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Suppressing Illicit Cannabis Markets After State Marijuana Legalization

In addition to its ongoing study of I-502,[1] WSIPP received the following assignment from the 2018 Legislature:

> *To the extent information is available, identify effective methods used to reduce or eliminate the unlicensed cultivation or distribution of marijuana or marijuana containing products in jurisdictions with existing recreational and/or medical marijuana markets.*[2]

In this report, we consider methods for suppressing illicit cannabis markets in the context of legalization.[3] We found little to no evidence of effective methods for suppressing illicit markets in this context. Legalization is expected to reduce or eliminate the illicit cannabis market by providing a legal alternative. However, in reviewing the scientific literature, we found that the response of the illicit marijuana market to legalization is much more complex and difficult to predict.

We begin in Section I by describing the legal cannabis supply system created by I-502, including how legal supply is regulated and how legalization can be expected to change illicit marijuana supply.

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Summary

In 2018, WSIPP was assigned to examine effective methods for suppressing illicit cannabis production and distribution in the context of legalization. We found little available evidence on this topic.

In lieu of such evidence, we explored reasons that the illicit market may survive even in the presence of a legal alternative. Continuing prohibitions—in other states and for youth—create a natural incentive for illicit markets. Even among adult marijuana consumers in Washington, who have access to the legal supply system, we found reasons the illicit market may survive. These reasons pertain to competition between legal and illicit suppliers.

We focused on regulation of the legal cannabis supply system, which is typically motivated to prevent criminal activity in the legal system and protect public health against harms of marijuana consumption. Such regulation may have the unintended consequence of supporting the illicit market by reducing the competitive advantage of legal cannabis suppliers. We then examined specific regulations in the nine states with legal non-medical cannabis supply systems, identifying regulatory features that can be expected to influence competition.

The most recent literature suggests that multiple components of a state's overall approach to legalization work together. The effects of individual regulatory features on the illicit market may depend on what other regulatory features are in place as well as the level of enforcement of continuing marijuana prohibitions. We conclude by describing a practical strategy for monitoring key indicators of progress in illicit market reductions as the state's approach to legalization develops.

[1] Initiative Measure No. 502. I-502 legalized non-medical marijuana for adults in Washington in 2012. Reports from WSIPP's I-502 study are available here.
[2] Engrossed Substitute Senate Bill 6032, Section 606(18)(c).
[3] The terms "marijuana" and "cannabis" are used interchangeably in this report.

In Section II we explore reasons that an illegal cannabis supply may persist after a legal marijuana supply is introduced. In Section III we explore policies to regulate legal cannabis supply systems that may affect illicit markets, and we describe similarities and differences in these policies across the nine states with legal non-medical cannabis supply systems.[4] In Section IV we explore practical strategies for monitoring progress on suppressing Washington's illicit marijuana market as the state's approach to legalization develops. In Section V we summarize our findings.

[4] A total of 12 U.S. jurisdictions have legalized non-medical cannabis. However, we omitted Vermont and the District of Columbia, which did not create legal supply systems. We also omitted Illinois, which passed non-medical cannabis legislation just prior to the publication of this report. See Exhibit 2 for a list of states included in this report. This report was finalized June 30, 2019, but was held until August pending the release of other publications cited in this report. Any updates to policy after June 30 are not reflected in this report.

I. Background

Per the language of our assignment, we focused on unlicensed cultivation and distribution of marijuana, which we shorten to "illicit supply" in this report. The exchange of cannabis between illicit suppliers and consumers who demand it constitutes the illicit marijuana market.

Illicit drug markets are undesirable for a variety of reasons, including violence, lack of product safety, exploitation of farmers and workers, and environmental destruction.[5] In addition, law enforcement efforts to reduce illicit drug markets consume limited public resources, and contact with the criminal justice system is associated with an array of negative consequences. These include family instability, diminished employment prospects, and disenfranchisement.[6]

One of the primary arguments for cannabis legalization is that it will reduce or eliminate the illicit marijuana market by creating a legal cannabis supply system. Below we describe characteristics of Washington's legal supply system, which provide background for how illicit supply can be expected to change as a result of legalization.

The Legal Cannabis Supply System in Washington

Upon legalization in Washington in 2012, one of the first tasks was the formulation of rules for the legal supply system by the Liquor and Cannabis Board (LCB). LCB defined a three-tiered cannabis supply system consisting of producers, processors, and retailers. Generally, producers grow cannabis, processors package and create secondary products such as extracts and edibles, and retailers sell cannabis and products for consuming cannabis to consumers.

Washington's cannabis supply system is not vertically integrated—businesses holding retail licenses cannot be involved in other parts of the supply chain, although producer and processor licenses can be held in combination. LCB rules also established license fees and requirements for applicants (e.g., age, state residency, and criminal background) as well as businesses (e.g., operating plans, physical premises, and financing of each establishment).[7]

The LCB initially capped the number of retailer licenses at 334. There was no stated cap on producer or processor licenses, but the LCB has stopped reviewing producer and processor licenses based on the assessment that cultivation capacity is sufficient for existing demand.

[5] Collins, J. (2014). Ending the drug wars: Report of the LSE Expert Group on the economics of drug policy. *London School of Economics and Political Science, 71*.

[6] Berson, S.B. (2013). Beyond the sentence: Understanding collateral consequences. *National Institute of Justice Journal, 272*, 25–28.

[7] RCW 69.50.331 and WAC 314.55.020.

Other notable features of the regulatory system are taxes and traceability monitoring. I-502 imposed a 25% excise tax on cannabis sales at each of the three tiers in the supply chain, taxing sales by producers, processors, and retailers. The 2015 Legislature replaced the three-tiered tax structure with a 37% tax on retail sales.[8] The LCB is required to review and make recommendations on the excise tax rate to "further the goal of discouraging use while undercutting illegal market prices."[9]

The traceability (aka, "seed-to-sale") system tracks all cannabis within the legal supply system from seed to retail sale and is one of the LCB's primary tools in monitoring regulatory compliance within the licensed system.[10] LCB enforcement officers use traceability data and other means to actively monitor production, distribution, and sale of cannabis in the licensed system.

The 2015 Legislature also incorporated medical cannabis into the existing non-medical cannabis regulatory structure.[11] In response to expected increased demand from medical patients, the LCB raised the state cap on retail licenses from 334 to 556. Medical marijuana patients in Washington may purchase their cannabis from licensed retailers; they can also grow their own limited number of plants, or participate in collective cultivation with other medical users, with higher limits on the number of plants in a location.[12]

These forms of medical cultivation and distribution, along with the licensed supply system, constitute the entire legal cannabis supply system in Washington. Marijuana supply is legal within that system, as long as it conforms to applicable rules and laws, but other forms of cannabis supply remain illegal. Next, we consider reasons the illicit supply of cannabis may continue even when a legal supply system is available.

[8] Second Engrossed Second Substitute House Bill 2136, Chapter 4, Laws of 2015.
[9] RCW 69.50.535(5)(a).
[10] WAC 314.55.083(4).
[11] Second Substitute Senate Bill 5052, Chapter 70, Laws of 2015. Previously, medical marijuana in Washington existed as a very loosely regulated, quasi-legal system.
[12] RCW 69.51A.250.

II. Reasons the Illicit Market May Survive After Legalization

In this section we explore two main reasons the illicit market may survive following legalization. The first is that continuing prohibitions—in other states and for youth—present natural incentives for illicit markets. The second is that newly created legal supply systems must compete with existing illicit suppliers, and a variety of factors may influence the competitive advantage of the legal market.

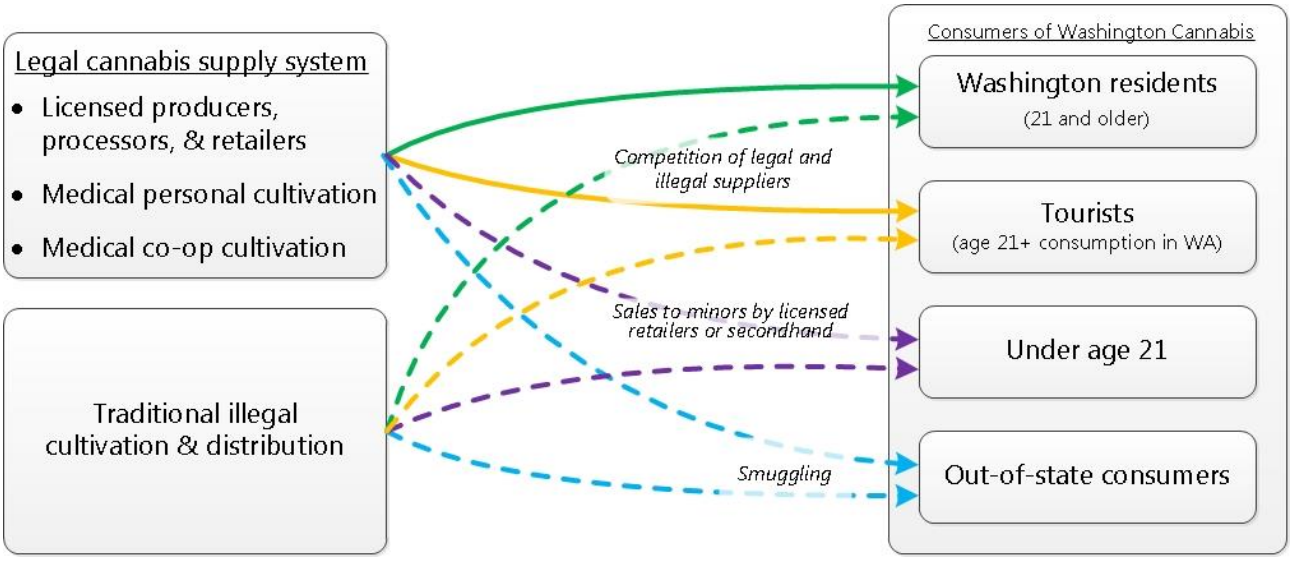
In Exhibit 1 we illustrate the different varieties of legal and illicit supply of marijuana that can exist post-legalization, and the areas in which legal and illicit suppliers compete.

