THE MARKET FOR AND ECONOMIC IMPACT OF THE ADULT-USE RECREATIONAL MARIJUANA INDUSTRY IN MICHIGAN

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Abstract:

With recent passage of adult-use (recreational) marijuana, the industry in Michigan appears to be maturing rapidly. However, some obstacles to growth exist. Undeveloped testing systems and local options to ban the sale of recreational marijuana induces uncertainty throughout the value chain. Despite this, the supply chain is maturing rapidly, with several well-funded vertically integrated firms already operating. Both indoor and outdoor growing operations are in place but over time it appears that much of the production will take place in dedicated indoor growing facilities. It is estimated that the level of retail sales once it becomes widely available is approximately $3 billion with a total economic impact in excess of $7.8 billion. Employment in businesses along the marijuana supply chain is estimated to be 13,500 with a total economic impact on employment in the state of 23,700. Total tax revenue raised is $495.7 million of which $298.6 million is excise taxes and $197.1 million are in the form of sales taxes. These figures are extrapolated from the experience in Colorado and adjusted for Michigan's population.

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Introduction

This study outlines the market and potential economic impact of the adult-use (recreational) marijuana industry in Michigan. The state is one of 11, plus the District of Columbia, that have legalized recreational marijuana. Canada has also legalized marijuana for recreational use. Marijuana use is still against federal law, and therefore interstate shipment of marijuana is problematic. As a result, at least in the short run, most of the marijuana consumed in the Michigan will be produced in Michigan. Federal regulations place restrictions on the sale, production and funds from state recreational and medical marijuana activities. If the federal government does legalize recreational marijuana, those states that can produce marijuana at the lowest cost will dominate marijuana production. This is especially true for outdoor production.

Estimating the impact of recreational marijuana in Michigan is difficult due to the lack of data specific to the state. However, other states, particularly Colorado, are developing a record of several years' worth of information on legal marijuana. It also provides a case-study of the trajectory of industry formation over five years of development. We extrapolated from the Colorado data to derive estimates for marijuana consumption, economic impact, and tax revenues. While based on survey data, consumption patterns in Michigan appear to be similar to those in Colorado.

It is estimated that the retail value of marijuana sales will be in the range of $3 billion a year once the market matures. It is also estimated that the total employment in activities along the marijuana supply chain is approximately 13,500. IMPLAN, a standard economic impact software package, was used to estimate the total economic impact including the impact of related industries (indirect impacts) and household spending (induced impacts). The total economic impact is estimated to be $7.85 billion with a total impact on employment of 23,700. Total tax revenues are estimated to be $495.7 million of which $298.6 million is excise tax on marijuana and $197.1 million is sales tax revenue.

It is very important to note that these figures are based on the assumption that the industry will grow over the next several years. If barriers to expansion persist, these estimates will overstate the expected economic impact and the tax revenue resulting from the legalization of recreational marijuana. Additional threats to these estimates are a change in national policies. As tax revenues for marijuana sales are largely attributable at the retail sales level, state tax revenues will likely be minimally impacted compared to the potential disruption to the in-state supply chain. That is, we would expect that grower operations in southern states will be able to outcompete in state production, and dominant national firms will develop in the processing of THC-based products.

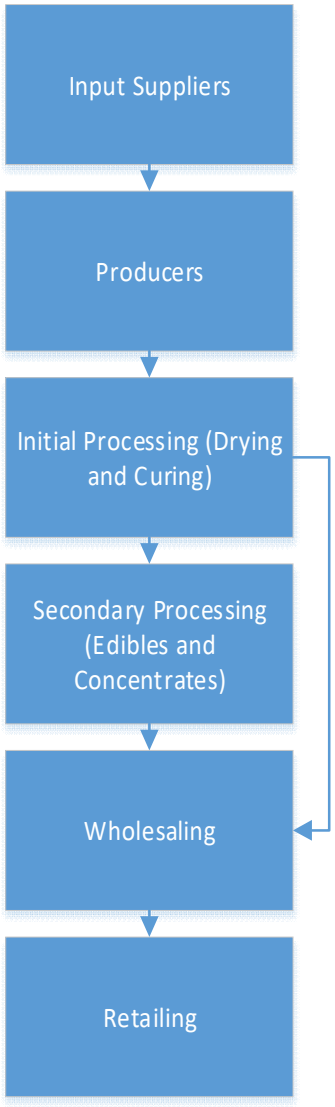
There are two possible barriers to the growth of the industry. The first is the lack of acceptance by local communities. Currently, there are relatively few communities that allow recreational marijuana. Many appear to be taking a wait and see approach and assessing the experiences of those communities that do allow for the sale of recreational marijuana before passing their own ordinances. The second barrier is the lack of testing facilities and capacity. Marijuana needs to pass testing before it can be sold, and currently, it takes several weeks before growers and processors receive their results. The slow rate of local approval and the backlog of testing has created a bottleneck in the supply chain and are factors that partially explain why marijuana prices in Michigan remain quite high.

