

Deal or No Deal: The Effect of Legalizing Recreational Marijuana on the Illegal Market*

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Abstract:

Recreational marijuana legalization has been a major policy shift in the United States over the last 10 years, with more than 21 states (and Washington D.C.) having codified legalization either through ballot measure or legislation as of 2022. As true whenever a consumer good changes from illegal to legal, this has had major ramifications for the criminal justice system, consumer culture, and markets. In this paper, I examine the effect that recreational legalization has had on the illegal market for marijuana in the Pacific Northwest. My first analysis involves how markets change within states that legalize. I develop a municipality-level measure on whether illegal drug markets were larger (per capita) than the median market and use that in a difference-in-difference analysis, pre- and post-legalization. I find that, post-legalization, municipalities where the illegal drug market was more rampant pre-legalization had less illegal marijuana activity post-legalization, controlling for municipality and year fixed effects. In my second analysis, I examine how markets changed across state borders in heretofore illegal marijuana states relative to their neighbors where marijuana was legalized. I find that municipalities closer to legal dispensaries across the Idaho border had higher arrest rates post-legalization than those that were farther away, while those municipalities in Oregon pre-legalization but post-Washington legalization close to Washington dispensaries were unaffected by Washington legalization.

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1 Introduction

Illegal market activity has been a focus of policymakers and governments for as long as individual goods have been made illegal. From the Prohibition in United States in the early 1900's, to an increased crackdown on illegal border crossings in many countries, to illegal weapons trade, illegal markets are a major issue for the public and for policymakers. Illegal transactions are extremely difficult to fully prevent for policymakers (Cook et al. 2007), and often lead to severely negative externalities, including violence. Therefore, there has been a large debate over legalizing many previously illegal activities in order to better monitor the market and remove many of these negative externalities. Many illegal markets have been debated like this, including: sex work, gun markets, and drug markets. Of particular note over the past 10 years has been the debate over the legalization of marijuana.

Marijuana is a psychoactive drug derived from the dried form of the plant Cannabis sativa or Cannabis indica (NIDA, 2019). It is widely used among the population of the United States, with about 18% of Americans using it at least once in 2019. (CDC, 2021). It is illegal federally, and has been classified as a Schedule I drug since the inception of such classifications in 1970. Despite being declared illegal across the United States in the 1930s, marijuana has had a remarkable staying power in both usage and the culture of the country. For the past 50 years, legalization of marijuana for recreational use has been under fierce debate, with those opposing it linking marijuana usage to harder drug (e.g., marijuana as a "gateway" drug) and those in favor pointing to the outsize impact marijuana arrests have had on marginalized communities. Additionally, many individuals use marijuana to combat chronic and/or severe pain, and over this same time period, many have advocated for marijuana to be at least legal for medical use. This has been a successful policy push in many states as marijuana has been legal for medical use (with a license) in many different states since California first legalized it in 1998. Legalizing recreational use of marijuana, however, has been a much slower process. By 2011, there was no area of the country where it was possible to recreationally use marijuana legally.

Since then, over the past twelve years, there has been a remarkable change in marijuana regulations. In 2012, Washington and Colorado legalized recreational marijuana (with 15 states having otherwise legalized medical marijuana). In 2022, however, 21 states had by now legalized recreational marijuana (with a further 15 having legalized only medical marijuana). This sharp shift has been at least somewhat driven by a revolution in the public opinion of marijuana, with 91% of Americans now supporting marijuana legalization in some form (up from 73% in 2010); and 60% supporting recreational use (up from 41% in 2010) (Schaeffer (2021) and Kohut et al. (2010)). This legal shift has occurred in not only liberal states (California, Colorado, Oregon), but also conservative ones (Missouri and Montana).

Recreational legalization is fundamentally different from previous rounds of loosening marijuana regulations because of its twin effects on public perception and law enforcement. For the public, recreational legalization makes marijuana relatively easy to purchase and use on a regular basis. Under medical marijuana legislation, individuals had to apply for a medical marijuana license in order to use marijuana. This process differed across states and also depended on the type of medical care you were receiving, if any. Some may have experienced medical marijuana laws as akin to recreational legalization, but to the vast majority of the public there was still a large barrier surrounding marijuana use. Recreational legalization then transforms marijuana into something similar to other sin goods such as cigarettes or alcohol. Anyone above the age limit is able to purchase the drug legally and simply. For the police, although some arrests still occur after the recreational legalization of marijuana as both possession and sale remain illegal in certain contexts (i.e., if one has a large amount on the street or if one is selling without a license), it becomes a much lower priority in terms of enforcement for both sales and possession offenses. This is true even when switching from a medical marijuana environment, as in a medical marijuana environment in order to consume recreationally, absent a medical license, users need to patronize illegal dealers. This is not true with the advent of legal dispensaries, and this is why recreational legalization had to alter how police approached marijuana.

This shift in public views and technical police priorities does not mean that marijuana enforcement is a decreasing concern in the United States. Figure 1 clearly demonstrates that cannabis arrests make up at least a plurality of overall arrests across the country throughout the past twenty years, and that they have not meaningfully decreased over that time period. This could potentially be because there still are a number of states where marijuana is illegal and could connect to the idea that legalizing marijuana just pushes the illegal market to other states that border legal marijuana states. It could also be that enforcement does not fall much in legal marijuana states, either due to the continued presence of illegal dealers or the increase in individuals holding more than legal amount of marijuana. Regardless, while regulations and opinions have changed across the country, marijuana is still something to be fully reckoned with for the criminal justice system.

In this paper I examine the effect that legalization has on illegal markets in two ways. First, I investigate how the illegal market changed within states that legalize. Second, I analyze how the illegal market changed in states that border those that have legalized, but have not made recreational marijuana legal themselves. For the first, I create a “major” market indicator for municipalities in both Washington and Oregon and use a difference-in-difference design to understand how legalization affected these major market municipalities differently than the minor markets. For the second, I use dispensary location data in Washington, Oregon, and Nevada to categorize each municipality in a marijuana illegal state (in this case

Idaho and Oregon before it's own legalization) as either close or far from a dispensary. For locations near the Oregon border, I examine how municipalities being closer to Washington dispensaries pre-Oregon legalization but post-Washington legalization affects possession and sales arrests, while for the Idaho border I use the location of dispensaries in Washington, Oregon and Nevada, post-legalization in each of those states to examine the same question. I then use a difference-in-difference framework to understand how close municipalities in still illegal states are differentially affected by legalization than far municipalities.

I find that within a state that legalizes, major markets pre-legalization have both fewer cannabis possession arrests and cannabis sales arrests. These arrests are a proxy for the illegal market for marijuana. While this could mean that major market enforcement is shifting differentially, absent a compelling reason to believe so, it is more likely that this means that the illegal marijuana market shifts away from the major marketplaces post-recreational legalization. In the border state models, I find slightly opposing results. In Idaho, I find that being closer to a legal dispensary across the border leads to more possession arrests and more sales arrests. In Oregon I find no changes in either sales or possession arrests. These effects could potentially be explained by the fact that Oregon had legalized medical marijuana at the time of examination while Idaho did not.

Marijuana and its effect on crime is a fertile area of research, and one that has been closely studied in Adda et al. (2014), Anderson et al. (2013), Anderson et al. (2014), Green et al. (2010), Hansen et al. (2020), Hoaken and Stewart (2003), Miron (1999), Morris et al. (2014), Pacula and Kilmer (2003), Pedersen and Skardhamar (2010), and Resignato (2000). There is not, however, a robust body of literature examining the effect of loosening marijuana regulations on the illegal market for marijuana itself. The closest are the following papers. Firstly, Becker et al. (2006) is an oft-cited model of how illegal drug markets work, and is the basis for a lot of my thinking on this subject and in this paper. Additionally, Saffer and Chaloupka (1995) also developed a model of the illegal market for drugs, but geared more towards the specific qualities of drugs and how the decriminalization of a drug would affect prices. There has been some research on how loosening marijuana regulations has affected hospital visits for other drugs (Kelly and Rasul (2013)) and opioid deaths (Powell et al. (2018), Mathur and Ruhm (2023)), which can be seen as a measure of the illegal market, but the most relevant papers to this part of my analysis are Chu (2014) and Xiong (2019).

Xiong examines the labor market for illegal drug dealers, finding that post-recreational legalization released marijuana dealers “graduate” to selling harder drugs like heroin or cocaine. My analysis is more on the demand side (as I concentrate on how much consumers are valuing the new legality of marijuana), but the paper is still useful context for this analysis due to the examination of recreational marijuana legalization rather than medical marijuana legalization. It also provides important context for my results, where the decrease

in the illegal marijuana market that I see might be sellers moving to other markets that are now more lucrative. Chu's work is closer to my paper, as it also uses Uniform Crime Report data, and a difference-in-difference. Chu compares towns in medical marijuana states versus towns in non-medical marijuana states to estimate the effect of medical marijuana laws on marijuana use. Chu also uses marijuana possession arrests to proxy for illegal marijuana use/the illegal market as I do. However, the difference-in-difference design here is limited by its simplicity, as it only compares non-medical states to medical ones. The mechanical change in how possession arrests are enforced in medical states comes a lot more into play with a design like this. I improve upon this in my design by adding marijuana sales arrests, which don't have the same mechanical problem and by also comparing within a state that legalizes, seeing how marijuana markets change in major vs. minor drug markets.