Continuing Marijuana Prohibitions

Prior to legalization, when there was no legal supply system, all forms of marijuana supply and consumption were illegal. Today, despite legalization, some forms of prohibition remain. Within Washington, all sales to minors and the unlicensed supply of marijuana to adults remain illegal. Outside of Washington, many other states continue to prohibit marijuana. These remaining prohibitions represent opportunities for illicit supply to continue.

Exhibit 1

Possible Varieties of Illicit Cannabis Supply in Washington after Legalization
(Dashed Lines Represent Illegal Activity)



Note:
"Traditional" illegal cultivation and distribution refers to the pre-legalization version of marijuana supply, which may continue after legalization. That supply source could also include cannabis from other states that is imported into Washington. Also, competition between legal and illegal suppliers is indicated where solid and dotted lines lead to the same consumers.

Licensed marijuana production in a legal context, without the pressure of evading law enforcement, can be expected to be less risky, less costly, and capable of producing marijuana of higher quality and variety than can be produced covertly under prohibition. If legally produced cannabis can fetch a higher price in prohibited markets (e.g., in other states or from youth) than in the legal market, there is an incentive for illicit supply, which could potentially outweigh the criminal risk.

In the same fashion, traditional illicit cultivation in legal states may be less costly due to "masking"[13]—that is, it can be more difficult for law enforcement to detect illicit versions of marijuana supply when legal versions are present. This could provide an incentive for illicit suppliers to favor cultivation in legal states for export to prohibition states.

The mixed legal status of cannabis within the U.S. is unique to that drug. In contrast, cigarettes and alcohol are legal in all states (though regulations vary), and other drugs like heroin, cocaine, and methamphetamine are prohibited in all states. State differences in marijuana prohibition create a natural incentive for smuggling.[14]

For example, marijuana was legalized in Washington prior to Oregon. One study has shown that the subsequent opening of the legal market in Oregon led to a decline in sales at Washington marijuana retailers near the Oregon border.[15] The effect was strongest for large transactions, suggesting smuggling from Washington to Oregon was occurring prior to the opening of the Oregon legal market.

There is also evidence suggesting that state legalization has reduced international drug smuggling at the southern border of the U.S. One study found a substantial decline in marijuana seizures at the border with Mexico between 2013 and 2018, using methods that adjust for changes in the level of enforcement intensity.[16] The reason for this decline may be increased competition from the illicit supply of cannabis from legal states. Interstate smuggling poses less criminal risk than international smuggling, and product quality is generally higher in legal state supply systems. It is reasonable to expect that legal marijuana states are a more competitive source of cannabis supply to states with continuing prohibition than is cannabis from Mexico.

Marijuana prohibitions that continue after legalization provide clear opportunities for illicit supply to continue. In addition, the illicit market may also persist as a competing alternative to legal supply.

[13] Hsiang, S. & Sekar, N. (2016). Does legalization reduce black market activity? Evidence from a global ivory experiment and elephant poaching data. *National Bureau of Economic Research*, Working Paper 22314.

[14] In this report the term smuggling refers to the transportation of marijuana across state lines for the purpose of distribution.

[15] Hansen, B., Miller, K., & Weber, C. (2017). The grass is greener on the other side: How extensive is the interstate trafficking of recreational marijuana (No. w23762). *National Bureau of Economic Research*.

[16] Bier, D.J., (2018). *How legalizing marijuana is securing the border: The border wall, drug smuggling, and lessons for immigration policy.* Cato Institute.

Competition Between Legal and Illicit Suppliers

As shown in Exhibit 1, newly created legal marijuana supply systems enter into competition with existing illicit suppliers for consumers who have access to both sources of supply. Consumers considering these two alternatives may weigh the legal risk of illicit market participation, along with other factors like price, accessibility, and product quality. Taking price as an example, legal suppliers can gain market share from illicit suppliers by lowering their price, all other things being equal. Through successful competition of the legal market, the illicit supply (for adult consumption in Washington) can be reduced or eliminated.

However, no matter how the legal market gains an advantage—whether by price, quality, convenience, or some other factor—successful competition brings with it potential harms. For example, lower prices tend to increase demand, and in the case of a product that can be harmful to consume,[17] successful competition of legal suppliers runs the risk of increasing cannabis consumption and the harms that potentially result.

Partly in response to such concerns, regulations such as excise taxes, limits on the number of retailers, and restrictions on vertical integration are imposed on the licensed supply system. Although they are intended to protect public health, because these restrictions apply to legal suppliers alone, they may also have the unintended effect of supporting the illicit market by diminishing the competitive advantage of licensed suppliers.

Similarly, regulation of the licensed supply system is also often intended to prevent criminal activity within the licensed cannabis supply system. These regulations could unintentionally support illicit markets. For example, in Washington persons with certain criminal histories are banned from licensure.[18] This requirement may make it more difficult for illicit suppliers to obtain a license and transition to legal supply. Further, participation in the LCB's traceability system is required of all licensed cannabis businesses to ensure that the supply of cannabis is compliant with the law. This requirement may increase the operating costs of legal suppliers, potentially affecting their ability to compete with illicit suppliers.

We found no evidence to suggest that specific regulations of legal cannabis supply systems systematically affect illicit cannabis supply. However, a number of researchers have explored factors on which illicit and legal suppliers compete. This developing literature provides a foundation for considering possible impacts of various regulations on the illicit supply of cannabis.

[17] National Academies of Sciences, Engineering, and Medicine (NAS). (2017). *The health effects of cannabis and cannabinoids: The current state of evidence and recommendations for research.* Washington, DC: The National Academies Press.

[18] WAC 314.55.040.

Price and Taxes

The price difference between legal and illegal marijuana is the most obvious factor driving competition. Legal marijuana prices tend to decline as legal markets develop,[19] which would put downward pressure on illicit marijuana prices. However, excise taxes are typically applied, which push prices upward. Excise taxes are taxes applied to specific goods (e.g., gasoline, cigarettes, marijuana) to depress demand for the good by raising its price and to generate revenue to address costs related to consumption of the good. However, by raising legal market prices, excise taxes can incentivize illicit market participation.

Excise tax rates on cigarettes are an interesting comparison. Cigarette excise tax rates have increased in a majority of states over the past decade,[20] and they vary widely between states, ranging from a low of $0.17 per pack (Missouri) to a high of $4.35 per pack (New York and Connecticut).[21] Studies have shown an association between higher state cigarette excise tax rates and larger illicit tobacco markets and that cross-border tax avoidance and evasion are associated with state differences in excise tax rates.[22]

The availability of lower tax cigarettes on American Indian reservations has also been linked to tax avoidance and evasion.[23] Excise taxes may have a similar effect for marijuana, motivating some consumers to a lower cost illegal alternative, if available.

Specific to marijuana, we are aware of two studies that addressed the role of marijuana excise taxes on consumer decision making and substitution with illegal marijuana. One study used data from Washington's marijuana traceability system to examine the effect on marijuana demand of changing the excise tax structure from a 25% ad valorem tax levied on sales of producers, processors, and retailers, to a 37% tax levied on retailers.[24] This study was one of the first to examine the response of *legal* marijuana demand to price. It found demand for legal marijuana to be more price-sensitive than prior estimates for illegal marijuana—that is, price increases produced greater reductions in demand for legal marijuana relative to illicit marijuana as examined in earlier studies under prohibition.[25]

The authors speculated that one reason for the greater price sensitivity of legal marijuana demand may be the availability of

[19] See for example: Smart, R., Caulkins, J.P., Kilmer, B., Davenport, S., & Midgette, G. (2017). Variation in cannabis potency and prices in a newly legal market: Evidence from 30 million cannabis sales in Washington State. *Addiction*, *112*(12), 2167-2177.

[20] Federation of Tax Administrators. (2019). *Cigarette Tax Increases: 2000-2019*.

[21] Tax Foundation. (2019). *How high are cigarette taxes in your state?*

[22] Tax avoidance is legal (e.g., in the case of cigarettes, purchasing cigarettes for personal consumption in a lower tax location). Tax evasion is illegal, and in the case of cigarettes, includes transporting low-tax cigarettes to higher tax jurisdictions for resale and also illegally produced and untaxed cigarettes. National Research Council. (2015). *Understanding the U.S. illicit tobacco market: Characteristics, policy context, and lessons from international experiences*. Washington, DC: The National Academies Press. See also DeCicca, P., Kenkel, D., Liu, F. (2013). Excise tax avoidance: The case of state cigarette taxes. *J Health Econ, 32*(6).