The supply chain for recreational marijuana appears to be maturing rapidly. Vertical integration appears to be a major attribute of the supply chain in Michigan with some licensees growing marijuana as well as processing it. Growers and processors also sell directly to retailers eliminating the need for independent wholesalers. While marijuana is grown both indoors and outdoors, indoor production appears to be more efficient and a better way to control the quality of the product.

Supply Chain

The supply chain – or value chain – of recreational marijuana is outlined in figure 1. One important agent in the supply chain that is often overlooked are input suppliers. Seeds, clones, land, greenhouses, fertilizers, lighting, labor and harvesting equipment are all examples of input supplies. Access to sufficient electricity generation capacity is particularly important for indoor marijuana growing facilities.

Figure 1: The Adult-Use Recreational Marijuana Supply Chain



Growers provide resources and make management decisions that result in the growing of marijuana. Two forms of marijuana are produced by growers. The first is the flower, or the bud, which has a higher THC content. The second, resulting from the process of harvesting the flower, generates leaves and other plant material known as trim. While having a lower THC content, this material also has value which is discussed below.

There are two primary production technologies for commercial marijuana production, the first is outdoor production, and the second is greenhouse/indoor production. Outdoor production has the advantage of requiring less initial investment and lower production costs. Greenhouses and indoor production have the advantages of producing higher yields, year-round production, and the potential to grow a more consistent product. Because of this, indoor production generally commands higher prices than outdoor production. For example, in Oregon, the price of marijuana grown indoors is approximately twice the price of marijuana grown outdoors (Oregon Liquor Control Commission). Given the climatic and quality control factors, greenhouse/indoor production will probably be the dominant technology used in Michigan. After the marijuana is harvested, it is then dried and cured. This process is similar to hop or tobacco production. This initial processing can be carried out at the grow and makes marijuana suitable for further processing or retail sales. Based on other states' experiences, most of this marijuana then goes to the wholesaler and then the retailer.

Some marijuana, mostly trim, is used to make marijuana products that are eaten – edibles - or used to make concentrates. Concentrates are becoming more popular with consumers, and this further processing creates a market for the trim and provides greater cash flow along the value chain. CBD oil, a co-product with a very low THC content, provides a second source of generated revenues.

The role of wholesalers is to link marijuana production to retailers. Wholesalers provide storage, transportation service, and aggregate raw materials for retailers. Wholesalers may take shipments from initial processors and from secondary processors. A stand-alone wholesale market does not exist in Michigan and it will take time to see how the supply chain develops. The retailers sell to consumers, where their primary role is to meet consumer expectations with respect to different product offerings and quality standards.

In Michigan it appears that processors also undertake the role of wholesalers. They contract with growers on a harvest-by-harvest basis, with price depending on the quality of the marijuana. At the present time there is comparatively little, if any, forward contracting; processors agreeing to buy a certain amount of marijuana at a determined price before the marijuana is grown. The lack of forward contracting increases the level of risk faced by marijuana growers and therefore impedes supply.

It should be noted that while all of these activities need to take place, one firm can act on multiple levels along the supply chain. This is sometimes referred to as vertical integration. For example, a retailer or a retail chain could work directly with growers to carry out its own wholesale activities. Another example would be if a retailer undertook its own manufacturing activities in order to produce edibles and concentrates. It is also conceivable for growers to process and market directly to consumers through wholly owned retail outlets, though the largest share of the statewide value chain will be distributive across different parties along the value chain.

Control of the supply chain is still being developed. Currently, it appears that the production and distribution of marijuana is not concentrated. This will likely be the case as long as recreational marijuana

is against federal law. However, some major firms are interested in the industry, especially beverage firms. Constellation Brands, Molson Coors, and Heineken are investing in cannabis or THC-infused beverages. Major pharmaceutical firms are also interested in the market, although perhaps primarily for the medical market.

The situation may be somewhat different in Michigan. While the market is still being developed, Michigan growers and processors appear to be larger and more likely to be vertically integrated. Most, if not all, processors sell directly to retailers. There is little, if any independent wholesaling. Also, several of the larger processors grow their own marijuana, often in a controlled indoor environment. Because of the short supply chains in Michigan, the supply chain for marijuana may mature faster than it has in Oregon, Colorado, and other states that legalized recreational marijuana before Michigan.