For an analysis on the effect of the location of dispensaries (i.e., the second half of this paper), Brinkman and Mok-Lamme (2019), Carrieri et al. (2019), Chang and Jacobson (2017), and Hao and Cowen (2017) are particularly relevant examples. Carrieri et al. use the short-lived legality of cannabis in Italy, and the location of grow shops to execute a difference-in-difference framework of the effect of marijuana legalization on crime. They find that illegal marijuana seizures decreased significantly post-legalization when near a grow shop, similar to my results. Chang and Jacobson leverage medical marijuana dispensary closures in Los Angeles to find a negative effect on other crimes from a dispensary being active in the area. Brinkman and Mok-Lamme use an IV design to estimate the effect of recreational dispensary location in Denver on crime in their neighborhood, where they estimate dispensary location based on the neighborhood's proximity to highway or major throughways. They find a negative effect on a multitude of crimes from having a recreational dispensary. These all relate strongly to the dispensary location section of this paper, where I add to this research by looking at not only where a dispensary is located but how the border between a legal and illegal state factors into the spillover from a dispensary. Finally, Hao and Cowen in particular have a similar design to my border methodology, finding that marijuana possession arrests increase sharply in bordering counties to a state that legalizes. However, they use county-level UCR data which has major flaws in how it is aggregated (I will be using agency-level data to account for this), and do not include the dispensary location data that I have. Others have done research on marijuana legalization and borders (Gavrilova et al. (2019) and Hansen et al. 2017), but my paper is one of the first to account for actual dispensary location with regards to a border and marijuana legalization.

In the end, this paper contributes to these literatures in several ways. There is substantive policy variation in the Pacific Northwest, which allows me to fully examine the spillovers on illegal markets in states that have legalized, states that will legalize, and states that have never legalized recreational marijuana. The data in this paper on the legal markets in these

states is relatively novel, with dispensary location and history that is rare in other papers. Finally, the states in the Pacific Northwest are relatively isolated compared to other parts of the country, and near an international border which limits spillovers. These are large states that do not allow quick and easy travel to other states in the same way that East Coast states do, being smaller and more concentrated.

This paper proceeds as follows: in section 2, I examine the context in which this paper exists - the Pacific Northwest of the United States; in section 3, I explain the data that I am using for this paper; in section 4, I examine the within-state methods and results; in section 5, I look at the border methods and results; in section 6, there is a discussion of these results and how we can explain them; and in section 7 I conclude.

2 Context: Marijuana in the Pacific Northwest

Marijuana regulation has had a complicated history in the Pacific Northwest and the United States at large. With a wave of regulations in the 1930's, marijuana became virtually outlawed in every part of the country. Despite this, marijuana maintained a large user base (for an illegal drug) and a prominent place in culture. In the 1990's, however, regulation began to change, with California being the first state to legalize marijuana for medicinal purposes in 1996. Medical legalization allows individuals who receive a prescription for marijuana from a doctor for a specific condition to obtain a license to grow and/or buy marijuana. Since then, many states have legalized medical marijuana in a similar way, and many have even gone further in the past 12 years, legalizing recreational marijuana. Recreational legalization allows individuals above a certain age (universally 21) to purchase and use marijuana. Amid this change, other states, however, have continued to fully criminalize marijuana. In the Pacific Northwest in particular, we can see this contrast with Oregon and Washington being early proponents of both medical and recreational legalization of marijuana, Nevada having legalized both later on, and Idaho which has never legalized either medical or recreational marijuana. This is a remarkably diverse region in terms of marijuana regulation, and thus is a fertile environment to study the illegal market for marijuana.

Oregon and Washington have always been two of the most liberal states in the US when it comes to marijuana. Washington was the second state (along with Oregon) to legalize medical marijuana in 1998, and the first state (along with Colorado) to legalize recreational marijuana in 2012 with a ballot measure. Possession became legal on December 6th, 2012, but sale and cultivation were still not legal at that time. Dispensaries did not start opening until July 8th, 2014. For Oregon, marijuana was decriminalized in small amounts extremely early in 1973, was medically legalized in 1998 along with Washington, and was approved for recreational use in 2014 via referendum. Recreational marijuana was then officially legalized

for possession on July 1st, 2015. Like Washington, however, dispensaries did not open for sale until later on October 1st, 2016. In both states, I am treating the legalization shock as having occurred on the initial legalization of possession.

In Nevada, marijuana regulations have traditionally been relatively similar in liberalness as Oregon and Washington. The state legalized medical marijuana in 2001 after two separate state-wide referendums that were in favor of amending the constitution for medical marijuana. In the same legislative session, it also decriminalized marijuana in small amounts. This made it the eighth state to legalize medical marijuana (though medical dispensaries were not codified until 2013) and the third to pass some form of decriminalization legislation. In 2016, recreational marijuana was approved by 54% of Nevada voters in a ballot referendum. Dispensaries began opening to the public in July 2017.

Finally, Idaho is one of the most restrictive states in the US in terms of marijuana. Since 1927, no use of marijuana in any form is legal in the state. It is illegal to possess any amount of marijuana in Idaho, where possession of less than 3 ounces is a misdemeanor punishable by up to one year in jail, and possession of 3 ounces to less than one pound being considered a felony punishable by up to five years in jail. Sale, delivery, possession with intent to distribute, and cultivation are also illegal, and are all felonies. Idaho even punishes those with marijuana “paraphernalia” with up to a year in jail, and individuals in the presence of marijuana cultivation could face up to 90 days in jail on a misdemeanor charge. Idaho has not made medical marijuana legal for use in any type of condition either.

2.1 Mechanical Changes in Laws and Enforcement Due to Legalization

Post recreational legalization there are several mechanical changes in my variables that I have to take notice of. Because I use arrests as a proxy rather than any direct measure of the illegal market, it is important to understand changes that affect arrests and would not actually affect any part of the illegal market.

The first change is how the law now treats possession of marijuana post-legalization. Pre-legalization, states varied on how much marijuana was considered a civil versus a criminal offense, but regardless every state considered possession without a medical license to be some type of offense. Post-legalization this obviously changes. In each state possession of some amount of marijuana is now legal, but the threshold for public possession differs. In Oregon, any amount 8 ounces and below is legal for public possession, while any possession of marijuana above 8 ounces is still a criminal penalty. In Washington this threshold is much lower, where possession of 1 ounce and below is legal, but above 1 ounce is a criminal penalty. Finally, in Nevada the threshold is 2.5 ounces. The threshold for all states only

matters for individual possession arrests, sales arrests are dependent on licensure.

Sale arrests do not change as much mechanically. It is still illegal to sell marijuana on the street, except now it is due to a lack of license rather than selling marijuana itself being illegal. It is a subtle distinction: the activity is still illegal, but the reason why has changed. In terms of how police treat these illegal sellers however, there is only some anecdotal evidence (Goldstein and Sumner, 2023) that police are not treating illegal sellers as stringently as they are allowed to under the law. Therefore, while there is not a pure mechanical change in how selling marijuana on the street is treated, there could be some lack of enforcement effect that I am simply not able to observe in this paper.

2.2 Pricing and Demand in the Legal Market

Looking at both Washington and Oregon, we can see that the legal market for marijuana has taken similar trajectories since legalization. For Oregon, we can see from Figure 2b that sales for legal marijuana increased sharply post-legalization, increasing quickly to 50 million dollars worth of sales within 2 years of legalizing sales. This further increased to around 110 million dollars in 2021, and then leveled off in the past two years to around 85 million dollars of sales per month. This works out to around 21 dollars per person (Oregon's population is around 4 million people during this time period). In Washington, we only have yearly data of legal sales made. Taking the numbers from Figure 2a as a monthly rate, Washington sales increased from 0 to around 42 million dollars a month on average, then peaking 5 years later with 125 million dollars worth of sales per month on average in 2021. Per capita, this works out to around 17 dollars a person per month (Washington's population is around 7 million people during this time period).

For pricing of legal marijuana, we only have retail price data for Oregon. It is clear from Figure 2c that after a period of elevated prices for both extracts/concentrates and usable marijuana (the best-selling marijuana products), prices dropped rather dramatically and stabilized around 20 dollars per gram for extracts/concentrates, and 4 dollars per gram for usable marijuana. This mirrors the large increase in sales in Oregon.

2.3 Location of Dispensaries and Markets

In Washington, using my definition of major and minor marketplaces, we can see from Figure 3a and 3b that each type of municipality, both major and minor markets, are located across the state. There is no concentration of markets in any one area, and almost every municipality has one type or the other close by. In both figures this remains the case, which indicates my measures of a major marketplace are relatively similar in terms of geographic placement.

In Oregon, like in Washington, these two categories of marketplaces do not concentrate in any one area, as even in high population areas like Portland and Eugene, there are still minor markets along with major markets (Figure 2c and 2d). There is almost no area of the state (other than the southwest) that has a large majority of one type of municipality over the other. This is again true whether we look at this using a marijuana definition or heroin/cocaine definition.

Looking at Figure 4, marijuana dispensaries in Washington along the border with Idaho are relatively well-distributed in terms of geography. For Oregon dispensaries, they are very closely concentrated in Ontario, Oregon, a small city of 11,000 that is also the largest population center on the border with Idaho. Ontario is additionally located relatively near to Boise, Idaho which could also explain the large concentration of dispensaries. Marijuana dispensaries are very concentrated in terms of location in Nevada. Most are located in one of the major cities, whether that be Las Vegas, Reno, or Carson City. For this paper, we are mostly concerned with dispensaries that are located close to the Idaho border. There are very few of these. In Figure 4 we can see that there are only 5-10 dispensaries near to the Idaho border, which are the ones we are concerned with in this paper.

In Figure 5 we can see that dispensaries along the Washington border in Oregon are relatively well-distributed, though slightly more concentrated nearer to Portland.