[23] Tribal members are exempt from state excise tax rates, but states can collect excise tax on sales to non-tribal members; state collection of these taxes from tribes can be difficult in practice. Wang, X., Xu, X., Tynan, M.A., Gerzoff, R.B., Caraballo, R.S., & Promoff, G.R. (2017). Tax avoidance and evasion: Cigarette purchases from Indian reservations among US adult smokers, 2010-2011. *Public Health Reports*, *132*(3), 304-308.

[24] Ad valorem taxes are taxes applied to the value of the good (as opposed to the quantity of a good). Hansen, B., Miller, K., & Weber, C. (2017b). The taxation of recreational marijuana: Evidence from Washington state (No. w23632). National Bureau of Economic Research.

[25] In the Hansen et al. (2017b) study, the quantity of marijuana consumed decreased by approximately 7% for every 10% increase in price.

illicit marijuana as a substitute for legal marijuana. Consumers may purchase less legal marijuana in response to price increases because they have an alternative (illicit) source of cannabis. By contrast, in earlier studies of illicit marijuana markets, prior to the existence of any legal markets, consumers had fewer options in responding to higher prices.[26]

That study did not directly address substitution of illicit for legal marijuana due to price increases. We are aware of one study that has, by asking people to estimate the amount of marijuana they would hypothetically purchase from legal and illegal alternatives at varying price differentials.[27] The study posed scenarios to participants in which legal marijuana was available at a fixed price, and illegal marijuana was available at varying prices, allowing researchers to identify the price differential at which respondents would resort to the illegal market. In other scenarios, the roles of legal and illegal marijuana were reversed, allowing the researchers to examine the price differential that would attract illegal market consumers to the legal market.

Results indicated that legal marijuana was preferred overall and that illegal marijuana was more price sensitive. Specifically, marijuana consumers were less likely to resort to the illegal market in response to higher legal prices, and they were more likely to switch to legal marijuana in response to higher illegal prices.

Even if legal market prices remain low, the relationship between the selling price and the cost of production is the bottom line for the survival of illicit suppliers. Larger, more efficient suppliers may be better able to endure price competition.[28] This points to the importance of local conditions—the effective price to competitively displace the illicit market likely varies from one jurisdiction to the next, depending on the strength of the illicit market.

It is also worth noting that low legal prices, although good for competition, and potentially harmful to public health, may also be a stimulus for smuggling by suppliers seeking a higher selling price.

[26] The study also found evidence that consumers changed their product choices to less expensive legal marijuana products to compensate for the tax increase. However, the net effect on tax revenue was overall positive—that is, even though the higher tax rate on consumers was associated with a decrease in pre-tax spending, the reduction in demand was offset by the larger collections on each dollar spent due to the higher tax rate.

[27] Amlung, M., Reed, D.D., Morris, V., Aston, E.R., Metrick, J., & MacKillop, J. (2018). Price elasticity of illegal versus legal cannabis: A behavioral economic substitutability analysis. *Addiction, 114*, 112-118.

[28] Rogeberg, O. (2018). Prohibition, regulation or laissez faire: The policy trade-offs of cannabis policy. *International Journal of Drug Policy*, *56*, 159-161.

Demand Shifts

Although lower prices in either market can be expected to increase demand, legalization may stimulate increased demand for reasons other than pricing. For example, even if price stayed constant, consumers of marijuana from either market may use more marijuana due to decreased legal risk of possession or increased social acceptability. Increased demand could provide an opportunity for illicit suppliers if it is not satisfied by legal supply.[29]

Supply Constraints

If the quantity of marijuana in legal production is restricted to a level below the demand for marijuana, the unmet demand presents an opportunity for illegal suppliers. Regulatory restrictions on the number of licenses in the legal supply system, and on the cultivation capacity of licensees, could reduce available supply below demand for the product. Conversely, limits on supply capacity that are set too high could lead to surpluses, and cannabis that cannot be sold within the legal system may be more likely to be sold out of state.

Access

Access to marijuana may also be an advantage of illicit suppliers. Cities and counties within legal states may ban marijuana businesses from their jurisdictions. Certain types of marijuana products may be banned in the legal system—for example, Canada currently does not offer concentrates in its legal system. Similarly, in Washington, home delivery of marijuana is illegal, but the ability to access marijuana without leaving one's home may be of value for the sake of convenience or for consumers concerned with keeping their marijuana consumption private. Such limitations on access in the legal system could provide an opportunity for illicit suppliers.

Production Costs and Enforcement

It is also possible that legalization could reduce the cost of illicit production. Legal risk to illicit suppliers could be reduced because the presence of legal cannabis businesses makes it harder to detect illegal businesses (i.e., "masking"),[30] or enforcement intensity may decrease for marijuana crimes in general with increasingly accepting attitudes toward marijuana. Reductions in criminal risk would, in theory, reduce the costs of illicit marijuana supply which could help illicit suppliers survive.[31]

[29] Hsiang et al. (2016).

[30] Ibid.

[31] Auriol, E., Mesnard, A., & Perrault, T., (2019). *Defeating crime? An economic analysis of cannabis legalization policies.* Paper presented at the 6th International Meeting in Law & Economics: Paris.

Barriers to Licensure

One of the most direct ways to reduce illicit cannabis supply would be to convert illicit suppliers into licensed suppliers. Expenses associated with licensure requirements, such as license fees and facility upgrades, may discourage illicit suppliers from entry into the licensed system. Criminal history requirements, intended to minimize crime in the licensed system, would have a similar effect.

From this review it is clear there are many reasons the illicit supply of cannabis may persist post-legalization. Continuing prohibitions in other states and for youth, alongside abundant marijuana available from the legal system, create a natural incentive for illicit supply. For adult consumption in Washington, legal and illicit suppliers compete for market share. There we found numerous factors in the competition between markets that may allow illicit supply of cannabis to survive this competition. Many of these factors can be directly influenced by regulation of the legal supply system.

Next, we consider how other states are approaching regulation of their legal marijuana supply systems, with a focus on specific regulatory features that may inadvertently support the illicit market by reducing the competitive advantage of legal suppliers.

III. Regulatory Features of State Legalization Potentially Affecting Illicit Marijuana Markets

Currently, eleven states and the District of Columbia have legalized adult non-medical marijuana. We omitted Vermont and the District of Columbia from our comparison because they do not have commercial cannabis supply systems.[32] We also omitted Illinois, which passed non-medical cannabis legislation just prior to the publication of this report.[33]

For the nine states with commercial non-medical cannabis supply systems, we compared their approaches to the following specific regulatory features:

- Tax rates,
- Price controls,
- Cultivation limits,
- Retail license caps,
- Vertical integration,
- Personal cultivation (i.e., home grow), and
- Criminal history disqualification for licensure.

To identify these regulatory features we consulted published statutes and administrative codes for each state. In cases that we could not clearly identify the presence or absence of a particular regulatory feature, we conducted broader searches of secondary sources. We also consulted several other policy tracking studies that have inventoried similar features of state marijuana policy.[34] Judgments of each policy feature were conducted by one researcher and confirmed by another. Additional details on coding of each regulatory feature are provided in the Appendix I.

One limitation of our approach is that we did not collect data from individuals within each state who may be more familiar with nuances of policy features that were not apparent from our relatively distant perspective. Results of the state comparison are shown in Exhibits 2 and 3 and summarized below.

Excise Tax Rates

Marijuana excise taxes vary in terms of where in the supply chain the tax is levied (e.g., wholesale, retail), whether they are applied to units of product or price, and the amount of the tax. Most states levy an excise tax on marijuana in the form of a tax on the value of a retail sale, but excise taxes on wholesale transactions are not uncommon either, and have been applied to the value of the sale and the quantity of cannabis sold. Washington has the highest excise tax rate on retail sales among legal states. We also cataloged sales tax rates, which, combined with excise taxes, are the two main sources of tax on marijuana commerce.[35]

[32] Vermont and the District of Columbia legalized possession and personal cultivation, but did not create commercial supply systems. There have been subsequent efforts in both the Vermont Legislature and the Council of the District of Columbia to establish retail systems but none has passed to date.

[33] Illinois' law went into effect June 25, 2019.

[34] Alcohol Policy Information System, Recreational Use of Cannabis Volume 1 & Volume 2; Prescription Drug Abuse Policy System, Recreational Marijuana Laws

[35] Excise taxes are sometimes referred to as selective sales taxes. To avoid confusion, we use the term excise tax to refer

Price Controls

Aside from excise taxes, price controls (i.e., price minimums) are another regulatory feature that may directly affect the price of cannabis. We found that most states prohibit licensees from distributing marijuana free of charge. Only Washington raised the price floor somewhat higher, prohibiting retail prices below acquisition cost.

Limits on Cultivation Capacity

Limits on the production capacity of the legal system may limit the potential for surplus marijuana, which may be at particular risk for diversion to the illicit market. However, set too low, they may leave unmet demand and an opportunity for illegal suppliers. Oregon, as one example, does not limit production capacity, and a recent report found a large surplus.[36] The state has since taken steps to limit cultivation capacity.[37]

Most states did not restrict cultivation capacity in policy. The one exception was Maine, which capped the number of cultivators and included language allowing for the possibility of increasing capacity if there is a shortage. Washington policy indicated that no additional cultivation licenses are currently being issued. Nevada included language allowing for restriction of production if it is deemed to be in the public interest.

to taxes levied on specific goods, and sales tax to refer to taxes levied on goods in general. Sales taxes are levied at retail sale, but excise taxes may be levied on wholesale or retail transactions.