The Life Cycle of Marijuana

Marijuana is an annual plant. There are both male and female marijuana plants and, as a result, growers will buy seedlings or use their own clones as opposed to seeds. Only the female plant is of economic value, and it is important to ensure that there are no male plants that would fertilize the female plant. Seeds generally take 3 to 7 days to germinate (Leaf Science, 2017). Once the seed has grown its first pair of leaves it is considered a seedling. At this point the plant needs up to 18 hours of light per day. The seedling stage generally takes 2 to 3 weeks. The vegetative state takes 3 to 16 weeks and also requires up to 18 hours of light per day. In this stage the demand for fertilizers is the greatest, primarily nitrogen and potassium. The final stage is the flowering state and takes 8 to 11 weeks. During this stage the light requirement falls to 12 to 14 hours per day. Currently, indoor growers cultivate marijuana plants by hand.

At the present time there are no federally registered pesticides for use on marijuana. The state of California allows pesticides that are approved for organic farming on cannabis (California Department of Pesticide Regulation). Marijuana also prefers relatively dry soil, with predictable moisture and moderate humidity. While the level of light in Michigan during the late spring and summer make it possible to grow marijuana outdoors, the variation in rain and humidity makes indoor production far less risky than outdoor production. Furthermore, indoor production is capable of producing three to four crops per year as opposed to one. If managed intensively, a light that generates three to four plants a year can produce 2.50 to 2.75 pounds of marijuana per year.

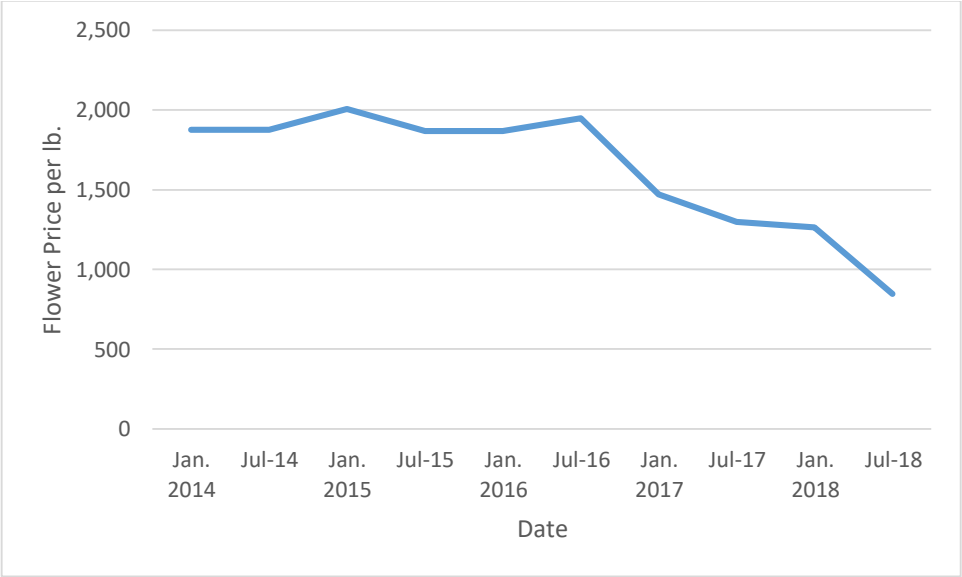
Market Price Estimates

In March of 2016 in the state of Washington, the retail price of marijuana was $9.32 per gram and the wholesale price was $2.99 per gram (Schwartz, 2016). In Washington the grow price is approximately 30 percent of the retail price. This is similar to retail/farm price ratios for fresh fruits and vegetables. As an illicit substance, marijuana prices are highest in states where it is illegal. Prices are subject to the laws of supply and demand.

Where demand outstrips supply, buyers will bid up the price of marijuana, but as supply increases relative to demand, prices will tend to abate. The long-term price floor, unfettered by regulatory supply constraints would be expected to approximate the cost of production, processing and selling plus normal, or competitive, markups.

Colorado presents an interesting test case because recreational marijuana has been legal since January 1, 2014. From that date to July 1, 2018 the price of marijuana declined from $1,876 per pound to $846 per pound. The trend in prices in Colorado is shown in figure 1.

Figure 2: Grow Price of Marijuana per Pound Colorado Jan. 1, 2014 to July 1, 2018



Source: Laxen

It appears that the price of marijuana was fairly consistent from January 2014, to July 2016 from about $1,860 to $2,000. As the industry has matured the price has dropped precipitously to about $846 per pound of flower in the summer of 2018. It is expected that prices in Michigan will also decline, perhaps faster than it did in Colorado because the national marijuana market has become more mature; entrepreneurs in the industry have learned from both their own mistakes and the mistakes of others.