3 Data

The largest problem when examining the illegal market for drugs is one of data. It is not possible (or extremely difficult) to get reliable data on the illegal drug market as there are no taxes paid, revenue recorded, or licensed businesses. Ideally, in order to see how a market changes, a researcher should have price, quantity, location of sale, and details about the seller, all of which, again, are (mostly) impossible to see for the illegal marijuana market. Therefore, in this paper, I use arrests for possession and sale of a particular drug as a proxy for how large an illegal market is in a particular municipality and how much the illegal market is affected in both legal and illegal states.

This presents several different problems, however. Firstly, not all criminal acts are seen by police and not all individuals are arrested for every crime they commit. This is a lesser issue too, for as long as crimes for which individuals are not arrested for do not vary across municipality (or at least do so randomly), than this proxy should still work fine. This is not a very large assumption and seems reasonable. A far larger issue is that possession of marijuana becomes legal for only certain amounts after recreational legalization. And now, arrests for possession could have potentially decreased for no other reason than that there simply less crimes to commit. Police could also be shifting priorities to other crimes

that are more important now that marijuana is socially and legally acceptable. There is a large decrease in arrests post-legalization that could reflect these factors. In Figure 6a, we can see that arrests for illegal marijuana sales declined precipitously in Washington after legalization and remained at consistently lower levels. The same is true for possession of marijuana arrests, which in Figure 6b also drop off after legalization. We can see the same pattern in Oregon in Figure 6c and Figure 6d. This is the primary reason why we need a difference-in-difference framework and why I use my “major” marketplace definitions in that model.

Arrest data comes from a public dataset collected by the FBI called the Uniform Crime Report (UCR). The data are available online from 1974 to 2019 and consists of monthly arrest reports from local and state police agencies in the United States. Participation in the UCR, however, is voluntary, though in general a large majority of agencies participate and every major city agency participates almost every month of every year. In this paper I only use data from 2000 to 2019. In the data there are counts by type of crime, race of offender, and gender of offender. The types of crime are varied and include possession and sale of different types of drugs (marijuana, heroin/cocaine, and synthetic narcotics), burglary, robbery, DUI, murder, rape, arson, aggravated and other assaults, and motor vehicle theft. It also includes various “quality of life” arrests, which are generally misdemeanors that are extremely low-level offenses that theoretically affect the quality of life in a neighborhood: vandalism, public drunkenness, and vagrancy. In this paper we only use the drug crime variables, some of the other crime variables as placebos, the population for whom each agency represents, and the year and month.

In the interest of being clear about the jurisdiction that each agency operates in, I have excluded several different types of agencies that almost certainly overlap with others. These include, but are not limited to, state agencies, federal agencies, tribal agencies, and university police departments. I have excluded them in order to be clearer about where these arrests are taking place.

Additionally, in general, not every agency reports every crime every single month. This could be due to overall non-reporting, or non-reporting for specific crimes. About 74% of agencies report in all twelve months in every year in all the data that I use in this paper (Idaho, Oregon, and Washington). When looking at a balanced panel version of the data versus the initial version of the data, there are significant differences in every mean of every variable, which shows that the balanced panel municipalities are quite different from the municipalities overall. This incentivizes using both the balanced and unbalanced panel estimates in both analyses. The summary tables for these statistics are in the appendix.

3.1 State Marijuana Data

The dispensary data for Nevada, Oregon, and Washington each come from their respective state governments. The Nevada Cannabis Compliance Board has the address and name of each licensed recreational cannabis dispensary in the state publicly available, though it does not have when each dispensary opened. The Oregon Liquor and Cannabis Commission does not have dispensary location data publicly available on its website, but emailing Commission representatives yielded a list of licensees that included both the address of each dispensary and the timing of when licenses were issued, expired, or renewed. Finally, the Washington State Liquor and Cannabis Board again has the address and name of each licensed recreational cannabis dispensary publicly available, but also includes closed dispensaries or licenses that are currently pending. I also get marijuana sales data from both the Oregon Commission and Washington Board, and pricing data from the Oregon Commission, all of which is publicly available online at each of the agency's websites.

4 Changes to Illegal Markets Within a State that Legalizes

When a government legalizes formerly illegal activities or products, one of the primary goals often stated by advocates is to shrink the illegal market and the power of illegal drug syndicates (McGinty et al., 2016). Illegal markets have many downsides in the view of any legalizing governmental body, including increased violent activity, increased gang activity, and the inability to collect tax revenue from any illegal transactions or income. Marijuana use is one activity that became widely prevalent despite its initial illegality and had developed a major illegal market. We are now experiencing a sea change in the legality of recreational marijuana, yet we know little about what happens to the illegal market for recreational marijuana when it does become legal. The illegal marijuana market additionally remains relatively robust and at a significantly lower price than the legal market (Goldstein et al. (2020) and Sambucci et al. (2019)). Therefore, it is important to understand to what extent the illegal market actually persists in the face of legalization, and, furthermore, why. In this section of the paper, I look at the changes to the illegal market for marijuana after recreational legalization in Oregon and Washington, two of the first states in the United States to legalize. Theoretically, if price and accessibility are equal, the availability of a legal option to buy marijuana should provide an incentive for consumers to switch from the illegal to legal market and also provide an incentive for new entrants to enter the market. This could create a crowd-out effect of the legal market on the illegal marijuana market, pushing dealers away from illegal marijuana and towards either legal jobs or towards other illegal jobs

such as dealing harder drugs like heroin or cocaine. If prices in the legal market far outstrip the illegal market, however, this incentive could be swamped by a large price differential. Legal dispensaries have to pay much more upfront costs than do illegal dealers (registration fees, rent or mortgage payments for a brick-and-mortar location, business loan payments, state and local taxes, etc.) and thus there could be a large price difference between the two markets. There may also be time and location costs for consumers to switch to the legal market in terms of cutting ties with illegal dealers that consumers know well. Either way, the net effect is unclear and warrants further study.

In this section, I aim to show that the legalization of recreational marijuana helped to shrink the illegal market in municipalities where, pre-legalization, there was a major illegal market. “Major” markets here are defined as municipalities that have total arrests that were greater than the median per capita number of arrests in a specific drug sale arrest category. These categories are: 1. sale of heroin or cocaine and 2. sale of marijuana before recreational legalization. I then estimate a classic difference-in-difference model, comparing the effect of legalization on arrests for possession and sale of marijuana for the major and minor illegal market municipalities.

I find that legalization decreased sales arrests for marijuana in major illegal market locations in Washington by 0.92 arrests per 100,000 (overall average 1.65) and by 0.99 arrests per 100,000 in Oregon (overall average 0.56). I find an insignificant negative effect on possession arrests in Washington and an insignificant positive effect on possession arrests in Oregon. I interpret this to mean that in municipalities with more substantial drug markets before legalization, legalization pushes many recreational consumers to the legal dispensaries, and that the price differential either does not exist or does not meaningfully diminish the effect of being able to buy legally and avoid the potential cost of enforcement. Another potential mechanism could also be from a corresponding decrease in enforcement in the major illegal market municipalities. This seems unlikely for the simple reason that there would have to be a concentrated effort among major market municipalities to reduce drug enforcement that did not occur in minor municipalities. It seems far more likely that both major and minor municipalities reallocated resources away from marijuana enforcement rather than just major municipalities. In this analysis, the liberal laws of these states may allow these results to be understood as a lower bound of the effect of legalization where the change is considerably less disruptive to the market and to norms.

4.1 Within-State Methods

For this analysis, I construct a simple measure of illegal market activity using arrests to proxy for the illegal market. The measure is if a municipality was above the median total

arrests in a particular drug arrest category, they are classified as having a “major” illegal drug market. These municipalities, having more illegal drug activity pre-legalization, are consequently more likely to have a differential response in post-legalization marijuana and possession arrests. I use sales arrests for this measure in order to better approximate the illegal market: sales arrests in any category are unlikely to be affected pre-legalization by impending marijuana legalization in a meaningful way and should better proxy for the illegal market regardless as they should be more reflective of the supply side of the market. This will allow me to separate out at least some of the effect of legalization from a potentially pure enforcement effect. The drug arrest categories that were chosen in order to define a major illegal market were: arrests for marijuana sale and arrests for heroin or cocaine sale. Arrests for marijuana possession, heroin or cocaine possession, and synthetic narcotic possession and sales were not chosen for several reasons. For marijuana possession and heroin or cocaine possession, there is a much stronger case for marijuana sales and heroin or cocaine sales to more properly reflect the illegal market as stated above. For synthetic narcotics, the large drop in arrests after legalization for possession in Figure 6 is very troubling, and possibly reflects some change in the nature of that particular market. This is an interesting area of research that I am hoping to explore at a later date. Regardless, the synthetic narcotics market is eliminated as an option. These measures are based on pre-legalization levels instead of overall levels in order for the variable of interest to not be correlated with legalization overall, and to further isolate the effect of being post-legalization. Additionally, a pre-legalization measure makes certain that legalization cannot possibly affect the measure - it is pre-determined before the legalization variable turns on.

The types of markets are very different in terms of observable statistics. For Washington, the “major” (by heroin market) municipalities are far more populous, have far more arrests, and far more police officers than the minor market municipalities. The same is true for the marijuana market definition. There are 116 of each type in both definitions. 85 municipalities are major markets in each definition, 62 are only a major market in one definition (31 in each definition), and 85 are only minor markets. In Oregon, the “major” municipalities are by far more populous and have far more police officers than the minor municipalities. There were 75 major heroin market municipalities, 94 minor heroin market municipalities, 84 major marijuana market municipalities, and 85 minor marijuana municipalities. There are 58 municipalities that qualify as major markets underneath both definitions, 43 that only qualify under one definition (26 under the cannabis definition and 17 under the heroin definition), and 68 that are always minor markets. The large difference between the major heroin and minor heroin market municipalities is due to the low median for heroin sales pre-legalization: 0. As expected, drug arrests per capita are far lower in the minor municipalities by a significant margin for both types of municipality in each state. Summary statistic tables

are located in the appendix.

