10.1056/NEJM198205273062101>

⁸⁰ See <https://www.denvergov.org/content/denvergov/en/environmental-health/public-health-inspections/food-safety-section.html>

⁸¹ “Dabs” is a popular name for cannabis concentrates. Dabs are small doses of the wax-like material produced from extracted oil. See Eschker and Gold (2016) “Medical Marijuana Patient Survey,” for preliminary findings.

out of 48 people responded “yes” to the question, “Do you personally know of any items or property that was accidentally damaged while making dabs?” Eleven of these people reported that the damage was fire, while eight said the damage was an explosion.⁸² A draft Eureka City ordinance contains some relevant information about fire hazards.⁸³ It describes how butane gas used in making concentrated cannabis oil can collect and ignite. It reports that “injuries from butane hash oil explosions account for eight to ten percent of severe burn cases.” The local fire district lists ten fire incidents from 2012 to 2016 at cannabis extraction sites using butane solvent and finds fire suppression costs total \$35,000 and property damages total over half a million dollars.⁸⁴ CDPH’s proposed regulations will establish safety standards for manufacturers conducting extraction through closed loop extraction systems.⁸⁵ Once again, we are aware of no systematic measure of potential safety benefits from cannabis regulation.

Consumer Surplus and Benefits and Costs

Our measure of the benefits and costs of regulation is the change in consumer welfare (or well-being) due to more or less consumption of cannabis. The demand curve for manufactured medical cannabis represents the most that people are willing to pay for the product, and willingness to pay is a common measure of the value to society of consuming a product. Consumer surplus is the amount that consumers are willing to pay for the product above the market price, and consumer surplus is measured as the area below the demand curve and above the market price.⁸⁶ We compare the benefits of the proposed regulations, as measured by an increase in consumer surplus, to the costs of regulations, as measured by a decrease in consumer surplus.

When the risk premium falls due to the new regulations, then the price comes down and more consumers purchase the product. A common way to measure those gains to consumers is by the increase in consumer surplus that occurs.⁸⁷ The “gross” benefit of MCRSA regulations is captured by the fall in the risk premium which lowers the supply curve and generates more consumer surplus. We calculate the increase in consumer surplus is \$317 million annually per

⁸² People could give multiple responses to the question, “What was the damage?”

⁸³ See [https://legistarweb-](https://legistarweb-production.s3.amazonaws.com/uploads/attachment/pdf/31314/Agenda_Summary_Butane_Ordinance.pdf)

[production.s3.amazonaws.com/uploads/attachment/pdf/31314/Agenda_Summary_Butane_Ordinance.pdf](https://legistarweb-production.s3.amazonaws.com/uploads/attachment/pdf/31314/Agenda_Summary_Butane_Ordinance.pdf)

⁸⁴ These costs may not be representative of other cities in California. Eureka has a population of about 27,000.

⁸⁵ Some extracting businesses will sell to the illegal domestic market or to the illegal out-of-state market and these will not be obtaining permits under MCRSA.

⁸⁶ As an example, suppose that one person is willing to pay up to \$20 for a cannabis edible, one person willing to pay up to \$15, and one willing to pay up to \$10. If the market price of cannabis edibles is \$16, then the first person has a consumer surplus equal to $\$4 = \$20 - \$16$, and the second person and the third person have a consumer surplus of zero since they are not willing to pay \$16. Total consumer surplus is equal to \$4.

⁸⁷ Continuing our surplus example, suppose that the price falls to \$8 for a cannabis edible. Now the first person has a consumer surplus equal to $\$12 = \$20 - \$8$, the second person $\$7 = \$15 - \$8$, and the third person $\$2 = \$10 - \$8$. Total consumer surplus is equal to \$21 which is an increase of $\$17 = \$21 - \$4$.

year starting in 2019.⁸⁸ We assume that these gains are constant in inflation adjusted dollars after 2019 and we use \$317 million as our “ongoing” value of lifetime annual benefits.