Market Dynamics

There are a few potential barriers to the growth of the industry in Michigan. The first is that, as of November 2019, more than 1,400 communities, including Detroit, have opted out of recreational marijuana, and several local jurisdictions have been slow to adopt ordinances to regulate the sale of recreational marijuana (Nicols, 2019). Over time it is assumed that more local governments will allow marijuana sales as marijuana consumption becomes more acceptable, and local communities obtain a more complete picture of the marijuana industry.

The second is the lack of sufficient numbers of facilities to test marijuana. According to some in the developing Michigan industry it, takes more than a month to get the results of tests to determine if the marijuana can be sold or processed.

Other factors are relevant, including the trajectory of federal regulations of marijuana production and sales. Federal deregulation has the potential to increase consumer demand in Michigan while inviting competition in production from states with more suitable growing environments.

Marijuana Production

Initially, demand for marijuana and marijuana-based products will exceed Michigan's production capacity. Because of federal regulation, which forbids interstate transport of THC products, supply will likely be limited until the in-state industry adjusts and ramps up production to meet demand. With a lag, it appears that marijuana production will eventually match the demand for marijuana.

In 2017, marijuana production in Colorado was 340.7 metric tons, which was slightly higher than the 301.7 metric tons consumed (Orens et al, 2019). Conversely, Oregon, another state that has legalized recreational marijuana, has a serious over-production problem.

The Size of the Market

Obtaining an accurate estimate of the size of Michigan's market for marijuana is difficult. It is likely that, at least in the short run, consumption of marijuana will increase due to the fact that marijuana consumption will be legal at the state level. For example, in 2014, 13.6 percent of adult residents of Colorado reported using marijuana in the previous 30 days; that figure rose to 15.5 percent in 2017 (Reed, 2018). The experience in Colorado suggests that legally produced marijuana supplants illicitly grown marijuana (Orens et al, 2019).

It appears that people in their twenties are the largest consumers of marijuana. In 2018 it was estimated that 35.9 percent of high school seniors, 42.6 percent of college students and 39.1 percent of young adults used marijuana or hashish. Furthermore, approximately 25 percent of college students and young adults consumed marijuana or hashish in the previous month (Schulenberg et al, 2019). Education appears to be negatively correlated with marijuana use, as people with no college education tend to be heavier users. Additionally, as people age, the consumption of marijuana appears to decline. It should be noted that these figures are based on self-reported surveys and the actual level of consumption may be somewhat different. However, given the increased acceptability of using marijuana, these figures may be relatively accurate.

Prices will eventually decline as output increases to meet demand. Lower prices will also be a factor in increased marijuana consumption. Also, the medical marijuana market will likely decline as the recreational market expands. Based on projected sales, the Michigan Department of Treasury estimates that sales tax revenues from marijuana sales will be $97.5 million in 2020 and $143.0 million in 2021 (Eubanks and Guilfoyle, 2020). Because the Michigan tax on recreational marijuana is ad-valorem, actual tax revenues will fluctuate in proportion to the sale price and quantity sold at the retail level. A major decline in the price of marijuana could reduce tax revenue. If the percentage decline in the price is greater than the percentage increase in consumption, tax revenues will decline.

One difficulty in determining the size of the market is the changing ways in which marijuana is consumed. Marijuana flower (or female buds) is the traditional form of consumption but other forms are becoming more common. Vaping marijuana is a new but increasingly popular method of marijuana consumption; 21.6 percent of 19 to 28 year olds surveyed indicated that they vaped marijuana at least once (Schulenberg et al., 2019). The figures from Colorado provide an example and are shown in table 1.

Table 1: Forms of Consumption Colorado 2017, Flower Equivalent

Product Form	Percent of Consumption
Flower	61.8
Concentrate	27.3
Trim	5.7
Infused Edibles	4.9
Infused Nonedibles	0.3

Source: Orens et al 2019

From 2014 to 2017, Colorado retail sales of flower increased by 516 percent, infused edibles increased by 226 percent and infused non-edibles increased by 135 percent (Reed, 2018).

A common unit of measure is required to obtain a good estimate of the amount of marijuana consumed. Since flower is the most popular form of consumption, all products will be in flower equivalents. This is shown in table 2.