The model that I will be using for the main analysis is:

$$Y_{mt} = \beta_0 + \beta_1 major_m + \beta_2 legal_t + \beta_3 major_m * legal_t + \eta_y + \alpha_m + \epsilon_{mt}$$

where Y_{mt} is the outcome variable (either arrests for possession or sales per 100,000 in population); $major_m$ is an indicator variable of whether or not a municipality m had higher than the median arrests for either sale of marijuana or sale of heroin or cocaine before legalization; $legal_t$ is an indicator variable of whether or not recreational marijuana was legal at time t ; η_y are year fixed effects; and α_m are municipality fixed effects. The outcome of interest here is β_3 which is the effect of being an above median illegal drug market post-legalization.

This is a difference-in-difference model, where we are comparing the difference before and after legalization in minor market municipalities versus the same difference in major market municipalities. The identifying assumption is that the arrests for possession of marijuana and arrests for sale of marijuana do not trend differently in these two types of municipalities pre-legalization. Figure 7 shows four different event studies for this type of design for Washington. Each shows the effect of being a major market each year both before after “treatment” (i.e., legalization). If the effects pre-treatment are insignificant, then it is generally accepted that there are parallel pre-trends. Here we can see that in the heroin/cocaine major market specification there seems to be parallel pre-trends. However, this does not hold if we look at the cannabis major market specifications. While the possession arrests specification (i.e., possession arrests on major cannabis market) does seem to have insignificant, if highly positive, pre-trends, the sales arrests specification clearly shows an initial positive pre-trend, breaking the assumption.

For Oregon, we can see a slightly different pattern in Figure 8. For both types of major market specification, pre-treatment effects are significant for the cannabis sales specification but not the cannabis possession specification. Though it does seem that the heroin/cocaine major market cannabis sales specification is less problematic here. Given all of this, I have chosen to focus on the heroin/cocaine major market specification rather than the cannabis major market specification as that seems to have more stable pre-trends on the whole.

Beyond looking at cannabis sales versus cannabis possession arrests and what definition to use for the major market, there are four different types of specifications for this model: weighted with a balanced panel, unweighted with a balanced panel, weighted with an unbalanced panel, and unweighted with an unbalanced panel. The balanced panel results remove municipalities that do not report arrests every month in every year. The weighted results are weighted regressions that use population weights to weight the regression. The most relevant results here are from the weighted and balanced specifications, which give represen-

tative results based on population among those municipalities of which we always have data for. I prefer these results because they don't allow for municipalities to drop in and out and affect the results that way. Additionally, using weighted regressions allows me to focus on the municipalities with higher populations. I am using per capita measures of arrests, which could be seen as precluding the need for weighted regressions, but using the weighted regressions gives me the ability to not have small municipalities with large changes influence the result more than they should. For example, if a small municipality of 1000 has 3 marijuana arrests in one month, that is 300 arrests per 100,000. If the month before it had 1 arrest (100 per 100,000), then it looks as if there was a 200% increase in arrests. This could unduly affect my results and is thus why I use the weighted regressions. All results have standard errors clustered by municipality.

4.2 Washington Results

Washington results are contained in Table 1 and can be summarized as significant negative effects on marijuana sales arrests from being a major market for marijuana or a major market for heroin or cocaine and significant negative effects on marijuana possession arrests from being a major market for marijuana pre-legalization. Again, as stated above, I am concentrating here on the balanced panel and weighted by population results.

Looking at the first set of results in Table 1, we can see that there does appear to be a significant (at the ten percent level) and large negative effect on sales arrests post-legalization from being a major market for heroin and cocaine pre-legalization. The coefficient of interest (major market interacted with legalization) in the balanced panel, weighted specification implies an effect of -0.9162 arrests per 100,000 people. Because of the relative rarity of arrests for the sale of marijuana either before or after legalization (1.64 per month per municipality in Washington), these results are significantly smaller than the marijuana possession results, but still represent a more than one-third drop in sales arrests based on the overall average in major heroin markets. The sign appears to be stable when weighting the results based on population in an unbalanced panel, when not weighting in a balanced panel, and when neither weighting nor balancing the panel. The significance and the magnitude, however, vary based on whether or not the regression is weighted for population or not. This could be because the more highly populated areas with major marketplaces see a larger decrease post-legalization than lower population major marketplaces. In general, however, this implies that where there were major markets for cannabis pre-legalization, the illegal market shifted more dramatically to the legal market post-legalization. That is to say, individuals were being arrested at a far lower rate for selling marijuana post-legalization in these areas, potentially showing a decrease in the overall illegal market.

The second set of results uses marijuana possession arrests as the dependent variable, but the same type of model as in the first set of results. That is to say, the independent variable of interest here is the interaction between the major heroin market dummy and the legalization dummy. Here there is a significant, negative, and large effect, in a balanced or unbalanced panel initially, but weighting the estimates by population loses the significance and decreases the magnitude of the effect substantially, though the sign stays the same. The main coefficient of interest here is in the weighted balanced estimates, showing a -0.2297 effect per 100,000 people on possession arrests from being a major marketplace for heroin and cocaine post-legalization. This could suggest that again the larger the marketplace pre-legalization, the larger the collapse of the illegal market. However, since these results are not significant we cannot draw any real conclusions.

In the third set of results, I use the major cannabis market indicator and regress cannabis sales on that and the interaction with legalization in Washington. We can see from these results that being a major cannabis market has a large, negative, and significant effect on cannabis sales arrests post-legalization. The coefficient of interest from the weighted and balanced regression shows an 2.6542 decrease per 100,000 people in sales arrests post legalization from being a major market for cannabis pre-legalization. This effect is almost unchanged whether or not the regression is weighted or uses a balanced panel. This result does need a caveat, however, for two reasons. Firstly, there are issues with pre-trending effects as explained above. Secondly, major cannabis markets do not include the city of Seattle. This could be an accurate representation, but it is also possible that Seattle police vastly under-enforced marijuana sales pre-legalization, and thus we do not have a complete picture of the illegal market in the most important municipality in the state. However, regressions removing Seattle from the sample do not show a significantly changed result.

In the fourth set of results, I use marijuana possession arrests as the dependent variable, with the same interaction of interest in the previous results. I find that being a major market post-legalization causes a significant 8.8068 decrease in cannabis possession arrests. This result holds whether or not the regression is weighted or balanced. This is a large result as the average for possession arrests for major marijuana markets is 17.78. Again, we do have to contend with the troubling pre-treatment effects in this specification, and thus the main results of this section are the heroin/cocaine major market results.

4.3 Oregon Results

Oregon results are contained in Table 2 and can be summarized as significant negative effects on marijuana sales arrests from being a major market for marijuana or a major market for heroin or cocaine and insignificant effects on marijuana possession arrests from being a major

market for either. Again, as stated above, I am concentrating here on the balanced panel and weighted by population results.

The first set of results looks at the effect of being a major illegal heroin marketplace on arrests for the illegal sale of marijuana. Again, the coefficient of interest here is the interaction between the dummy for a major illegal market and the dummy for recreational marijuana being legal. The direction, significance, and magnitude of the effect is similar to Washington, with an implied effect of -0.9949 arrests per 100,000 from recreational marijuana being legal and there being a major illegal heroin market in a municipality in the weighted, balanced panel specification. It remains almost identical no matter if there is a balanced panel or if the regression is weighted by population. This is a particularly large effect, as the pre-legalization mean for marijuana sales arrests in major heroin markets in Oregon is 0.97. These results offer more compelling evidence that legalization has reduced the illegal market in a significant way in these major marketplaces.

The second batch of results in Table 2 looks at the effect of being a major illegal heroin and cocaine marketplace before legalization on marijuana possession arrests. Here, we have a positive, though insignificant and small, effect on cannabis possession arrests. This contradicts the same coefficient in the Washington results, though both results are insignificant. The coefficient implies an increase of 1.68 arrests per 100,000 from marijuana being legal and being a major illegal market pre-legalization. This effect does change dramatically when we use other specifications: when unweighted, the effect dramatically changes sign and magnitude. This could mean that post-legalization, there is still a larger illegal market in major marketplaces. However, the lack of significance precludes us from drawing any strong conclusions.

The third set of results looks at the effect of being a major illegal market (based on marijuana sales) on arrests for possession. The coefficient of interest (major market interacted with legalization) in the balanced panel, weighted specification implies an effect of -1.2033 arrests per 100,000 people. This effect is significant at the 0.01 percent level. It remains virtually unchanged whether weighting the results by population or using a balanced panel. As with the Washington results, it is important not to place too much emphasis on this or the following results, due to the worrying pre-treatment effects.

The fourth and final set of results looks at the effect of being a major illegal market (again based on marijuana sales) on arrests for possession. The coefficient of interest in the balanced panel, weighted specification implies an effect of -0.398 arrests per 100,000 people. This estimate is not significant and is furthermore not very large in magnitude. It appears to be stable when weighting the results based on population in an unbalanced panel and when neither weighting nor balancing the panel. However, an unweighted balanced panel changes the sign of this estimate. It is unclear why this would be the case, other than that

the balanced panel has higher population municipalities with a “major” market and this mechanically increases the effect of being “major” after legalization, which goes away once the regressions are weighted for population. However, again since the effect is not significant, strong conclusions should not be drawn.

