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Elasticity Memo
PPPA 6007

<p style="text-align:center">Michigan Marijuana Tax</p>

I.   Introduction

At the time the bulk of this memo was written, Michigan had not yet legalized

recreational marijuana. During the midterm elections last Tuesday, November 6, voters in the

state passed Proposal 1, which legalized adult-use recreational marijuana and imposed a total

16% tax on sales (Gray). This memo does not focus on the impact of legalization on marijuana

consumption in Michigan, but analyzes the hypothetical impact that the tax alone would have on

consumption if the pre- and post-legalization marijuana markets were otherwise the same. I

anticipate that in this theoretical situation, total annual marijuana consumption in Michigan

would decrease by somewhere between approximately 7,000 and 25,000 lbs.

II.   Policy Background

In 2008, Michigan became the 13th U.S. state to legalize medical marijuana ("Michigan

Proposal"). This past November 6, the state became the first in the Midwest and the 10th in the

country to legalize recreational use of the drug (Ingraham) when Proposal 1 passed by a 56-44

margin (Gray). Included in the bill is a tax on recreational marijuana, which includes the state's

general 6% sales tax, as well as a 10% excise tax. This tax is lower than that of all of the other

states that have already legalized recreational marijuana. Proposal 1 is expected to create an

estimated $100 to $200 million annually in revenues for the state, much of which would be spent

on education and infrastructure (Bishop-Henchman).

III.   Methodology

The statutory incidence of the 16% tax on marijuana sales in Michigan will fall on

producers, shifting the supply curve inward (see Appendix) and increasing prices. I will assume

in my calculations that the marijuana market is a single market both before and after implementation of the proposed policy, where the tax is the only relevant part of the policy. In reality, Proposal 1 not only imposes a tax on the sale of recreational marijuana, but it also legalizes it. This change in state law transforms the market from being completely illegal to consisting of both illegal and legal transactions. In this analysis, however, I am only interested in the pre-tax *illegal* market and the post-tax *legal* market. Since the tax would not apply to the illegal part of the new market, I cannot estimate the tax's impact on consumption in this part of the market—only in the theoretical world where marijuana is suddenly legal and all transactions are taxed. In addition, my calculations rest on the assumption that Proposal 1 would affect only the supply curve. However, the policy might also affect the demand curve. For example, perhaps more people will decide to start smoking weed because they feel that the stigma surrounding the drug has decreased. This change in preferences would shift the demand curve to the right.

In my highly simplified analysis, in order to understand the effect of the tax on quantity demanded, I calculate:

1. The average price of 1 oz. of marijuana prior to the proposed tax (P_o)

2. Multiple price estimates of the new price of 1 oz. of marijuana based on the new tax, based on different distributions of economic incidence (P_n)

3. Estimated overall consumption of marijuana in Michigan before the tax (Q_o)

4. How the tax affects the consumption of marijuana in Michigan (Q_n)

IV.   Calculations

1. To determine the average price of 1 oz. of marijuana prior to the tax, I use data from the crowdsourcing website "Price of Weed," where consumers anonymously enter the price they paid for weed (per oz.) in cities and states across the country ("What"). Data are aggregated

by state and product prices are divided into three categories: high quality, medium quality, and low quality.

The validity and generalizability of these data are very limited. Reporting price to the website is completely voluntary, and there is therefore selection bias: people who submit data are not a representative sample of the entire Michigan population. These numbers are also self-reported, and may or may not be accurate.

While consumers are constantly submitting new numbers to the website, when I last checked, the numbers for Michigan in these three categories were $290.68, $273.47, and $225.23, respectively. The website also lists n, or the sample size of people who submitted price data, for each category. For Michigan, n = 5162, 5058, and 368, respectively ("What").

I calculate the average price of weed for the collective total of entries in all three "quality" categories by multiplying each price by its respective n, adding these all together, and then dividing by the total number of entries:

Average = ((5162*290.68) + (5058*273.47) + (368*225.23)) / (5162+5058+368)

The average price of 1 oz. of weed in Michigan before the tax is $280.18.

2. To determine the post-tax price of 1 oz. of marijuana, I make multiple estimates based on how the economic incidence of the tax—or burden—is distributed among consumers and producers (in this case, retailers). For calculations, see Fig. 2 in the appendix.

    If consumers bear ¾ of the tax, the new price would be $313.80.

    If consumers bear ¼ of the tax, the new price would be $291.39.

    If consumers and retailers bear the tax equally, the new price would be $302.59.

    A significant limitation to determining the post-policy price of marijuana, P_n, is that I do not know what the actual economic incidence of the tax is because I do not know the

actual equations for the supply and demand curves, or the elasticity of supply. Although I provided multiple estimations of the distribution of the tax burden, it is possible that none of these are correct. I am also assuming that prices after implementation of the policy would reflect the prices of illegally sold marijuana before the policy, only with the added tax. However, because there are essentially separate markets for marijuana before and after legalization, and shift in demand could also affect prices, this is not necessarily true.

3. To calculate a rough estimate of the quantity of marijuana consumed before the tax, I use data from two different sources. First, I use state-specific data from the Substance Abuse and Mental Health Services Administration's National Survey on Drug Use and Health from 2015-2016 ("2015"). The survey lists the estimated number of people of various age groups in Michigan who used marijuana in the past year and past month. For my calculations, I use the number of people age 18+ who used marijuana in the past year (1,205,000). I then attempt to determine these 1,205,000 people's total consumption (Q_o) during that year by using a previously estimated average annual consumption of marijuana among Americans, or 3.53 oz (Stiffler).