Table 2: Marijuana Equivalency

Product Type	Solvent	Purchase Amount	Trim Used in Production	Flower Equivalent
Edible	Butter	10 mg.	.08 grams	.07 grams
Edible	Butter	100 mg.	.77 grams	.69 grams
Edible	Butane	10 mg.	.08 grams	.07 grams
Edible	Butane	100 mg.	.82 grams	.72 grams
Edible	CO2	10 mg.	.09 grams	.08 grams
Edible	CO2	100 mg.	.92 grams	.82 grams
Concentrate	Butane	1 gram	5.84 grams	5.20 grams
Concentrate	CO2	1 gram	6.59 grams	5.84 grams
Concentrate	Ethanol	1 gram	5.86 grams	5.21 grams
Concentrate	Water	1 gram	10.29 grams	9.15 grams

Source: Orens et al, 2015

While there is some variation of raw inputs depending on the size of the amount purchased and the type of solvent used, the band is very narrow. For the purposes of this analysis, the ratio used for edibles is 1.14 units of trim to 1 unit of flower, and in the case of concentrates, 1.12 units of trim to one unit of flower. Conversely, 1 gram of flower equals to 0.3 grams of concentrate, and 1 gram of flower equals three 10 mg. edible units (Orens et al, 2015).

Overall, residents and visitors to Colorado consumed 301.7 metric tons of flower equivalent. However, concentrate accounted for 27.3 percent of all marijuana consumed. Consumers appear to be interested in products that have a higher concentration of THC, the psychoactive ingredient in marijuana. In Colorado, from 2015 to the end of 2017, the THC content in flower increased from 16.6 percent to 19.9 percent and the THC content of trim increased from 14.9 percent to 17.2 percent (Orens et al, 2019).

The price of marijuana is also difficult to estimate. It is fair to say that as the market matures the price will decline. For example, in Colorado the pretax price of flower declined from $14.05 to $5.34 per gram from 2014 to 2017, and the price of concentrate fell from $41.43 to $21.57 per gram (Orens et al, 2019). The price further declined by 2019 to $1.78 per gram for flower and 97 cents per gram for trim (Colorado Department of Revenue, 2019). In Oregon, the retail price of usable marijuana declined from $7.00 per gram in December 2017, to approximately $4.80 per gram in December of 2018 (Oregon Liquor Control Commission, 2019). This is despite the fact that the potency of marijuana increased.

Over-production could put further downward pressure on prices. Excitement over a new market could lead to overinvestment in production with resulting lower prices. For example, the Oregon Liquor Control Commission (2019) estimated that in 2018, the excess supply of marijuana equaled 6.5 years of demand. However, over- and undersupplied markets may have negligible impacts on the overall size of the market measured in dollars. For example, in cases of undersupply, supply constraints may reduce the volume to be sold – reducing the market value. However, the supply shortage will cause the unit price to increase – increasing the market value. The extent to which the undersupply impacts the overall market value depends on how consumers respond to price changes. If consumers are price sensitive, such that they reduce demand by proportionately more than the increase in price, then overall market value will decline. Alternatively, if they are not price sensitive and will seek to maintain a level of consumption regardless of price, then a supply shortage will increase the overall economic size of the market.

Another variable in determining demand is how much marijuana users consume. As is the case with many products, a minority of consumers ingest the majority of marijuana, with heavy consumers using on average 1.6 grams of flower or flower equivalent per day (Orens et al, 2019). These consumers tend to be less sensitive to price changes.

Additionally, approximately 20 percent of Oregon adults consumed marijuana in 2018, with an average annual per capita consumption of 224.6 grams of flower equivalent (Oregon Liquor Control Commission, 2019). It should be noted that the majority of marijuana is a consumed by a relatively small number of consumers. Colorado estimates that 21.8 percent of marijuana users account for 66.9 percent of consumption and that 30 percent of consumers account for 87.1 percent of all marijuana consumption (Schwartz, 2016).

In order to assess consumption in Michigan data from the National Survey on Drug Use and Health was used. In this survey, individuals were asked to indicate whether they had used marijuana within the last 12 months and whether they had used it within the last month. Use in Colorado, Michigan, Oregon and Washington were compared.

As shown in Table 3, people between the ages and 18 and 25 were more likely to indicate use over the past 12 months and over the last month. More importantly, Table 3 indicates that the three states with recreational marijuana had a higher rate of usage by 4 to 9 percent over Michigan for 18 to 25 year olds. Similarly, this rate was between 5 and 9 percent for all adults. Additionally, Table 3 shows that marijuana consumption is common among young people in all four states, including in Michigan where, at the time of the survey, recreational marijuana use was illegal. Assuming that Michigan will experience similar rates of usage as those in Colorado, Oregon and Washington when recreational use is legalized seems to be reasonable, if not slightly conservative.