5 Spillovers Across Borders

If a market is legal in one area, while illegal in another, the border between will become a flashpoint in both law enforcement and the market itself. When this happens, of particular concern are the spillovers from the legalization area to the illegal area. If individuals are crossing borders to purchase goods that are illegal where they live, law enforcement is often compelled to respond. This can have significant and important costs, for both individuals and the government, as individuals face the risk of fines or prison time, while the government is forced to spend money on greater enforcement along its borders if it wants to keep this particular good functionally illegal and/or out of its area of governance.

This scenario is especially relevant with recreational marijuana in the United States, as while it continues to become legal state by state in the USA, there is an open question of how those states that border states with legal recreational marijuana deal with the potential influx of “legal” marijuana across their borders. Many states still have not legalized either medical or recreational marijuana but do end up bordering states that have much laxer marijuana regulations. Do these border states increase law enforcement along state lines? Or does access not actually change that much in border states to warrant a response to legalizing recreational marijuana in a neighboring state?

In this section, I plan to answer these questions for the states of Idaho (which currently borders three states, Nevada, Oregon, and Washington, that have legalized recreational marijuana) and the state of Oregon (which borders Washington, and between 2012 and 2015 had not yet legalized marijuana while Washington had). For this design, I examine the effect of being close to a dispensary that is across the border in a legalizing state on arrests for possession or sale of marijuana in municipalities in the state where marijuana is illegal. What this means in practice is using a difference-in-difference to compare arrests in municipalities within a certain number of miles of a dispensary versus those outside that radius post recreational legalization in the legalizing state.

Through this specification, I find that being near a dispensary after legalization significantly increases the number of possession and sales arrests in an Idaho municipality, while being near a dispensary post-legalization in Washington seemingly has little effect on arrests in Oregon. There are some troubling pre-treatment effects in both states for several different designs which implications I will explore.

5.1 Border Methods

As stated above, I will be using a difference-in-difference specification in my analysis and applying them to two different borders in two different time periods. The two borders are the Idaho border with three different states and the Oregon/Washington border. The dependent variables here are the same as the within-state results: arrests for possession or sale of cannabis. Here though, the independent variable of interest is the interaction between being within a certain number of miles of a dispensary and whether marijuana was legal at the time in that dispensary's state. The treated here are those municipalities that were ever within 25 or 50 miles of a dispensary across the border. For Idaho this includes any dispensaries in Washington, Oregon, or Nevada and for Oregon this means dispensaries across the border into Washington. The untreated are those municipalities that are outside of the range of either 25 or 50 miles (depending upon the specification). The pre/post period is the timing of legality of recreational marijuana in the state where the dispensary is located. I use the following model:

$$Arrest_{mt} = \beta_0 + \beta_1 * Legal_{mt} + \beta_2 * Near_m + \beta_3 * Legal_t * Near_m + \eta_y + \alpha_m + \epsilon_{mt}$$

Where $Arrest_{mt}$ is the number of arrests for possession or sale of cannabis in municipality m at time t, $Legal_t$ is a 0/1 dummy indicating whether or not recreational marijuana at the dispensary nearest to municipality m was legal at time t, and $Near_m$ is a 0/1 dummy indicating whether or not a municipality m was within X miles of a dispensary (either 25 or 50 miles depending on the specification). η_y and α_m are year and municipality fixed effects, respectively. The effect of interest here is β_3 , which is the effect of being near a dispensary after recreational marijuana was legal in that dispensary's state. For Idaho the time period is from 2000 to 2019, but for Oregon the time period is 2000 to 2015, as including 2016 to 2017 would have meant comparing treated Oregon to not only untreated Oregon but also treated Oregon that had legalized recreational marijuana. This is not the effect I want to capture, and thus I do not include those years. All results have standard errors clustered by municipality.

The identifying assumption here is that the arrests for possession of marijuana and arrests for sale of marijuana do not trend differently in these two types of municipalities pre-legalization. In Figures 9 and 10, there are event study charts for each type of design for Idaho and Oregon respectively. These are: cannabis possession on 25 miles interaction, cannabis sales on 25 miles interaction, cannabis possession on 50 miles interaction, and cannabis sales on 50 miles interaction. For Idaho, in Figure 9, we can see pre-treatment effects that violate parallel pre-trends in figure d, which shows an negative effect that goes

toward zero before treatment. Therefore, it is important to be cautious when interpreting the significant cannabis possession results that we will see in the Idaho results.

For the Oregon border, while cannabis sales arrests seem to have parallel pre-trends, cannabis possession arrests clearly do not. There are clearly positive effects in the pre-treatment time period, and thus again I cannot emphasize the Oregon possession results.

The municipalities within/outside of 25 miles are very similar in Idaho, with generally the same average population, police officers, and arrests. There are significant differences here, but the magnitudes of the differences are small enough that we can treat them as similar. Within/without 50 miles we can see some larger differences, particularly with regards to number of police officers (higher in towns within 50 miles). Again, however, there is not so large of a difference here that it hurts my analysis below. The numbers for Oregon do not follow the same pattern, mostly due to the presence of Portland near the border of Washington. Thus, the border municipalities are all higher population, with more arrests and more officers, no matter the range that I choose. The summary statistics are contained in tables in the appendix.

5.2 Idaho Border Results

Table 3 contains the Idaho border results. There are four different models here to examine, and each has a weighted, balanced, weighted and balanced, and no weighting or balancing versions as in our previous results. The four models are based on the model explained above, with two using the 25 mile range in the interaction of interest, and 2 using the 50 mile range. In each of those sets one specification uses cannabis possession arrests as the dependent variable, and the other uses cannabis sales arrests as the dependent variable. In general, these results suggest an increase in arrests by being close to a dispensary post-legalization, as 2 out of the four models show a positive and significant effect from the interaction of interest, and one other showing a positive effect.

In the weighted and balanced panel regression for the first set of results for sales arrests, we see a negative effect from our main interaction term, implying a decrease of 0.3744 arrests per 100,000 from being within 25 miles of a dispensary post-legalization. This effect is rather large (0.89 sales arrests on average per month per municipality) but is insignificant.

The second set of results uses the same interaction, but this time uses cannabis sales arrests as the dependent variable. The most relevant results here is the weighted and balanced panel regression. The coefficient from that regression suggests an increase of 2.9517 cannabis possession arrests per 100,000 from being within 25 miles of a dispensary post-legalization. This effect, however, is not significant and furthermore is not large in magnitude compared to the number of possession arrests on average (14.64 possession arrests on average every month

per municipality). Mechanically, the story here could be that being close to a dispensary across the border decreases the illegal market overall but increases the number of people with marijuana (explaining the following results). However, since both 25 mile results are insignificant it is hard to draw solid conclusions from this.

The third set of results now switches the range to be within 50 miles of a dispensary and uses sales arrests as the dependent variable. The weighted and balanced specification implies a 0.7131 increase in sales arrests per 100,000 from being within 50 miles of a dispensary post-legalization. This effect is significant on the 10% level and large in magnitude. This effect contradicts the previous sales effect, suggesting that there is something happening to the illegal market between 25 and 50 miles. This could potentially be that the illegal market decreases nearer to the border because it is so much easier to buy marijuana, but increases further away because the illegal market is now reaping the benefits of easier to obtain marijuana and thus selling more. However, again, as this result is insignificant it is hard to draw too many conclusions.

The final results from Idaho use the 50 mile interaction but now use possession arrests as the dependent variable. These results show a 7.3647 increase per 100,000 in sales arrests from being within 50 miles of a dispensary post-legalization. This effect is significant at the 5 percent level and relatively large in magnitude. This reflects an increase from the 25 mile range regression and could reflect that there already was a relatively robust market nearer to the border. If this was the case, then legalization wouldn't have affected the closest municipalities as much, but perhaps affected municipalities slightly farther away by increasing the range of the spillover. The spillover could have increased due to legalization because of individuals being more aware of the ability to get marijuana across the border, whereas before it was easier to get across the border but not completely legal.

5.3 Oregon-Washington Border Results

As in the Idaho border results, we have four different models that we are looking at in the Oregon border results, all difference-in-differences: a model where the dependent variable is cannabis sales arrests and the dependent variable is a dummy for less than 25 miles to a dispensary, the previous model but with a dummy for less than 50 miles to a dispensary, and the previous two models but with cannabis possession arrests as the dependent variable. All the results are contained in Table 4. In general, these results do not show any effect from being near to a dispensary post-Washington legalization. This could mean that the legal environment in Oregon was already so lax at the time of Washington recreational legalization that police, consumers and illegal market participants changed their behavior very little once Washington legalized. This could be because Washington legalization didn't

meaningfully increase access to marijuana in Oregon.

Looking at the first set of results in Table 4, where I regress cannabis sales arrests on the interaction between the legal dummy and the 25 miles dummy, there is an insignificant negative effect from the interaction. The coefficient of interest here is in the weighted and balanced regression and implies a 0.0453 decrease in sales arrests from being within 25 miles of a dispensary post Washington legalization but pre-Oregon legalization. This effect could imply that the illegal market is decreasing in the face of legal competition in Washington. However, because it is insignificant it is better to be cautious about such claims.

The second set of results is the same difference-in-difference as the previous results but with cannabis possession arrests as the dependent variable instead of cannabis sales arrests. Here there is an insignificant negative effect implying a decrease of 1.4606 possession arrests per 100,000. While a negative effect here could imply a story that police are making fewer arrests in these locations due to lack of will in the face of Oregon's impending legalization, because of the insignificance we cannot draw any real conclusions.