When costs rise due to the new regulations, then the price goes up and fewer consumers purchase the product. A common way to measure those losses to consumers is by the decrease in consumer surplus that occurs.⁸⁹ In order to calculate “gross” costs of MCRSA, we add the \$39.1 million in increased industry costs to our model which raises the price of manufactured medical cannabis. We calculate there is a reduction of \$315 million annually in consumer surplus starting in 2019. We assume that these costs are constant in inflation adjusted dollars after 2019 and we use \$315 million as our “ongoing” value of lifetime annual costs.

Taken together, the \$317 million in ongoing annual consumer benefits and \$315 million in annual consumer costs yield \$2 million per year in ongoing annual “net” benefits.

Geographic Distributional Effects

Medical cannabis manufacturers are located relatively more in rural counties of Northern California. We surveyed manufacturers and asked where they manufacture medical cannabis.⁹⁰ They were allowed to list more than one county. The two largest locations for manufacturing were Humboldt and Sonoma Counties, with 16 percent of respondents reporting manufacturing in both of these locations. Other counties that reported were San Diego (nine percent); Alameda, Los Angeles, and Mendocino (seven percent each); Riverside, Sacramento, and Shasta (four percent each); Contra Costa, El Dorado, Orange, San Luis Obispo, and Trinity (three percent each); and, Calaveras, Kern, Lake, Marin, Monterey, San Bernardino, San Francisco, and Tehama (one percent each).

We also asked manufacturers to indicate which types of business best describe their operations, and they were allowed to give multiple responses. Forty-three percent of manufacturers indicated they were also cultivators and twelve percent indicated they were also dispensaries. This evidence suggests that manufacturers also cultivate to a large degree, and their location is relatively more similar to cultivators than dispensaries.

⁸⁸ We continue our simplifying assumption that the supply curve is horizontal. When the risk premium falls and prices fall, the increase in consumer surplus is the area of the trapezoid to the left of the demand curve and between the starting and ending price. Thus, all the gains from a drop in the supply curve go to consumers. The consumer surplus change is calculated starting at the initial price of \$82.64 and the initial quantity of 7.9 million oil grams

⁸⁹ Continuing our surplus example, suppose that the price rises to \$12 for a cannabis edible. Now the first person has a consumer surplus equal to $8 = 20 - 12$, the second person $3 = 15 - 12$, and the third person zero since they are not willing to pay \$12. Total consumer surplus is equal to \$11 which is a decrease of $10 = 21 - 11$.

⁹⁰ These findings are based on self-reported answers to our survey and may not be representative of manufacturers in general.

In contrast, previous work shows that the distribution of dispensaries by counties is relatively located in major population areas with Los Angeles having 28 percent of dispensaries.⁹¹ Other counties with dispensaries include San Diego (14 percent); Riverside and Orange (7 percent each); Alameda (5 percent); Sacramento, Kern, San Bernardino, Santa Barbara, Santa Clara, San Luis Obispo, and Santa Cruz (3 percent each); Solano, San Francisco, San Joaquin, Contra Costa, Ventura, and Fresno (2 percent each); and, Marin, Shasta, Humboldt, El Dorado, and Monterey (1 percent each). We believe that consumers that purchase manufactured medical cannabis products live where these dispensaries are located.

These geographic differences indicate different benefits and costs of regulation. Current manufacturers that will see profit margins decline and increased competition from new companies are located relatively more in northern rural counties, while consumers that will see gains from falling prices and better regulated products, are located in relatively more urban counties.

Alternatives

Imprinted Warning Label

CDPH considered two alternatives to the draft regulations that made a change in one area of regulation. The first alternative considered is to imprint a warning label to the manufactured product itself, in addition to the other labeling requirements described earlier. This warning label is applied directly to the surface of the product, either by being marked, stamped, or imprinted. Many infused products such as cookies and candies have a surface conducive to printing, stamping, or marking the THC warning symbol, using edible ink. The benefit of an imprinted warning label is that the warning label is still visible even after outside packaging is removed. A child may still be aware that an unpackaged candy is a cannabis product. Colorado recently passed legislation to make imprinted labels a requirement.