Table 3: Percent Indicating Marijuana Use: Colorado, Michigan, Oregon and Washington

State	Within last year 18-25 Yr-Olds	Within last year All Adults		Within last month 18-25 Yr-Olds	Within last month All Adults
Colorado	49.23	27.77		33.21	18.12
Oregon	49.57	28.56		33.11	19.65
Washington	44.50	24.18		30.44	17.01
Michigan	**40.92**	**18.91**		**27.50**	**13.08**

Source: 2017-2018 National Survey on Drug Use and Health

The final data point to consider is the population of Michigan. Michigan's population count of adults is higher than that of the referent states, though Michigan has a slightly larger share of 18-25 year olds, as shown in Table 4.

Table 4: Estimated Population 2017: Colorado, Michigan, Oregon and Washington

State	Population 18-24	Total Population 18 and Over	Percent 18-24
Colorado	516,709	4,184,186	12.3
Michigan	997,075	7,717,047	12.9
Oregon	362,918	3,160,871	11.5
Washington	658,536	5,282,568	12.4

Source: U.S. Census Bureau

We use Colorado estimates of per-capita use by 18-24 year-olds and 25 or older, along with total annual sales to project expected Michigan sales. While 18-24 year-olds make up about 12.3 percent of Colorado's adult population, they consume about 21.9 percent of marijuana based on self-reported usage. Hence, it is important to recognize demographic differences between Colorado and Michigan in generating usage projections, where Michigan has a higher share of the adult population in the age group of 18-24 years of age.

One additional source of demand that needs to be considered is nonresident consumption. Tourism is a major industry in Michigan, and some believe that Michigan could become a destination for marijuana tourism. Of the Great Lakes states, only Illinois has legalized recreational marijuana, although marijuana consumption for medical purposes is legal in Ohio. Given the fact that marijuana is legal in Canada, tourism from Ontario is unlikely, especially given the weakness of the Canadian dollar. Colorado is also a tourism state. Using Colorado as an example, in 2017, it was estimated that 9.1 percent of the marijuana consumed in Colorado was from non-residents (Orens et al, 2019). We implicitly assume that about 9 percent of the marijuana sold in Michigan will go to other states, primarily to Indiana and Ohio. While marijuana tourism may arise from these states, it is also likely that marijuana use will also arise from passive tourism demand of those visiting Michigan for other reasons.

Recreational marijuana tourism can be a significant draw, especially along borders with states without recreational marijuana. At least one small town near the Indiana border appears to be drawing customers as far as 200 miles south of their location (Beggin, 2020). While tourism demand is projected to be relatively small compared to in-state use, the total value of tourism sales is not insignificant. Additionally, passive tourism demand – those who travel to Michigan for other reasons but take up recreational use while visiting – may increase, as a larger share of U.S. residents will be accustomed to marijuana use.

However, we anticipate the net effect of federal regulation will be a decrease in tourism-based demand for Michigan marijuana and that the vast majority of recreational marijuana will be consumed by Michigan residents. Before then, there may be some potential for retailers along the border between Michigan, Ohio, Indiana, and Wisconsin (along the border with the Upper Peninsula).

Table 5 shows calculations used in projecting Michigan sales. Using Colorado estimates, we estimate the volume purchased by our two age groups: 18-24 years and 25+. We start with total volume of flower-equivalency for Colorado, which was estimated at 301.7 metric tons. Since nine percent of total sales was estimated to be sold to non-residents, we subtract out 24.9 metric tons from in-state purchases. As 18-24 year-olds consumed 21.9 percent of the instate marijuana sales, we estimate that 60.6 metric tons were consumed by this group. The remaining 216.2 was allocated to the 25+ age group. Dividing the two age groups by respective populations provides our per-person average usage in volume (metric tons).

To project Michigan usage, we work backwards. As shown in Table 5 and starting with population counts, Michigan has just under a million 18-25 year-olds and 6.7 million adults over the age of 25. Multiplying these by per-person consumption rates in Colorado provides our projected usage volume in metric tons. We also exert that tourism uptake is proportional to that of Colorado, at 9 percent in-state sales. From these volume estimates, we project that Michigan demand will be just under 560 metric tons a year.

Table 5: Projection Calculations of Volume of Sales

	Colorado			
	18-25	25+	Tourism$^{\psi}$	Total
Volume (metric tons)	60.6	216.2	24.9	301.7
Population	516,709	3,667,477	*NA*	4,184,186
per-cap Consumption	0.0001173	0.0000589	*NA*	*NA*
	Michigan			
	18-25	25+	Tourism$^{\psi}$	Total
Population	997,075	6,719,972	*NA*	7,717,047
per-cap Consumption	0.0001173	0.0000589	*NA*	*NA*
Volume (metric tons)	116.9	396.1	46.2	559.2

$^{\psi}$ *Tourism volume of purchases based on 9 percent of residential sales*

Assuming a retail price of $5.34 (the pretax price per gram) yields a total market value of $2.986 billion per year; this is at the retail level and assumes that the rate of consumption in Michigan will be similar to that of Colorado once the Michigan industry matures and more retail operations are established. We project this will take between four to six years based on the experience in Colorado.