The third set of results is similar to the first, though instead of a less than 25 miles dummy, I use a less than 50 miles dummy. Again we see a negative, though insignificant, effect of 0.0181 on sales arrests from being near a Washington dispensary post-Washington legalization. Again, I cannot draw any real conclusions due to the insignificance.

The final set of results is different than the other three, in that they imply an increase of 0.3587 in possession arrests in municipalities near Washington dispensaries post-Washington legalization. This is again an insignificant effect, though it would line up better with my previous Idaho results.

Because of both troubling pre-trends and the insignificance of my Oregon results, I would say that I do not fully find a border spillover here. Something could be potentially happening in Idaho, but without controlling for pre-treatment effects, I cannot say for certain whether it is real. In the appendix I have included results using a 100 miles dummy for both Idaho and Oregon contexts. The results are similar to the 50 mile results and are included in table A3.

6 Discussion

6.1 Enforcement versus Consumer Channel

Though these results at first glance seem to suggest that consumers are switching from the illegal market to the legal one in states that legalize, and increasing the illegal market in states that border and don't legalize, because I use arrests as a proxy I cannot with complete confidence say that this is the only driver of my results. Is the illegal market truly decreasing

due to legalization? Or are police simply toning down enforcement in those areas where the marijuana market flourished the most? Additionally, there is some anecdotal evidence (Goldstein and Sumner, 2023) that police are not enforcing illegal dealers post-legalization as much as they could under the law. I have some suggestive evidence that points to the illegal market decreasing, but I cannot completely rule out the enforcement channel.

The main piece of supporting evidence is an analysis of how police employment changes post-legalization in both a state that legalizes and a state that doesn't. To do this, I use the difference-in-difference models that I employ in the main sections of my paper. What this means is that I substitute police employment variables for the cannabis sale and possession arrests variables that I use for my dependent variables in my earlier regressions. To quickly recap: I examine how police employment is changed post-legalization in a legalizing state in municipalities where there was a major drug market and how employment was changed in municipalities in a non-legalizing state within 25 and 50 miles of a dispensary of a legalizing state.

What I find is that police employment does not seem to change very much in either model. The tables for these results are located in the appendix in tables A4 through A7. In the major market model for within a legalizing state, I find no effect on either number of employees at an agency or the number of officers at an agency. In the proximity to dispensary model for a non-legalizing state I find some significant results, however. For Idaho, I find that municipalities within 25 miles of a dispensary increased both the number of employees and the number of officers post-legalization. This does not hold for being within 50 miles of a dispensary. For Oregon, however, I find no significant results.

The Idaho results can be indicative of a greater enforcement effort across the border, however, paired with the insignificant results for municipalities within 25 miles for the model with arrests as the outcome, the picture is a little more complicated. Police could be responding to legalization by increasing support at the border, but the lack of response from arrests in the same municipalities doesn't quite fit with that narrative. Either police are increasing drug enforcement and it is not translating into arrests at all (potentially through increased enforcement decreasing illegal actions entirely or police employment having little effect on illegal activity (unlikely)) or police employment increasing has changed an initial negative effect from legalization to no effect.

That the effect of legalization in Oregon, Washington and Nevada on nearby municipalities in Idaho was initially negative before an increase in police employment counteracted it could make some at least statistical sense with my results in Oregon. In the border model results for Oregon, I see a negative effect from being near legal dispensaries in Washington. As I don't see an increase in police employment in Oregon in the same way that I do in Idaho, this could mean that the actual effect of legalization on municipalities in illegal states

is a negative one.

Regardless, this does suggest that my results are not the results of a change in police enforcement, at least due to the insignificant results in Oregon and Washington. However, an enforcement channel is still a possible driver of a lot of my results potentially due to re-allocation of resources in both border municipalities and major market municipalities. Therefore, I cannot completely rule out this channel.

6.2 Extrapolating Results to the United States at Large

The issue of border spillover is one that could be extrapolated to the United States at large. The amount of policy variation in the country is large, therefore, it is possible to expand my results across the US. As an initial, back-of-the-envelope calculation, I will be extrapolating my Idaho results to states that have neither legalized recreational nor medical marijuana. I will be basing these calculations on the populations of counties that border states that have legalized recreational marijuana but are in states that have not legalized either medical nor recreational marijuana. These states, as of August 2024, are: Indiana, Iowa, Kansas, Texas, Wisconsin, and Wyoming. The border counties in these states represent, on average during my time period, a total of 5,172,129.7 people, among 497 agencies recorded in the UCR data.

If I use my results for Idaho on these border counties, we can get a rough estimate of the overall impact of recreational legalization on border states. Using the 50 mile estimates for a balanced and weighted panel, legalization could potentially have increased marijuana sales arrests in these states by 354.41 arrests per 100,000, or 18,330.58 arrests overall. This is a rough calculation, but hints at the larger impact of legalization that could be studied further. If we use the possession results, this translates to 3,660.26 more arrests per 100,000 or 189,313.18 arrests overall.

7 Conclusion

The illegal market is clearly dependent on the regulations surrounding the good in question, and no regulation is more important than whether or not that good is legal. In this paper I have examined how the Pacific Northwest illegal markets were affected by the rapidly changing regulation landscapes, where Washington, Oregon, and Nevada all legalized recreational marijuana over the span of five years. When looking at how the illegal market changes within a state that legalizes, I find that possession arrests and sales arrests for marijuana both decrease in major markets in Washington and sales arrests for marijuana decrease in major markets in Oregon. This suggests that the illegal market, in places where it was already strong, faced large crowd-in from the legal market. With the exponential increase in

sales in both Oregon and Washington in the legal market, we can potentially surmise that this decrease in the illegal market is largely due to individuals switching from illegal to legal buyers.

When looking at how illegal markets change across borders, I find marginal results. In Idaho possession and sales arrests increased in municipalities close to a dispensary, though troubling pre-treatment effects mitigate these effects somewhat. In Oregon, however, both possession and sales arrests remain virtually unchanged. It could be that the difference here is the legal environment in Oregon. Where Idaho police focus on the border with states that have legalized in order to catch offenders, Oregon police operate (at this point in time) in an environment where marijuana is legal to possess and use for a portion of the population. It may be that Washington legalizing does not affect how much access people in Oregon have to marijuana: it was already relatively accessible. But, given the problems with the results in Idaho, I am a little more inclined to posit that these results don't actually show that much of a spillover across borders.

This is an important result for both policymakers and for future work. For policymakers, it should be heartening to see results that the legalization of marijuana is at the least weakening the illegal market. There is still work to do, however, as potential spillovers into other states should be of some concern. While this paper does not support the idea that the illegal market is simply shifting to other locations, given the results in Idaho it is still of some concern. Therefore, policymakers should understand that legalization is not a completely watertight way of eliminating the illegal market and capturing the tax receipts from that market. More work needs to be done in decreasing barriers to entry for marijuana firms and cracking down on illegal sellers.

Finally, for future work it will be important to fully examine the scale of the shift to a legal market. While this paper posits that there has been a decrease in the illegal market from legalization, how many consumers actually switch over to the legal market is of paramount performance for both policymakers and researchers. This is because we can therefore understand how much of the illegal market there still is to capture and how effective the legalization has been. Therefore, a rewarding line of analysis could be using results like this, estimating how many arrests are equal to how many actual buyers, and then estimating how many consumers are actually switching over to the legal market. Additionally, a further line of research that I am interested in pursuing is looking at how dispensary location affects the major markets within a state that legalizes. This could provide further insight into my results in that municipalities that end up having a dispensary could have differential results in addition to being a major marketplace, where actually having a legal dispensary in a major marketplace post-legalization could lead to a further decrease in the illegal market than this paper has already shown. All in all, it is clear that the illegal market for marijuana is a

fertile area of research for criminal justice researchers for years to come.