[36] Oregon Liquor Control Commission (2019). *Recreational marijuana supply and demand legislative report.*

[37] Selsky, A. (2019, May 30). Oregon, awash in marijuana, takes steps to curb production. *The Seattle Times*.

Limits on the Number of Retail Licenses

Similar to limits on cultivation capacity, caps on the number of retail licenses issued are intended to restrict the supply capacity of the legal system. Retail license caps potentially affect the illicit market by creating the potential for unmet demand, and they also limit opportunities for entry into the legal market.

We found that most states do not restrict the number of retailers. Washington is one exception, which capped retail licenses at 556. Nevada restricts density of retail outlets by county population, and California policy includes language that the licensing authority can consider retailer density in reviewing applications.

Vertical Integration

Restrictions on vertical integration prohibit entities from owning businesses at multiple levels of the supply chain, such as a cultivator owning a retail outlet. Vertical integration may be an effective competition strategy in that it can increase the size and efficiency of firms. Conversely, restricting it may lead to more competition among legal firms. Restricting vertical integration is a legacy of alcohol regulation following Prohibition, motivated by concerns that more powerful firms may seek to gain market share by promoting excessive consumption.[38]

We found that most states do not address vertical integration in their marijuana regulatory policy. Only Washington prohibits it—cultivators and processing facilities may not hold retail licenses.

[38] van Lynseele, A. (n.d.). Washington vertical integration: What it is and why it matters. *Cannabis Law Journal.*

Personal Cultivation

Prohibition of home cultivation in jurisdictions with legalization may be motivated by an interest in revenue generation or supporting enforcement against illicit production. Regarding the latter, the reasoning is that if home cultivation is prohibited it is easier to recognize illicit cultivation occurring in residences. However, home cultivation is typically legal for medical users, which would diminish this potential benefit of a ban on home cultivation. We found that Washington is the only state to prohibit personal cultivation for non-medical use. All other states allow limited home cultivation, with limits ranging from 3 to 12 plants.

Criminal History Disqualification for Licensure

Converting illicit suppliers into legal market participants is a particularly direct strategy for reducing the illicit market. In Washington, a prior felony can disqualify a person from licensure. Yet, prior to legalization, producing or distributing marijuana was a felony offense, and since legalization, it remains a felony offense if done without a license. Therefore, many illicit suppliers may be barred from participation in the legal supply system. One motivation for disqualifying persons with a criminal history may be to bar organized crime from involvement in the legal system, one of eight federal law enforcement priorities laid out for legalizing jurisdictions.[39] However, such requirements conflict with the aim of reducing illicit markets by conversion of illicit suppliers into the legal system.

We found that most states try to strike a balance, disqualifying license applicants with criminal backgrounds but providing exceptions for past marijuana convictions. Alaska and Michigan were the most strict, making no exceptions for marijuana crimes, followed by Washington which allowed only for prior marijuana possession convictions (a misdemeanor offense). California and Oregon had the most flexible policies in this regard, leaving consideration of criminal background to the discretion of the licensing authority.

[39] James M. Cole, *Guidance Regarding Marijuana Enforcement*, August 29, 2013.

Exhibit 2

Regulatory Features of Cannabis Supply Systems in States with Legalized Non-Medical Cannabis Use

State	Status of legalization[a]	Transactions subject to excise tax[b]	Excise tax amounts	State sales tax	Price control
Washington	**Enacted: 2012 Sales initiated: 2014**	**Retail**	**37% ad valorem at retail**	**6.5%**	**Retail sales below acquisition price prohibited**
Alaska	Enacted: 2014 Sales initiated: 2016	Wholesale	$50/oz. for flowers; $25/oz. for immature buds; $15/oz. for trim; $1/clone at wholesale	0.0%	Free cannabis prohibited
California	Enacted: 2016 Sales initiated: 2018	Wholesale & retail	$9.25/oz. for flowers; $2.75/oz. for leaves; $1.29/oz. for fresh cannabis plant; 15% ad valorem at retail	7.25%	Free cannabis prohibited
Colorado	Enacted: 2012 Sales initiated: 2014	Wholesale & retail	15% ad valorem at wholesale; 15% ad valorem at retail	Not applicable	Free cannabis prohibited
Maine	Enacted: 2016 Sales initiated: pending	Wholesale & retail	$338/lb. for flowers; $94/lb. for trim; $1.50/seedling; $0.30/seed at wholesale; 10% ad valorem at retail	Not applicable	Free cannabis prohibited
Massachusetts	Enacted: 2016 Sales initiated: 2018	Retail	10.75% ad valorem at retail	6.25%	None
Michigan[c]	Enacted: 2018 Sales initiated: pending	Retail	10% ad valorem at retail	6.0%	None
Nevada	Enacted: 2016 Sales initiated: 2017	Wholesale & retail	15% ad valorem at wholesale; 10% ad valorem at retail	6.85%	None
Oregon	Enacted: 2014 Sales initiated: 2016	Retail	17% ad valorem at retail	0.0%	Free cannabis prohibited

Notes:

[a] Enactment indicates the year of passage; additional details on coding decisions in each column are shown in Appendix I.

[b] Excise taxes levied at wholesale are imposed on transactions between cultivators (i.e., producers) and other licensees.

[c] As the most recent state to legalize, Michigan's policy is particularly subject to change.

Exhibit 3

Additional Regulatory Features of Cannabis Supply Systems in States with Legalized Non-Medical Cannabis Use

State	Cultivation limits	Retail license caps	Vertical integration	Home cultivation (non-medical)	Criminal history disqualification for licensure
Washington	**No additional licenses being issued**	**556 total for the state, with limits for each county based on consumption and population**	**Vertical integration of retail with producers/ processors prohibited**	**Prohibited**	**Point system based on felony and misdemeanor convictions, but some allowance for prior misdemeanor marijuana possession convictions**
Alaska	No	No	Allowed	Limited to 6 plants (3 mature)	Felony convictions; alcohol sales violations; and misdemeanor drug, assault, weapon, or fraud
California	No	No, but consideration of density in granting new applications	Allowed	Limited to 6 plants	Discretion of licensing authority
Colorado	No	No	Allowed	Limited to 6 plants (3 mature)	Felony convictions, except marijuana convictions that would no longer be a felony under current law
Maine	Limits on the number of cultivators, by cultivator size; additional licenses can be issued in case of under-supply	No	Allowed	Limited to 3 mature plants	Controlled substance convictions punishable by incarceration of 1+ year, and fraud convictions, except marijuana convictions that would no longer be a felony under current law
Massachusetts	No	No	Allowed	Limited to 12 plants	Felony convictions except marijuana, unless distribution of marijuana to a minor
Michigan	No	No	Allowed	Limited to 12 plants	Felony convictions, and controlled substance and fraud misdemeanors
Nevada	Allowance for regulatory agency to limit cultivation if necessary	Yes, in terms of number of retailers per county population size	Allowed	Limited to 6 plants	Felony convictions, except marijuana convictions that would no longer be a felony under current law
Oregon	No	No	Allowed	Limited to 4 plants	Discretion of licensing authority

Regulation as a Component of the Overall Approach to Legalization

States vary widely in the extent to which they restrict legal cannabis supply. Washington appears to be one of the most restrictive states, considering that it has the highest excise tax rate, is the only state to ban vertical integration and home cultivation, and it placed limits on cultivation capacity and the number of retailers. Based on expectations explored earlier of how individual regulatory features may affect competition between illicit and illegal suppliers, this would suggest that Washington may have a less competitive legal market and a larger illicit market as a result. However, we next explore recent research that suggests the response of the illicit market to legalization depends on the combined effects of an overall approach to legalization. Effects of any single regulatory approach may depend on other regulations that are in place, and also on the level of enforcement directed against illicit markets.

Although we have focused thus far on regulatory factors that potentially affect the illicit marijuana market by restricting the legal market, law enforcement can also affect the competition between markets by increasing costs for illicit suppliers and reducing demand among illicit market consumers.

We are aware of one study examining law enforcement practices after legalization, which surveyed law enforcement agencies in Colorado and Washington two years after legalization. Although it had a very small sample, the study found that 50% of sampled agencies reported that marijuana was a low priority following legalization.[40]

Some of the most recent economic literature has begun to explore the combined effects of law enforcement and regulation as legal and illegal cannabis markets compete.[41] One economic modeling study used simulated data to explore the "policy mix" of enforcement and legal marijuana pricing as they affect the competing goals of illicit market reduction and harms of increased cannabis consumption.[42] The study examined the "ejection" price—the price of legal marijuana that will eradicate the illicit market—finding that the ejection price will necessarily move low enough to increase overall marijuana demand. This increased demand would potentially increase harms resulting from increased cannabis consumption.

[40] Wiens, T., Lenk, K.M., Fabian, L.E., & Erickson, D.J., (2018). Law enforcement practices in the first two states in U.S. to legalize recreational marijuana. *International Journal of Drug Policy*, 61, 38-43.
[41] Rogeberg (2018).
[42] Auriol et al. (2019).