Expected Tax Revenue

There are two taxes that will be derived from the sale of marijuana. The first is a 10 percent excise tax that retailers will pay on the sale price (Oosting, 2019). The second is 6 percent retail sales tax. The Senate Fiscal Agency estimates that the total revenue raised could be $262 million a year once the industry matures (Oosting, 2019), without going into detail on expected sales volume tied to those revenue projections (Michigan Senate Fiscal Agency, 2018). Using our retail sale volume projections, we anticipate Michigan Excise tax revenues will increase by $298.6 million annually, and sales tax (sales price plus excise tax) to be $197.1 million. Collectively, we project that public revenues will increase by $495.7 million

annually from the direct sales of recreational marijuana when the market stabilizes in about four to six years. This does not include estimates of reduced revenues through other, foregone, taxable purchases that may include medical marijuana and/or other sales and excise taxable goods and services that compete with recreational marijuana sales.

One often overlooked issue when assessing the expected tax revenue impacts of legalized marijuana is the impact on alcohol consumption. While good data is difficult to obtain it appears that as marijuana consumption increases, alcohol consumption declines (Schulenberg et al, 2019). Some people apparently substitute marijuana consumption for alcohol consumption. While legalized marijuana will raise revenues, there appears to be a somewhat offsetting reduction in alcohol consumption. One study indicated that alcohol sales declined by 20 percent in counties where recreational marijuana is legal (Vittert, 2019). This figure may be somewhat high and alcohol sales appear to be declining with or without legal recreational marijuana.

Economic Impact

Economic impacts arise when a new industry or economic activity is introduced in the local economy which infuses new transactions into the economy. It is important to properly account for what constitutes new transactions. Technically, transactions generated can only be considered new if they do not supplant other transactions which would have taken place in the absence of the new industry or activity. That is, if consumers increase expenditures on marijuana products by $10 and subsequently reduce expenditures on beer by $10 – and that marijuana products are a substitute for beer for these consumers – then no new expenditures have taken place. Similarly, expenditures on marijuana products may be substituted for other expenditures like those for movies, lottery tickets and other products or services. Based on this understanding of what is not new expenditures, the only new expenditures generated that we can be sure of are those generated by recreational marijuana tourists who made the trip into Michigan for the pursuit of recreational marijuana. Other tourists, who are likely to purchase marijuana during their trip but made the trip on other grounds, are likely substituting other planned trip expenditures to purchase marijuana products. That is, overall, we expect the true economic impact, in terms of new economic activity to be modest.

Rather than measure the economic impact in isolation, an alternative measure by which to gauge the economics of recreational marijuana is an economic contribution analysis. An economic contribution analysis provides a snapshot of the importance we attribute to the projected Michigan marijuana products and services sectors to the overall economy. To this extent, an economic contribution study of Michigan's projected marijuana industry shows the extent to which this industry contributes to the overall macroeconomic environment, including direct and secondary effects as dollars re-circulate throughout the economy. However, the results should be interpreted with care. Economic contribution estimates assert the size of the economy that the marijuana product value chains contribute but does not assert the economy will expand by the estimated values.

The IMPLAN Pro. 3.0 economic simulation model was used to model economic expenditures. The modeling framework traces transactions across industries and institutions (households and government units) to account for secondary transactions and recognizes that one's expenditures are another's revenues. Secondary transactions arise as dollars spent in the state economy are respent multiple times. For example, when consumers purchase marijuana-based products from a retailer, the retailer will re-spend a portion of the earnings to restock, purchase services and other inputs to retailing. A portion will

be directed to households in the form of labor income and payments to shareholders, and to government, in the form of tax and license payments. Much of these expenditures will go to instate purchases, but the share that is used to purchase inputs from outside the state will cease to re-circulate further. This process repeats itself through subsequent rounds of expenditures and revenues. This process continues, only hampered by the extent to which subsequent expenditures leave the state.

Transactions are distributed across supply sectors for modeling. We start with agricultural marketing dollar provided by the USDA. However, these industry expenditure shares must be modified to reflect expected expenditure breakouts reflecting the average marijuana product value chain. The breakout shown in Table 6 are the resulting estimates derived from heuristic adjustments to baseline agricultural value chains. Specific adjustments include more weight on processing – accounting for the myriad different CBD and THC consumer products derived from marijuana plants, on grow production recognizing increased value-added activities tied to greenhouse operations, and energy – also accounting for greenhouse operations with year-round production.