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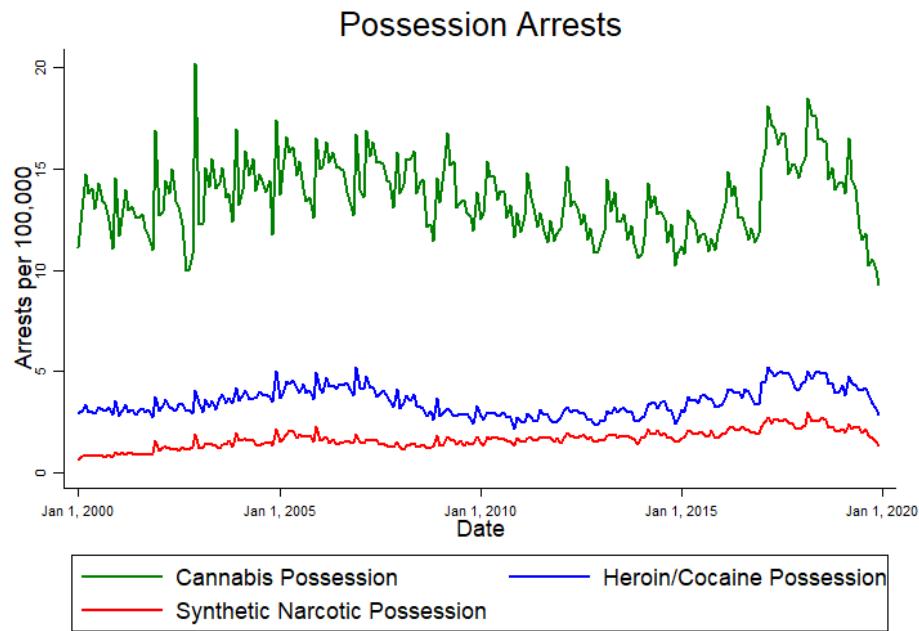
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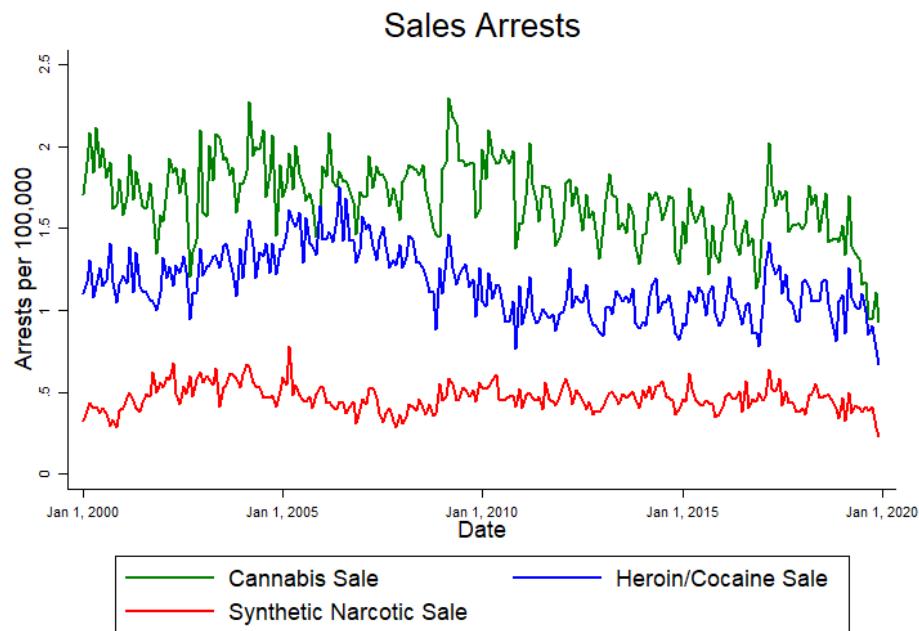
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(a)



(b)

Figure 1: Marijuana Still a Focus Point of Enforcement: Possession and Sales Arrests in the United States from 2000 to 2019. Source: FBI Uniform Crime Report.

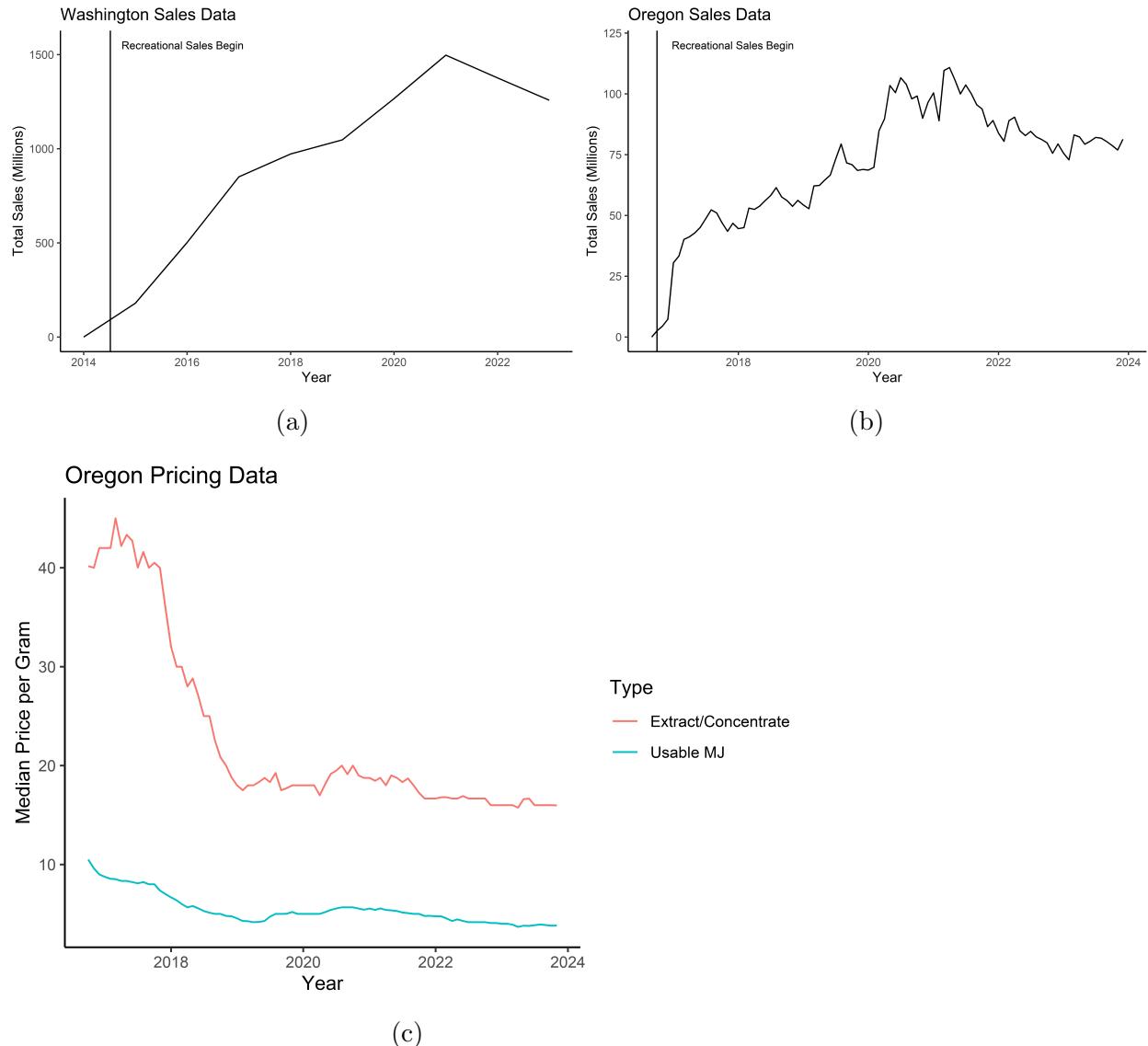


Figure 2: An Explosion in Sales with a Corresponding Decrease in Price: Sales and Price Data from Oregon and Washington Post-Legalization. Sources: Washington State Liquor and Cannabis Board and Oregon Liquor and Cannabis Commission.

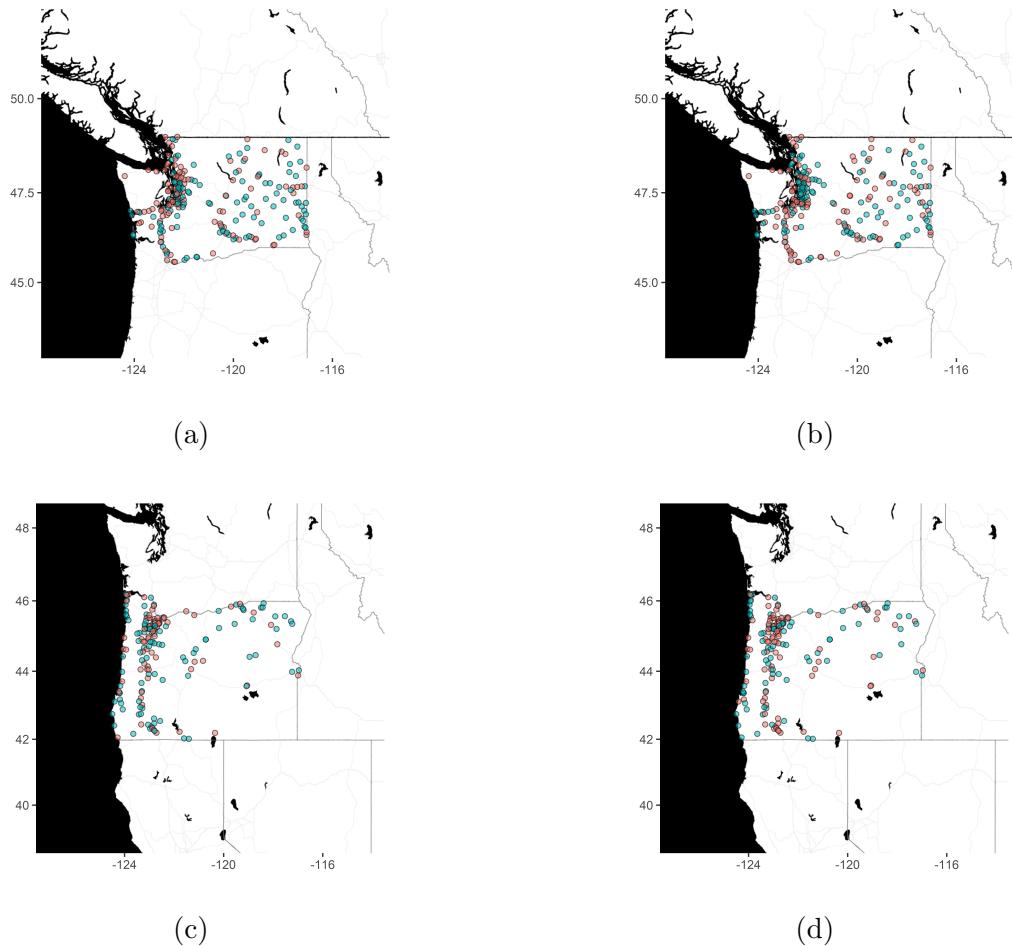


Figure 3: Market Locations Spread Out Across Both Washington and Oregon: Maps of Major and Minor Market Locations for Oregon and Washington. Source: FBI UCR.