However, the ejection price can be higher, with accordingly smaller increases in consumption, when law enforcement pressure increases the cost to suppliers of illicit production or the risk to consumers of purchasing illicit marijuana. The study favored increasing the criminal risk to consumers, through arrests and fines, because these enforcement measures are generally less costly to the criminal justice system than imprisoning illicit suppliers.

Although that study is a theoretical exercise, it illustrates that the expected effects of a given strategy to reduce illicit cannabis supply are likely to depend on what other strategies are in place. Law enforcement can be expected to be particularly effective in the presence of a viable legal marijuana market that offers in-demand products at a competitive price. However, a low price of legal marijuana will increase consumption, posing risks to public health. The legal market price could be higher (and consumption lower) if other strategies, such as law enforcement, effectively increase the cost to produce illicit cannabis or decrease demand for it.

IV. Practical Strategies for Monitoring Progress in Illicit Market Reductions

Our review of state regulatory approaches was not designed to identify how these policies affect the illicit market. One could imagine a study comparing states in terms of regulatory restriction and illicit market size. Such a study could provide evidence of effectiveness for illicit market reduction, but the inherent difficulties in measuring the size of the illicit market make this type of evidence unlikely.

However, most if not all legalizing states have traceability data systems which provide rich information on legal market transactions, including price. Washington seems to be the only state that makes its traceability data publicly available.[43] The ability to incorporate multiple state traceability data systems into a single analysis would allow researchers to examine relationships between regulatory features and legal market performance. This type of research would provide strong implications for the size of illicit markets across states.

A more feasible approach to assessing progress in illicit market reductions as the state's approach to legalization continues to develop may be to monitor basic indicators of competition between illicit and legal markets over time. These basic indicators include legal and illicit marijuana pricing and a direct measure of the size of the illicit market.

Monitoring Marijuana Pricing

Washington has the highest excise tax among legalizing states. This increases the retail price of cannabis, but other factors, such as supply and competition, also influence the price. As shown in Exhibit 4, the pre-tax price of legal cannabis has fallen continuously through the most recent data available from the traceability system. Based on the previously cited studies of the price-sensitivity of legal marijuana demand, it is reasonable to expect that the decreasing legal price puts pressure on the illicit market, but we can also expect it to increase consumption.[44]

More current data on legal marijuana pricing in Washington were not available. Data from the LCB's traceability system have not been available since October 2017 due to administrative issues with the database. For the purpose of monitoring illicit market reductions, a first priority would be to secure the availability of legal price data from Washington's supply system.

[43] A number of scholarly publications have used Washington's traceability data, but we found none that have used such data from other states. While states may conduct extensive market analysis of their own traceability data for internal use, these data are not typically available to external researchers.

[44] Amlung et al. (2018); Auriol et al. (2018); and Hansen et al. (2017b).

Exhibit 4

Retail Pre-Tax Cannabis Flower Price in Washington's Legal Supply System

Note:
Source: Washington Liquor and Cannabis Board traceability system.

Regarding illicit marijuana pricing, illicit markets are undocumented by design, so reliable data sources on illicit market price, market size, or other aspects of illicit market activity are scarce. We believe the best available estimate of illicit cannabis pricing in Washington is from the International Cannabis Policy Study (ICPS), an evaluation of the effect of cannabis legalization in Canada that is also collecting data in U.S. states for comparison.[45] The first wave of data collection took place in the fall of 2018 and is expected to continue annually for the foreseeable future. An estimate of illicit marijuana pricing in Washington is expected to be available from the ICPS in the next several months.

Potential limitations of the ICPS are sample size and the frequency of data collection. ICPS investigators are willing to expand individual state samples for a fee. However, ICPS data collection occurs annually, and more frequent measurement of illegal market pricing may be desirable for monitoring purposes. An original data collection effort would be needed to provide more frequent illegal market pricing in Washington.

Monitoring legal and illicit market pricing would provide useful information about the competitiveness of the legal market, but would offer only an indirect indication of effects on the illicit market. Legal pricing that is lower than illicit pricing would strongly suggest that the illicit market is shrinking. However, it is more likely that the

[45] Hammond D., Goodman S., Leos-Toro C., Wadsworthe E., Reid J.L., Hall, W., . . . Elliot, R. (2018). *International Cannabis Policy Study Methods*.

illicit market price will be lower than the legal market price, to compensate for the criminal risk of purchasing illicit cannabis. There are no available standards to gauge how much higher the legal market price can be while still being competitive.[46] Data on the size of the illicit market would offer a more direct approach to monitoring illicit market reductions.

Estimating the Size of the Illicit Cannabis Market

The best available estimates of the size of the illicit marijuana market calculate the total amount of cannabis consumed in a state and then deduct the amount of cannabis sold in the legal system, leaving a remainder (i.e., "residual") which is interpreted as deriving in large part from illicit sources. Total demand is calculated using population survey estimates of the number of marijuana users and the average number of days of use. These estimates are combined with estimates of the average amount of cannabis consumed per use occasion, for an estimate of the total amount of cannabis consumed. The amount of legal cannabis sold, as indicated by traceability system data, is then deducted from this total (Exhibit 5).

The Liquor and Cannabis Board contracted with a private research firm to produce a residual estimate for Washington this year. The study estimated a total of 250 metric tons (MT) of cannabis was consumed by Washington residents in 2017,[47] compared to 175MT in 2013—an earlier estimate by the same firm before legal retail sales began.[48] This represents an approximate 40% increase in total cannabis consumption. Using data from Washington's marijuana traceability system, the amount of legal cannabis sold was deducted from total cannabis consumed, leaving an estimated 47% residual (estimates ranged from 40%-60%). In other words, in Washington in 2017, approximately half of the total marijuana consumed was obtained from sources outside the licensed system.

It is important to recall that there are multiple sources of cannabis outside of the licensed retail system, and only some of them are illegal. The approximate 47% residual could also include legal home or cooperative cultivation by authorized medical cannabis users, as these are legal sources of cannabis that are excluded from the traceability data (only retail sales are included in the traceability data).[49]

[46] It should also be noted that price figures are dependent on the quantity purchased. Market price differences could reflect differences in unit pricing but they could also reflect differences in quantity of the typical purchase (Hammond et al., 2018).

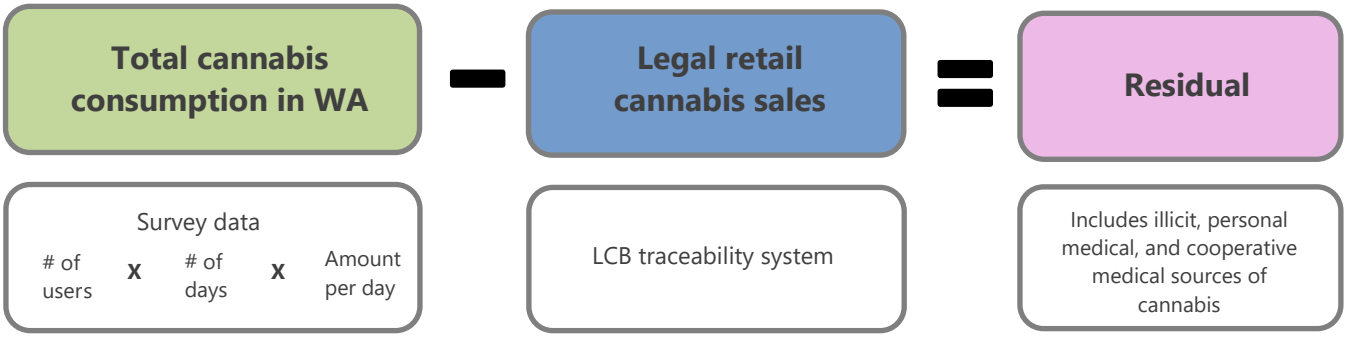
[47] Estimates ranged from 200-300MT; Kilmer, B., Davenport, S., Smart, R., Caulkins, J., & Midgette, G. (2019). *After the grand opening: Assessing cannabis supply and demand in Washington State*. Santa Monica: RAND.

[48] Estimates ranged from 135-225MT; Kilmer, B., Caulkins, J., Midgette, G., Dahlkemper, L., MacCoun, R., & Pacula, R. (2013). *Before the grand opening: Measuring Washington State's marijuana market in the last year before legalized commercial sales*. RAND Corporation.

[49] It should be noted that the more recent estimate uses legal sales data from fiscal year 2017, which is the first full year following the requirement that all medical dispensaries operating under the former quasi-legal medical system be incorporated into the licensed I-502 regulatory system. Therefore, the 2017 sales data include some portion of medical consumption of marijuana purchased through the licensed system.

Exhibit 5

Simplified Illustration of Residual Estimation of Illicit Cannabis Market Size



Another limitation of this estimate is that it does not account for certain types of illicit cannabis supply—cannabis that is illegally grown in Washington and smuggled out of the state, and cannabis that originated from the legal system and is smuggled out of state. Smuggling of cannabis purchased at licensed retail stores would inflate legal sales but would not be reflected in total consumption. Consequently, the residual would underestimate the size of the illicit market by the amount of legal sales that are smuggled out of state.[50]

In contrast to Washington, where legal sales account for only a portion of total consumption, a residual estimate from Colorado using a similar method indicates that legal sales *exceed* total consumption, suggesting that some legal sales are smuggled for consumption out of state.[51] This highlights a limitation of residual estimates—illicit supply can be indicated by both a positive residual (when legal sales are less than total consumption) and a negative residual (when legal sales are greater than total consumption).