Special equipment, such as ink jet printers or new molds, is needed to apply such a label and costs could be substantial for many small businesses. We found a range of prices between \$65,000 and \$150,000 for a printer that could imprint edible ink on cookies and harder foods, while we found a price range of \$25,000 to \$160,000 for printers for cakes. Ink prices varied between 0.001 cents and two cents per print. We use a cost per printer of \$75,000 and if we assume that ten percent new firms enter the market, then 100 firms need to purchase the machine each year, for an ongoing annual cost of \$7.5 million. When this is added to existing industry total costs of \$39.1 million, the revised value of annual costs is \$46.6 million.

The imprinted label may not be effective for very small children who cannot read and do not realize what the label means. Additionally, the label could still be physically removed. A recent paper shows that while accidental consumption of cannabis by children appears to rise after

⁹¹ See <http://www2.humboldt.edu/hiimr/docs/california%20dispensaries.pdf>

legalizing cannabis, in one hospital, about one-third of cases are due to poor supervision or storage by the adult, and the median age of the child was two years.⁹² We could find no evidence there is additional safety benefits of imprinted labeling beyond the standard labeling requirements which state, “The package shall be child-resistant, which means the package is designed or constructed to be significantly difficult for children under five years of age to open or obtain access to the product contained therein within a reasonable time,” and packaging shall not contain “. . . any likeness to images, characters, or phrases that are popularly used to advertise to children.” We are aware of no study that estimates the marginal increase in safety from imprinted label requirements. One recent study found that colors, tastes, and marketing products with cartoons may be important for the attraction to cannabis edibles.⁹³

We believe that extra benefits of imprinted warning labels would be small, and we assume that demand for manufactured medical cannabis rises by five percent. To this increase in demand we add the fall in the risk premium and we calculate \$387 million as the ongoing lifetime “gross” benefit of these alternative MCRSA regulations.⁹⁴ In order to calculate “gross” costs, we use the \$46.6 million in increased industry costs and the associated rise in price and calculate that consumer surplus falls by \$398 million on an ongoing lifetime basis. Taken together, the \$387 in ongoing annual consumer benefits and \$398 in annual consumer costs yield \$12 million per year in ongoing annual net costs.

Using an imprinted warning label was ultimately rejected because we could find no evidence that imprinted labeling was cost-effective at reducing child exposure to cannabis.

Background Checks for All Employees

An alternative to a Live Scan requirement for owners with a five percent or more financial stake in firms is to require Live Scan background checks for all participants (employees and owners) in a company. Requiring background checks on current employees is a different consideration than requiring background checks on owners. If owners with more serious past criminal activity are not allowed to own businesses, then the remaining businesses may be more compliant with regulations.

Pre-employment background checks for employees are designed to help the employer identify better qualified job applicants, reduce theft and job turnover, and increase productivity. But we believe these benefits of background checks are less likely to materialize in this case. First, current employees must be competent employees: otherwise they would no longer be working at the firm. One could imagine that background checks on current employees may not reveal much relevant information, at least as it relates to worker productivity. Second, the cannabis industry has had only a quasi-legal status, and employers would have been particularly hesitant

⁹² See <http://jamanetwork.com/journals/jamapediatrics/article-abstract/2534480>

⁹³ See <http://lcb.wa.gov/publications/Marijuana/Concerning-MJ-Infused-Edibles-Factors-That-Attract-Children.pdf>

⁹⁴ Consumer surplus rises not only because the price falls, but also in this case because demand shifts 5 percent, which more area under the demand curve at any given price.

to hire troublesome workers.⁹⁵ It is likely that cannabis workers were pre-screened through shared acquaintances and others who would vouch for their trustworthiness. We do not believe that any additional benefits will be realized by requiring background checks for all employees.