Table 6: Estimated Sector Inputs Shares

Industry Group	Input Percent
All industries	100.0
Agribusiness	4.9
Grow production	14.3
Processing	22.5
Packaging	2.5
Transportation	4.9
Wholesale trade	13.3
Retail trade	21.5
Energy	10.0
Finance & Insurance	3.1
Advertising	2.0
Legal & accounting	1.0

A custom industry was generated using the value chain breakout in Table 6 to model the Michigan marijuana value chain. Standard agricultural value added attributes were included. These attributes allocate net income payments to labor, capital and indirect business taxes levied on grow production. Value added attributes of other supplying firms remain unchanged from their baseline values. Because the 10 percent excise tax is allocated at the retail price and because agricultural products are usually not assessed Michigan's six percent sales tax, direct tax estimates are added to simulation results in the aggregate.

Findings

The estimated economic contributions of Michigan's new recreational marijuana industry, at $3 billion in output, are shown in Table 7. Starting with employment, we project that as the sector reaches an initial state of maturity, the value chain will employ some 13,500 people directly. A rough breakout suggests that about 10,000 of those positions will be on the retail and wholesale trade sectors, including shipping,

supplying around one thousand retail outlets. Because all Michigan retail sales will come from instate production. We anticipate about 1.25 million pounds of wet harvest to be harvested and processed commercially. Accordingly, grower operations will employ about 3,500, while process operations will employ around 3,500. The average wage of these direct jobs will be about $28,600, contributing about $384.7 million to labor income and $1.8 billion to total annual gross state product.[1]

Accounting for respending of direct dollars by industry participants and all subsequent recirculation of dollars in the state economy, we estimate that total employment contributions will be just over 23,700 Michigan jobs with annual pay of just under $1 billion. When accounting for all associated transactions, recreation marijuana will contribute some $7.9 billion in annual transactions and contribute $4.7 billion to the state's gross state product, which includes the approximate $500 million dollars in direct public revenues from the sale and licensing of marijuana products.

Table 7: Estimated Economic Impacts

	Employment	Labor Income	Value Added	Output
Direct Effects	13,500	$384,743,000	$1,797,627,000	$2,986,000,000
Secondary Effects	10,300	$559,284,000	$2,855,060,000	$4,866,919,000
Total	23,700	$944,027,000	$4,652,687,000	$7,852,919,000

Totals may not sum up due to rounding

We should be careful to note that these estimates are not to be interpreted as economic impacts that would not exist in the absence of Michigan's new recreational marijuana sector. Rather they represent the contribution this sector will have on the existing economy at the end of the first four to five years. There is sufficient reason to assert that the true economic impact may be lower as recreational marijuana sales will crowd out other expenditures for medical marijuana, beer and alcohol and possibly other recreational expenditures. Hence the actual effect on the state's economy is not easily predicted.

Other conflating factors may impact these estimates. The time span we selected draws from the primary referent state, Colorado, experience. In this time span of four to five years, as seen in Colorado, we anticipate that the sector will largely reach an initial state of equilibrium. This is likely not a long-run steady state, but rather at some point, firms along the value chain will start to consolidate such that there will likely be a few dominant firms with higher levels of efficiency than fringe firms that make up the periphery of the value chain. Gained efficiencies from economies of scale will likely be further advanced by national and global efficiencies as national demand for customized processing equipment come online. That is, as more states legalize recreational marijuana, national equipment manufacturers will increase interest in developing processing and product innovations for industry adoption. The combined efficiency impacts will likely reduce the overall economic contribution in terms of employment and likely reduce the cost of final goods for consumers. Whether consumers will respond to lower costs by increasing overall demand sufficient to generate larger economic contributions remains to be seen, as no state has surmounted the initial industry consolidation phase of industry development.

[1] Gross state product is a term to describe total state earnings by private and public entities.

Summary

The marijuana industry in Michigan appears to be maturing rapidly. An improved testing system and a wider acceptance of recreational marijuana by local communities would assist in the maturation process. It is estimated that the level of retail sales once it becomes widely available is approximately $3 billion with a total economic impact in excess of $7.8 billion. Employment in businesses along the marijuana supply chain is estimated to be 13,500 with a total economic impact on employment in the state of 23,700. Total tax revenue raised is $495.7 million of which $298.6 million is excise taxes and $197.1 million are in the form of sales taxes. These figures are extrapolated from the experience in Colorado and adjusted for Michigan's population.

The supply chain for marijuana was also analyzed. It appears that the supply chain is maturing rapidly, with several well-funded vertically integrated firms already operating. Both indoor and outdoor growing operations are in place but over time it appears that much of the production will take place in dedicated indoor growing facilities.

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