With those limitations in mind, the 2013 and 2017 estimates for Washington State can be crudely compared for some insight into the extent that illicit supply has been reduced by legalization. None of the 175MT of cannabis consumed in 2013 was purchased from the licensed system (sales began in 2014), and the 53% share for the licensed system in 2017 amounts to more cannabis (130MT) than the increase in total consumption estimated between 2013 and 2017 (75MT). This implies, but does not prove, that the amount of illicit cannabis supply in Washington has declined as a result of growth in legal supply.

The more recent study also noted that the large growth of the legal system in 2017 may indicate supply shortages during the first two years of the legal system. This suggests that as the legal supply system continues to develop it will claim a larger share of demand. Due to the unavailability of legal sales data from the traceability system beyond 2017, a more current residual estimate could not be produced.

[50] The estimate does account for uncertainty in the amount of legal sales that may be illegally consumed by youth, and it accounts for legal sales to out-of-state visitors for personal consumption; it also acknowledges considerable uncertainty of the estimate of the size of the illicit market.

[51] Orens, A., Light, M., Lewandowski, B., Rowberry, J., & Saloga, C. (2018). *Market size and demand for marijuana in Colorado 2017 market update.*

Survey Estimates

A simpler approach for measuring the size of the illicit market is to ask cannabis users where they obtain their cannabis. Survey data from the Canadian study of legalization (ICPS) cited previously, include items addressing whether respondents obtain marijuana from illicit suppliers.[52] By focusing on adult cannabis consumers in the ICPS sample, these data could provide a basic indicator to monitor competition between legal and illicit suppliers. This method would not provide a more accurate estimate of the total size of the illicit market than the residual method, but survey data collected consistently over time would provide a practical indicator for the purpose of monitoring illicit market reductions. As we noted before, potential limitations include the sample size for Washington (which can be augmented for a fee) and annual frequency of measurement (which can only be improved by a wholly new data collection effort).

Other Data Sources on Illicit Market Size

There are a number of other data sources that provide a partial reflection of the size of the illicit marijuana market in Washington, but as a group, they provide more limited information than the previous sources. In Appendix II we include information from all of these other data sources, which include:

- Nationwide law enforcement seizures of marijuana originating from Washington, and postal seizures in Washington, both of which reflect out-of-state smuggling of Washington marijuana;
- Data from the LCB on results of underage compliance checks among licensed retailers, and license cancellations among licensed cannabis businesses;
- Law enforcement seizures of illegally cultivated marijuana in Washington State, which provide some information on traditional illicit supply; and
- Criminal incidents in Washington involving illicit marijuana supply, including cultivation and distribution violations.

Overall, these data sources suggest that the level of illicit cannabis supply activity has been stable following expected declines around the time of legalization in 2012. One exception was postal seizures, which increased between 2014 (the year legal cannabis sales were initiated) and 2016.

[52] Hammond et al. (2018).

All of these data sources are based on records of enforcement agencies, and they only reflect illicit supply that comes to the attention of law enforcement. It is possible that changes in these indicators are influenced by the level of enforcement activity directed towards illicit supply, which is a fundamental limitation of these data sources as an indicator of illicit market size. For most of these data sources we were not able to obtain data reflecting the level of enforcement activity, so we were not able to account for this limitation.[53]

In contrast, our preferred estimate of the size of the illicit market, the "residual" method, is not dependent on the level of enforcement activity. Neither is the method of survey measurement of the number of adult cannabis users who obtain their cannabis from illicit suppliers. Although the residual method can be expected to produce more accurate estimates of the overall size of the illicit market, it is more complicated to produce. A survey measure of adult participation in the illicit market would be a relatively simple alternative, which we find to be more feasible for monitoring purposes, along with legal and illicit market pricing.

[53] There is one other method to include, from a study published just prior to this report. The study analyzed the amount of marijuana metabolites in Washington wastewater to estimate change in marijuana consumption since legalization. An approximate doubling in the amount of THC consumed in Washington between 2014 and 2016 was compared to much larger growth in the amount of THC sold in the legal system, suggesting that many users have converted from illicit to legal supply. However the study did not provide a more precise indication of the impact of legalization on the size of the illicit market. Burgard, D.A., Williams, J., Westerman, D., Rushing, R., Carpenter, R., LaRock, A. . . . & Banta-Green, C.J. (2019). Using wastewater-based analysis to monitor the effects of legalized retail sales on cannabis consumption in Washington State, USA. *Addiction*.

VI. Summary

WSIPP was assigned to examine effective methods for reducing or eliminating illicit marijuana supply in jurisdictions with legal markets. We found very little evidence to inform that question. In lieu of such evidence, we explored how illicit markets may be changed by the introduction of a legal cannabis supply system.

It is commonly assumed that illicit markets will naturally be reduced or eliminated by the sheer availability of a legal market. However, we found a number of factors that could potentially support the survival of illicit suppliers in the presence of legal markets.

The creation of a legal supply system in combination with continuing prohibitions in other states creates an opportunity to smuggle legally produced cannabis out of the state, a type of illicit supply that did not exist prior to legalization. Continuing prohibitions for youth cannabis use also present an opportunity for illicit cannabis supply.

In addition, traditional forms of illicit cultivation and distribution outside of the legal system may continue, despite the availability of a legal supply system. Illicit suppliers may have an easier time evading detection in the context of legalization because differentiating illicit from legal supply operations could be more difficult. Demand may also increase following legalization, due to reduced criminal risk or greater social acceptance, which can create an opportunity for illicit suppliers if demand is not met by legal supply.

Regulations are typically imposed on legal suppliers with the aim of preventing criminal activity in the licensed system and preventing over-consumption to protect public health. Such regulations —including excise taxes, limits on cultivation capacity, and traceability monitoring of legal production—may reduce the competitive advantage of legal suppliers, thereby providing support to the illicit market. Conversely, illicit market reductions obtained by reduced restriction of the legal market may come at the expense of public health and criminal activity within the licensed system. Efforts to reduce illicit cannabis supply must account for these competing aims as well.

We then compared the nine legal states with legal non-medical cannabis supply systems in terms of regulatory features that might be expected to influence the illicit market. This comparison indicated wide variability in the level of restriction of state regulation of commercial cannabis supply systems.

Washington appears to have one of the most restrictive legal supply systems—it has the highest excise tax rate, is the only state to prohibit vertical integration and home cultivation for non-medical use, and has placed limits on cultivation capacity and the number of retail outlets. This would suggest that Washington's legal supply system may be less able to eliminate the illicit market through competition. For example, high excise tax rates can be expected to reduce the competitive advantage of legal suppliers. However, other factors, such as competition and supply, may lower the pre-tax price of legal cannabis. The implications of regulatory restriction on the size of the illicit market in any given state likely depend on many other features of the legal system in that state.

Other examples of this interdependency include the possibility that law enforcement may more effectively deter demand for illicit cannabis when legal cannabis is available at a competitive price. Similarly, the legal market price that will successfully compete with illicit supply can be higher, with less risk to public health, when law enforcement provides pressure on illicit suppliers, raising their cost of production. The effects of any one component of a state's overall approach to legalization are difficult to predict because of the multiplicity of factors that determine the survival of the illicit market.

Due to this complexity, a practical strategy for considering effectiveness in reducing the illicit market in Washington could be to monitor basic indicators on the illicit market as the state's approach to legalization continues to develop. These indicators would include the difference between the legal and illicit market prices, and the size of the illicit market.

We identified the lack of current legal market pricing data due to administrative issues with Washington's traceability system. Illicit market pricing could be obtained from survey data collection. We identified an existing survey that could provide this information on an annual basis. More frequent indication of illicit market pricing would require a new data collection effort.

We also considered all available data sources on the size of the illicit cannabis market in Washington, preferring a recent "residual" estimate that deducts the amount of legal marijuana sales from an estimate of total consumption, leaving a remainder or residual of marijuana consumed in the state that is not supplied by the legal system. The residual market was estimated to supply 47% of total cannabis consumed in Washington in 2017. The residual could include marijuana legally grown by medical users, among other limitations of the method, so the exact portion of the residual that is illicit is unknown. That being said, it is safe to say that a substantial amount of illicit cultivation and distribution of cannabis still exists in Washington.

Moving forward, monitoring current data on legal and illicit market pricing and illicit market size would provide useful information for the ongoing consideration of adjustments to the regulatory and enforcement features of the state's overall approach to legalization.

Acknowledgments

The authors would like to thank representatives of the Northwest High Intensity Drug Trafficking Area (NWHIDTA), Washington Association of Sheriffs and Police Chiefs (WASPC), the Washington Liquor and Cannabis Board (LCB), and the Washington State Patrol (WSP) for providing information included in this report.