The draft regulations indicate the CDPH will only reject those with a record of serious crimes such as violent felonies (e.g., homicide or assault) and providing cannabis to a minor. We assume that CDPH will follow procedures similar to Federal Law and safeguards from the U.S. Equal Opportunity Employment Commission.⁹⁶

If CDPH staff had to check the background of all workers employed in manufacturing medical cannabis, we estimate the caseload to be more than 4,000 workers. Some employee background checks will necessitate detailed review. We could find no direct estimate of typical criminal conviction rates for workers employed in cannabis manufacturing or workers in California in general.⁹⁷ Nationally, some estimate that about 30 percent of adults have an arrest that can show up in a criminal records search.⁹⁸ Thirty percent of 4,140 is 1,242 workers, which we take to be the upper limit for how many California cannabis workers would require a detailed review. We assume that staff costs are approximately one full-time staff at a salary of \$120,000 including benefits per year to evaluate background checks needing detailed review, to handle appeals of denials, and to generally administer background check compliance.

There are additional costs. Denying employment limits the talent pool of workers just as it does with owners. We expect some employees to work with an attorney to purge their criminal records, as allowed under AUMA. Finally, there is the reduction in consumer surplus and the common measure to social welfare, which derives from increased firm costs, increased market price, and reduced production.⁹⁹

In addition to costs, there are concerns over the distributional impacts of background checks. Stakeholders at the pre-regulatory meetings identified background checks as a key area of concern, especially for small manufacturers. Many cannabis manufacturers are relatively small,

⁹⁵ As already mentioned, cannabis manufacturers could not get local permits until fall 2016 under AB 2679. See <http://www.eastbayexpress.com/LegalizationNation/archives/2016/10/04/california-medical-marijuana-extract-makers-get-historic-protections>

⁹⁶ See https://www.eeoc.gov/eeoc/publications/background_checks_employers.cfm

⁹⁷ See <http://www.cbpp.org/research/full-employment/strategies-for-full-employment-through-reform-of-the-criminal-justice>

⁹⁸ See http://www.cbpp.org/research/full-employment/strategies-for-full-employment-through-reform-of-the-criminal-justice#_ftnref17

⁹⁹ The economic justification for regulation is usually that regulations will improve upon the market outcome. Cannabis manufacturers may currently conduct background checks, and it is likely that some do because it is worth the expense, but we are not aware of a published report on the percent that conduct checks. Other manufacturers will not believe that the effort and cost of a background check will improve the quality of their workforce. We cannot think of a market failure that mandatory background checks would address.

and we find many employ about three to four people with annual sales of \$50,000 to \$100,000. Small firms are less likely to use background checks.¹⁰⁰

The “gross” benefit of these alternate MCRSA regulations is once again captured by the fall in the risk premium, and we calculate the increase in consumer surplus is \$317 million annually per year starting in 2019. We assume that these gains are constant in inflation adjusted dollars after 2019 and we use \$317 million as our “ongoing” value of lifetime annual benefits. Extending background checks to employees increases the number of individuals in each firm from about two owners to two owners and three employees, or an increase by a factor of 2.5. There are also the extra costs of CDPH staff time and consumer surplus loss. We estimate that background checks on all employees will double Live Scan costs for the industry (described above) and this alternative will cost an extra \$3 million per year. When this is added to existing industry total costs of \$39.1 million, revised annual industry costs are \$42.1 million. In order to calculate “gross” costs, we use the \$42.1million in increased industry costs and the associated rise in price and calculate that consumer surplus falls by \$322 million on an ongoing lifetime basis. Taken together, the \$317 in ongoing annual benefits and \$322 in annual costs yield \$5 million per year in ongoing annual net costs to consumers.

Requiring background checks on all employees was ultimately rejected because we could find no evidence that such a requirement would lead to any increase in benefits, yet costs increase.