   Q_o = 1,205,000 marijuana consumers per year * 3.53 oz. per year = 4,253,650 oz.

   The quantity of marijuana consumed before the tax is 4,253,650 oz.

There are many limitations on my calculations of the original quantity of marijuana consumed, Q_o. The 3.53 oz. estimate is outdated, describes overall American consumption but not specifically consumption in Michigan, and likely does not account for the full range of people who consume marijuana. Another problem with Q_o is that the statistic I use from the National Survey on Drug Use and Health describes usage among people age 18 and older, and does not include marijuana consumers under age 18. This age category also includes

people between the ages of 18 and 20, who would not be legally allowed to consume or
purchase marijuana and therefore would not count in the post-policy legal market. Finally,
the number of people in this age group who have consumed marijuana in the past *year* is
approximately 200,000 greater than the number who have consumed marijuana in the past
month. I used data for the past year, but this might result in an overestimate of consumption
because many of these people who consumed marijuana in the past year but not the past
month may consume much less than 3.53 oz. per year.

4. The elasticity of demand for marijuana is rather inelastic. Davis, Geisler & Nichols (2016)
   found elasticity estimates between -0.67 and -0.79 (Davis). Because it is so difficult to
   determine the true elasticity of demand for a product in an illegal market, I use both
   elasticities to find a range of possible effects of Michigan's proposed 16% tax on marijuana
   on quantity demanded, as well as all three price estimates based on different economic
   incidence distributions. The equation for elasticity of demand is:

   $E_D = ((Q_n - Q_o) / Q_o) / ((P_n - P_o) / P_o)$

   So, rearranging the equation to find Q_n gives us:

   $Q_n = ((Q_o)*(E_D)* ((P_n - P_o) / P_o)) + Q_o$

   See Fig. 3 in the appendix for calculations.

The lowest estimate of new quantity is 3,850,423 oz, where P = $313.80 and elasticity = -0.79.

The highest estimate is 4,139,623 oz., where P = $291.39 and elasticity = -0.67.

The respective decreases of each estimate from the original quantity (Q_o) of 4,253,650 oz are:

   4,253,650 - 3,850,423 = 403,227 oz. = 25,201.7 lbs.

   4,253,650 - 4,139,623 = 114,027 oz. = 7,126.7 lbs.

V.   **Conclusion**

If the illegal marijuana market before November 6 and the subsequent legal market were the same, and taxation was the only factor influencing this market, the total amount of marijuana consumed annually in Michigan could be expected to decrease by between approximately 7,000 and 25,000 lbs. as a result of the new policy. It is somewhat meaningless to compare these numbers with other estimates, since they are calculated based on assumptions that do not reflect the actual impact of the policy. In reality, the state of Michigan will benefit from the collected revenue on marijuana sales that would not have been collected before the passage of Proposal 1, although this memo does not predict how much revenue the state would collect annually compared to proposed estimates of $100 to 200.

Appendix
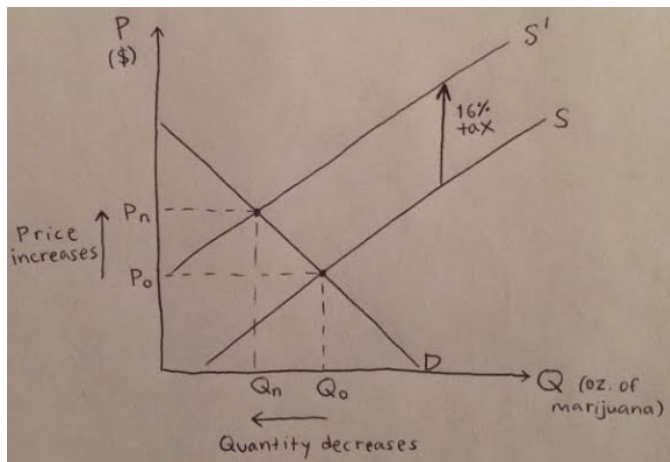
Fig 1: Supply and Demand Graph

Fig 2: Prices based on Tax Burden

Tax Burden	Calculation	Price (per oz.)
Consumers bear ¾ of tax	(280.18)+((280.18)*(0.16)*(3/4))	$313.80
Consumers bear ¼ of tax	(280.18)+((280.18)*(0.16)*(1/4))	$291.39
Consumers and retailers share burden equally	(280.18)+((280.18)*(0.16)*(1/2))	$302.59

Fig 3: New Quantities based on Elasticity and Price

	Elasticity Estimate: -0.67	Elasticity Estimate: -0.79
Calculations for P=$313.80	$Q_n=(4{,}253{,}650*(-0.67)*((313.80-280.18)/280.18))+4{,}253{,}650$ = **3,911,673 oz**	$Q_n=(4{,}253{,}650*(-0.79)*((313.80-280.18)/280.18))+4{,}253{,}650$ = **3,850,423 oz**
Calculations for P=$291.39	$Q_n=(4{,}253{,}650*(-0.67)*((291.39-280.18)/280.18))+4{,}253{,}650$ = **4,139,623 oz**	$Q_n=(4{,}253{,}650*(-0.79)*((291.39-280.18)/280.18))+4{,}253{,}650$ = **4,119,201 oz**
Calculations for P=$302.59	$Q_n=(4{,}253{,}650*(-0.67)*((302.59-280.18)/280.18))+4{,}253{,}650$ = **4,025,699 oz**	$Q_n=(4{,}253{,}650*(-0.79)*((302.59-280.18)/280.18))+4{,}253{,}650$ = **3,984,872 oz**

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