Appendices

Suppressing Illicit Cannabis Markets in the Context of Legalization

Appendices

I. Additional Detail on Coding of Regulatory Features

Column	Additional Detail on Coding
Status of legalization	"Enacted" refers to the year of passage of non-medical cannabis legalization. "Sales initiated" refers to the beginning of licensed retail cannabis sales for general adult use.
Excise and sales tax	Excise taxes are defined as taxes specific to marijuana, and sales taxes are taxes applied to all goods. Some states refer to taxes applied solely to cannabis as marijuana-specific "sales" taxes, but in our framework, these are considered excise taxes.
Price control	Some states prohibit advertising or promotion of free marijuana without explicitly prohibiting free exchange of marijuana (e.g., MA, NV); this did not constitute price control in our coding.
Cultivation limits	Cultivation limits were defined as a limit on the total cultivation capacity of the licensed system. This is accomplished in some states by limiting the number of cultivation licenses. Limits on the size of individual cultivators without a limit on the overall number of licenses or the overall capacity of the system were not considered cultivation limits.
Retail license caps	Retail license caps were defined as a limit on the number of retailers in the state or areas of the state. Limits on the number of licenses an individual entity can hold were not counted as retail license caps in this study.
Vertical integration	We focused on prohibition of combined ownership of retail licenses with licenses for production or distribution.
Home cultivation	We focused on policies regarding home cultivation for non-medical use specifically. Some states specify limits for both individuals and residences; we focused on limits per person.
Criminal history disqualification for licensure	Criminal history was defined as prior to licensure. Disqualifications were often specified in terms of the recency of criminal history (e.g., crimes within past 5 or 10 years), but we did not include that information in our coding. We identified conditions that would require disqualification, as opposed to violations that could be considered but that would not necessarily result in disqualification.

II. Additional Data Sources on Illicit Marijuana Supply in Washington

Cannabis Smuggling

Several available data sources provide partial information on cannabis smuggling out of Washington. In general all of these data sources, because they are records of enforcement actions, may reflect change in the amount of prohibited activity or change in enforcement intensity. This is the primary limitation of these data sources.

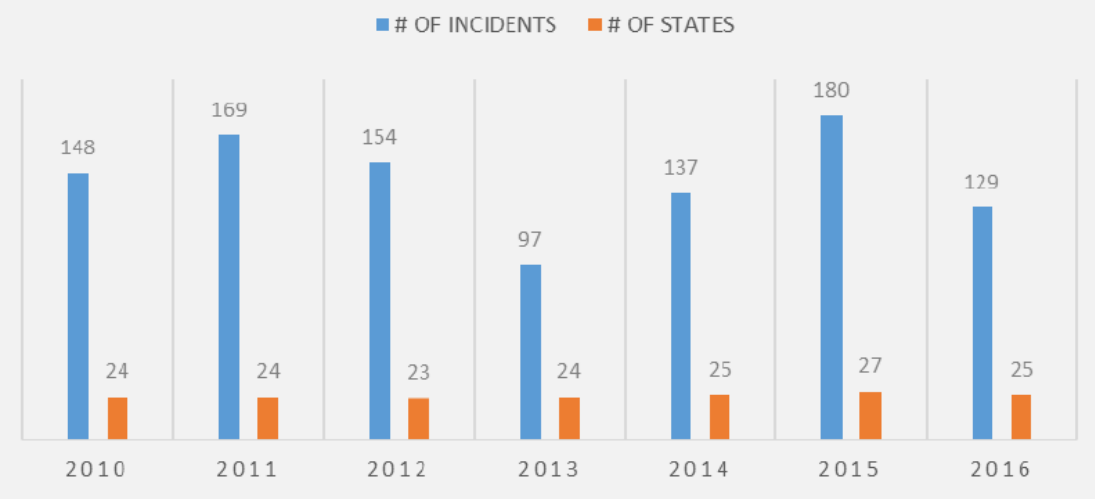
The National Seizure System (NSS) is a federal database that records marijuana seizures by local, state, and federal law enforcement agencies. Reporting is voluntary in general, but some agencies are required to report in association with funding. Despite that limitation, these data are among the few that directly address export of marijuana from Washington. We were not able to gain access to these data, so we reproduce NSS data reported by the Northwest High Intensity Drug Trafficking Area (NWHIDTA).[54] As shown in Exhibit A1, NSS data through 2016 indicate a dip in 2013 in the number of seizures of Washington marijuana in other states but no clear trend over time.

The United States Postal Inspection Service (USPIS) tracks data on the number of seized parcels containing marijuana shipped by the United States Postal Service (USPS). Similar to the NSS data, postal seizures offer some perspective on illegal export of marijuana from Washington. The data include parcels seized in USPS facilities in Washington State. The data do not indicate the origin or destination of parcels, but importing marijuana after legalization seems much less likely than exporting. Data available from 2014 through 2016 indicate an increase in seized marijuana parcels (Exhibit A2).

[54] Northwest High Intensity Drug Trafficking Area (2017). *Marijuana Impact Report, Volume 2.*

Exhibit A1

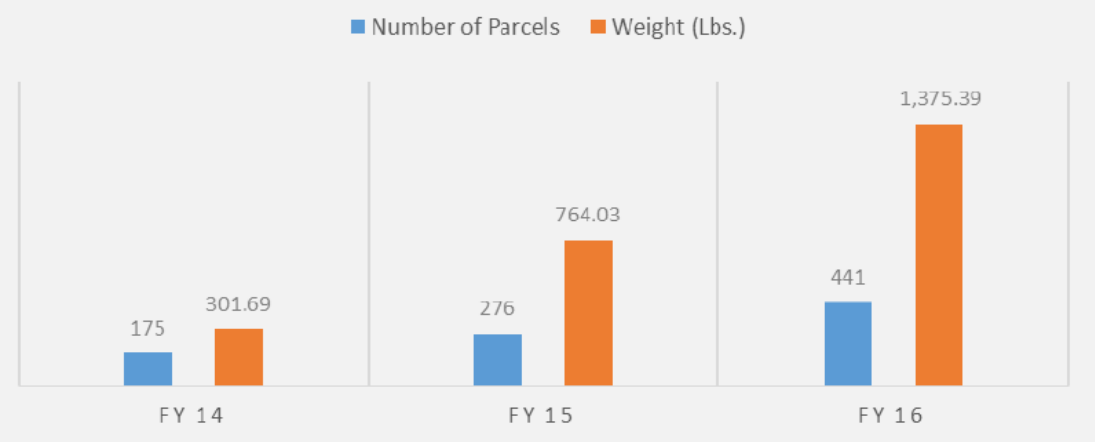
Seizures in other States of Marijuana Originating from Washington



Notes:
Reproduced with permission from NWHIDTA.
Source: Data from the National Seizure System as reported in NWHIDTA Marijuana Impact Report Volume 2.

Exhibit A2

USPIS Marijuana Seized in Washington



Notes:
Reproduced with permission from NWHIDTA.
Source: Data from the United States Postal Inspection Service as reported in NWHIDTA Marijuana Impact Report Volume 2

Illicit Activity within the Licensed Cannabis Supply System

Neither of the above data sources differentiates marijuana produced in the licensed system from illicitly produced marijuana. Illicit supply activities among licensees include diversion of marijuana from the legal system for illegal sale in Washington or elsewhere, purchasing illicitly cultivated marijuana into the legal system (i.e., "inversion"), and underage retail sales.[55] Enforcement of these activities falls under the jurisdiction of the LCB.

We obtained LCB enforcement data on license cancellations. These data do not specifically indicate diversion, but license cancellation is the most extreme enforcement response of the LCB and tends to be reserved for cases involving suspected diversion. From market inception in July 2014 through February of 2018, there have been 34 cancellations. There are another 33 suspended licenses currently pending appeal in the administrative hearing process.[56] These cancellations have resulted from a variety of noncompliant activities, including actual diversion of cannabis, large amounts of cannabis that is unrecorded in traceability data, failure to declare large investments in the licensed business, and fraudulent documentation.

The LCB also conducts random undercover checks for underage sales at cannabis retailers. Annual compliance rates were 88%, 92%, 94%, 96%, and 96%, from 2015 through 2019. There have been three license suspensions for repeated underage sales.

Illicit Cultivation Outside the Licensed System

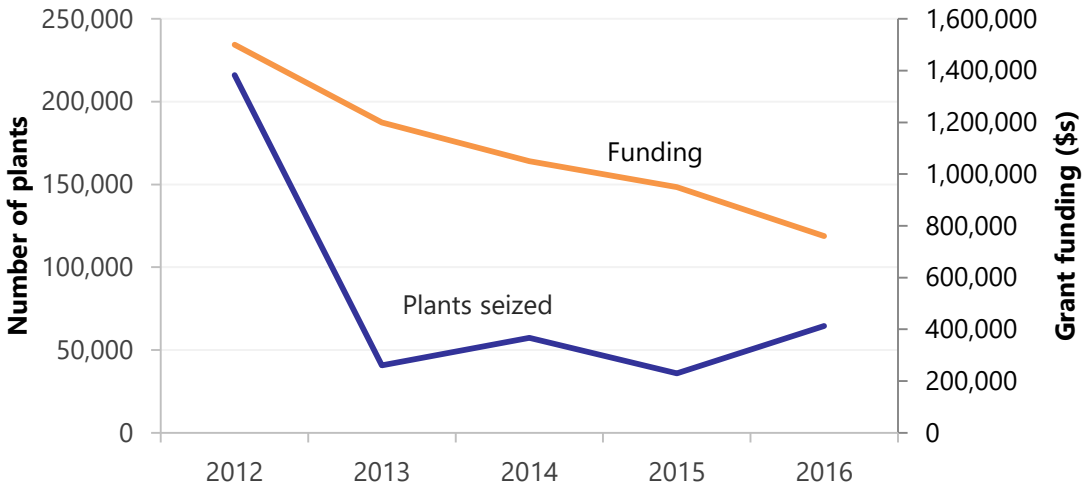
The Drug Enforcement Agency (DEA) supports local, state, and federal law enforcement with grants through the Domestic Cannabis Eradication/Suppression Program (DCESP). DCESP reports the number of plants eradicated at indoor and outdoor grow operations, including operations on federal lands. The numbers reported under this program likely represent the majority of all marijuana plant eradication, but enforcement efforts unsupported by DCESP funding may not report information to the DEA.[57] DCESP funding has fallen in recent years, which we include along with the number of plants seized in Washington by the DCESP program, in Exhibit A3.