Fiscal Impacts

Local Government

MCRSA requires licensees to be licensed at the local level prior to applying for a state manufacturing license. Local jurisdictions are allowed to develop a permitting process for cannabis businesses, but are not required to do so. Manufacturers must obtain local, cannabis-specific authorization in order for CDPH to grant a license. In the absence of a cannabis-specific permit, a simple letter of authorization will suffice. This workload is expected to be absorbed by existing local government personnel and resources and the proposed regulations do not significantly impact local government costs or tax revenue.

State Government

By Fiscal Year 2019-20, CDPH anticipates \$5.6 million in ongoing program authority budget to administer MCRSA and \$600,000 has been identified as CDPH’s portion of the cost of the Track and Trace system. This brings ongoing annual costs to \$6.1 million per year. In the startup,

¹⁰⁰ Forty-eight percent of firms sized 1-99 employees conducted criminal background checks on all employees, compared to 69 percent of firms sized 100-499 as reported in <http://www.esrcheck.com/wordpress/2012/07/25/shrm-background-check-survey-finds-nearly-70-percent-of-organizations-conduct-criminal-checks-on-all-job-candidates/>

there are also additional costs for IT and a \$2 million Track and Trace cost. CDPH is paying for startup costs through a loan from the General Fund. CDPH's loan on June 30, 2017 will be \$3.8 million. However, CDPH will be adding to the General Fund loan until revenue sufficiently covers expenses.

There are anticipated legal costs associated with addressing enforcement issues, such as appeals of denials of license applications and enforcement of provisions such as embargoing. Based on the expected 1,000 license applicants, CDPH anticipates that some license applications will be denied and that a high percentage of those denials will be appealed. Most appeals will take place at the administrative level, with a much smaller number that will continue appeals through the courts. CDPH anticipates there will also be additional legal costs associated with enforcing the provisions of MCRSA and these regulations with respect to those entities that obtain licensure in addition to the costs associated with addressing license application denials.

CDPH estimates that of the anticipated 1,000 license applicants, there will be some number of those applicants that will not be able to obtain a license. While some of those applicants are likely to simply withdraw their applications, some will seek to appeal this decision. In addition, CDPH also anticipates that once the licensing program is fully operational, licensees will be subject to some form of enforcement action from CDPH. In the event CDPH must embargo medical cannabis products or issue an administrative fine, some licensees will seek to appeal such decisions. CDPH does not anticipate there will be a large number of such cases as most licensees will work with CDPH to correct any deficiencies. However, CDPH estimates that, assuming no more than ten administrative appeals per year, the costs of administrative appeals from any enforcement actions will include (a) staff time, including approximately .5 PY of an Administrative Litigation Attorney III (\$99,920); .5 PY of a House Counsel Attorney (\$99,920); .2 PY of an Associate Governmental Program Analyst (\$25,820); and, .1 PY of an Assistant Counsel (\$23,825); and (b) charges from the Office of Administrative Appeals, at approximately \$14,500 per appeal, or \$145,000 total. Where the licensee continues to appeal the decision to the Superior Court, CDPH would incur approximately \$50,000 per each appeal for Attorney General representation. CDPH does not anticipate more than one such appeal to the Superior Court per year. It should be noted that the costs for an administrative appeal to either OAHA or the Superior Court can vary greatly depending on the specific facts of each case, and can be significantly higher than estimated.

There is also anticipated litigation costs associated with defending the regulations. CDPH does not expect the proposed regulations will generate any lawsuits independent of a challenge to the underlying statutes themselves. If the requirements set forth in statute as implemented by the regulations are challenged, CDPH estimates the costs of defending one such lawsuit as follows: \$100,000 for trial court litigation, plus \$110,000 for any appeals, over the course of three years, for an average of \$70,000 per year. As indicated above, actual litigation costs are always dependent on the specific facts of each case, could vary greatly, and could be significantly more costly than estimated above.

Other State Agencies

CDPH will carry out enforcement of the licensing program. It will also consult and coordinate with the other agencies identified in MCRSA and elsewhere to carry out administration and crafting policy. No other significant direct or indirect impacts on other state agencies due to MCRSA regulations have been identified.