DCESP data reflect a decline in the number of plants seized. This may reflect reduced illicit cultivation, but it could also be explained by reduced law enforcement activity or greater difficulty in detecting illicit cultivation in the context of legalization.

[55] LCB views inversion as unlikely because illicitly cultivated cannabis can be sold more profitably out of state.
[56] Source: Washington Liquor and Cannabis Board.
[57] Government Accountability Office. (2019). Illegal Marijuana: Opportunities Exist to Improve Oversight of State and Local Eradication Efforts. GAO-19-9.

Exhibit A3

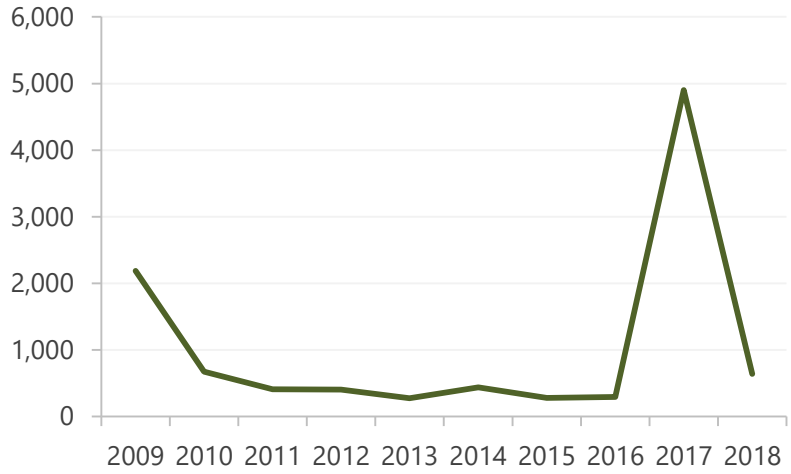
Federal Domestic Cannabis Eradication/Suppression Program Seizures in Washington State



Note:
Source: Plant seizures from the U.S. DEA's DCESP program website; funding amounts from website.

Exhibit A4

Pounds of Marijuana Seized by Washington State Patrol



Notes:
These numbers do not include efforts by the WSP marijuana task forces.
The spike in 2017 was due to a single incident involving a large amount of marijuana.
Source: Email from Washington State Patrol 5/3/2019.

We also obtained marijuana seizure data from the Washington State Patrol (WSP). The WSP data include marijuana seizures in criminal incidents in which WSP was involved. WSP marijuana seizures are shown in Exhibit A4. The 2017 spike was the result of a seizure from a single truck.[58]

Illicit Cannabis Supply Criminal Incidents

We also obtained data on criminal incidents involving marijuana from the Washington Association of Sheriffs and Police Chiefs (WASPC). These data provide a more general view of illicit marijuana supply activity, potentially including traditional illicit supply activities and illegal supply activities within the legal supply system.

In the WASPC reporting system, an "incident" consists of one or more offenses committed by one or more individuals at the same time and place.[59] In this report, we focused on incidents in which marijuana was seized (i.e., "marijuana-related").[60] This set of incidents can include many different types of violations. We focused on incidents involving drug violations related to illicit supply of marijuana: cultivating, transporting, selling, and purchasing. If an incident involved more than one of the violations of interest, it was counted for each violation. It is also important to note that the violation of record is not necessarily marijuana-related—strictly speaking, marijuana was seized in the incident, but the violation could have been for a different drug. Last, because we focused on incidents, the data reported here do not accurately reflect the number of individuals involved in these incidents.

Data are submitted by law enforcement agencies to WASPC, and the number of law enforcement agencies submitting data varies from year to year. Annual incidents involving marijuana were obtained from 2010 through 2017. To account for variation in agencies reporting, we limited the data to agencies reporting in all years from 2012 to 2017.[61] This subset of the data comprised agencies serving between 60% and 71% of the state population across years.[62] We report population-adjusted rates to account for changes in the size of populations served by agencies reporting consistently over this time period.

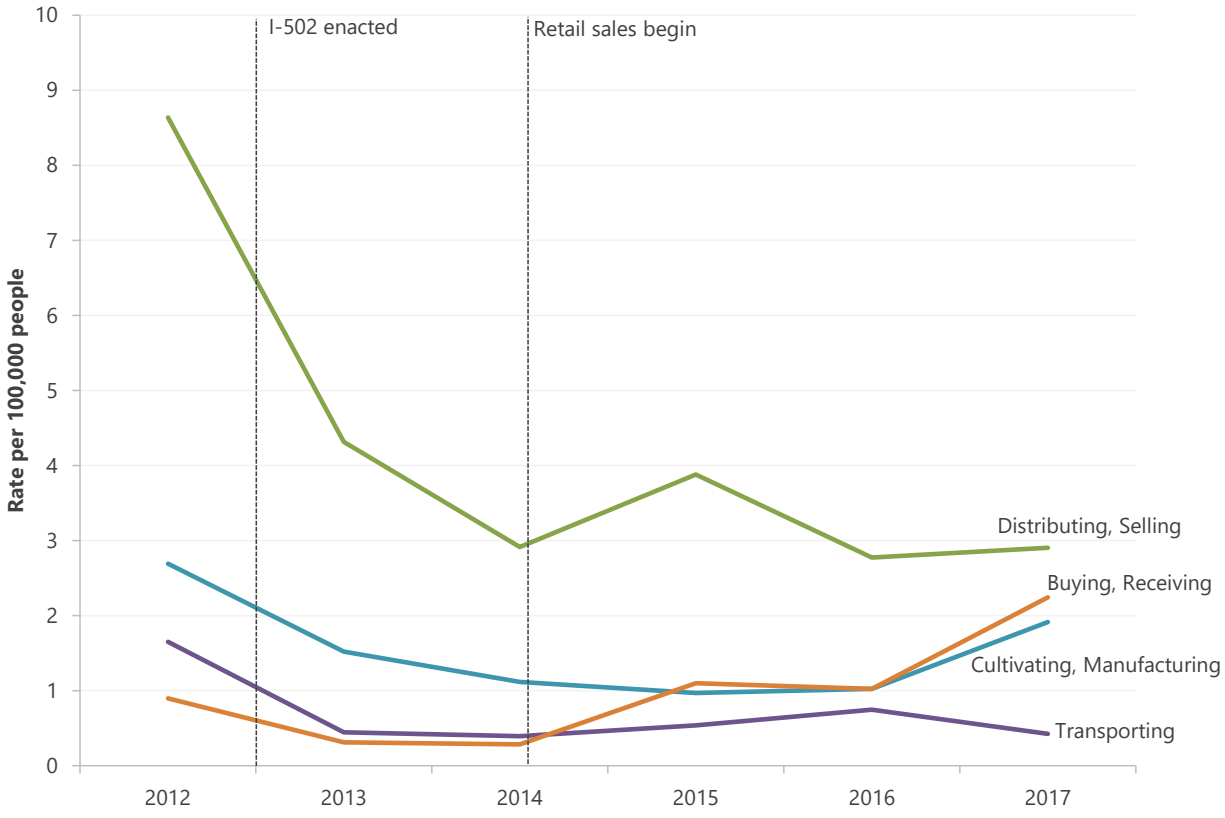
In Exhibit A5, we illustrate marijuana-related incidents by violation type. The exhibit reflects declines following legalization in 2012 for all four illicit supply violations, which remained low in subsequent years for the most part. Incidents involving illegally cultivating cannabis and purchasing cannabis reflected a slight increase in 2017.

These trends could reflect a reduction in illicit marijuana supply activity, but they could also be caused by reduced enforcement of marijuana crimes or reduced ability to detect illicit marijuana activity in the context of legalization.

[58] Per email with Lt. Prouty, Washington State Patrol 5/3/2019.
[59] WASPC uses the data reporting conventions of the National Incident-Based Reporting System (NIBRS); the definition of a criminal incident can be found in the NIBRS Resource Guide. The NIBRS system is being rolled out in Washington with 98 agencies reporting in 2010 and 255 reporting in 2018.
[60] This is a necessary practical strategy because very few criminal offenses are specific to marijuana.
[61] Limiting to agencies reporting from 2010 to 2017 would have produced a much smaller subset of the data.
[62] To calculate population coverage of reporting agencies we used annual agency population estimates from national NIBRS tables and total state population estimates from the Washington Office of Financial Management.

Exhibit A5

Marijuana-Related Criminal Incident Rates by Violation Type



Notes:
Data were limited to law enforcement agencies reporting data in all years. The rate per 100,000 people was calculated using the annual population served by reporting agencies.
Source: Washington Association of Sheriffs and Police Chiefs (WASPC).

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