Legend:

- Low = **Blue**
- High = **Red**

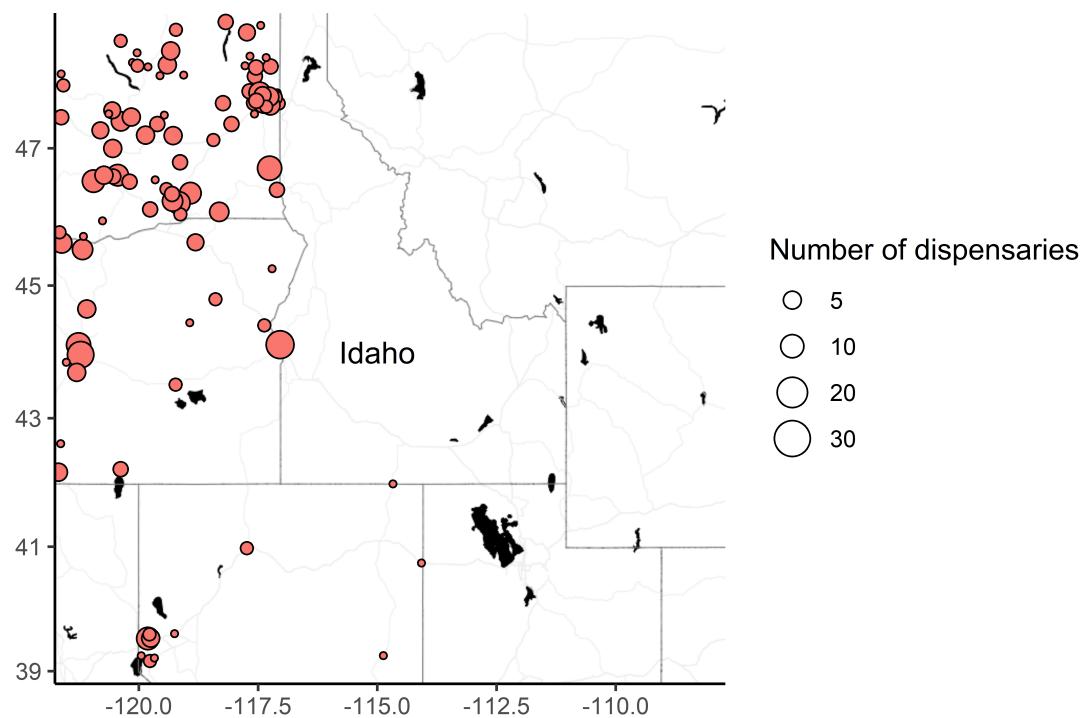


Figure 4: Dispensaries Mostly Located in Washington and Oregon Along Idaho Border.
Sources: Nevada Cannabis Compliance Board; Washington State Liquor and Cannabis Board; and Oregon Liquor and Cannabis Commission.

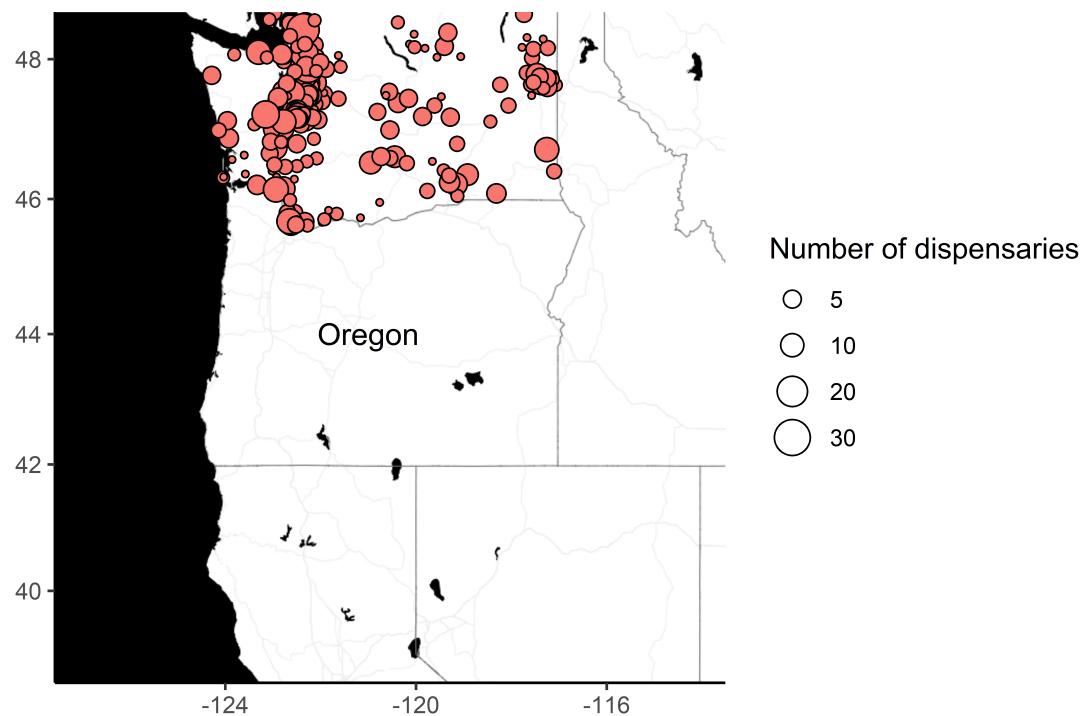


Figure 5: Dispensaries Spread Out Along Oregon/Washington Border. Source: Washington State Liquor and Cannabis Board.

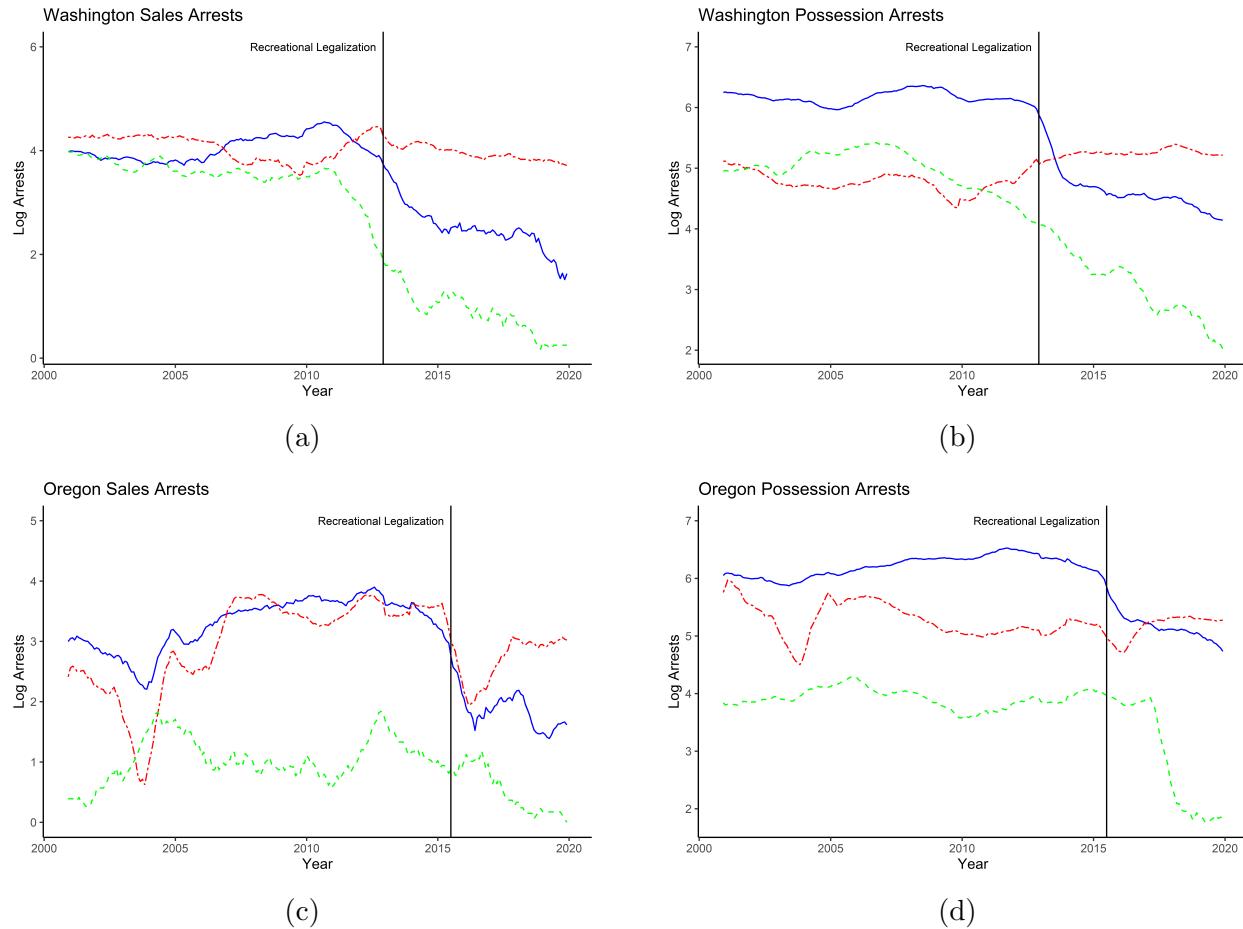


Figure 6: Arrest Trends in Washington and Oregon: 12 Month Rolling Average 2000-2019.
Source: FBI Uniform Crime Report.

Legend:

- Heroin/Cocaine = Red
- Marijuana = Blue
- Synthetic Narcotics = Green

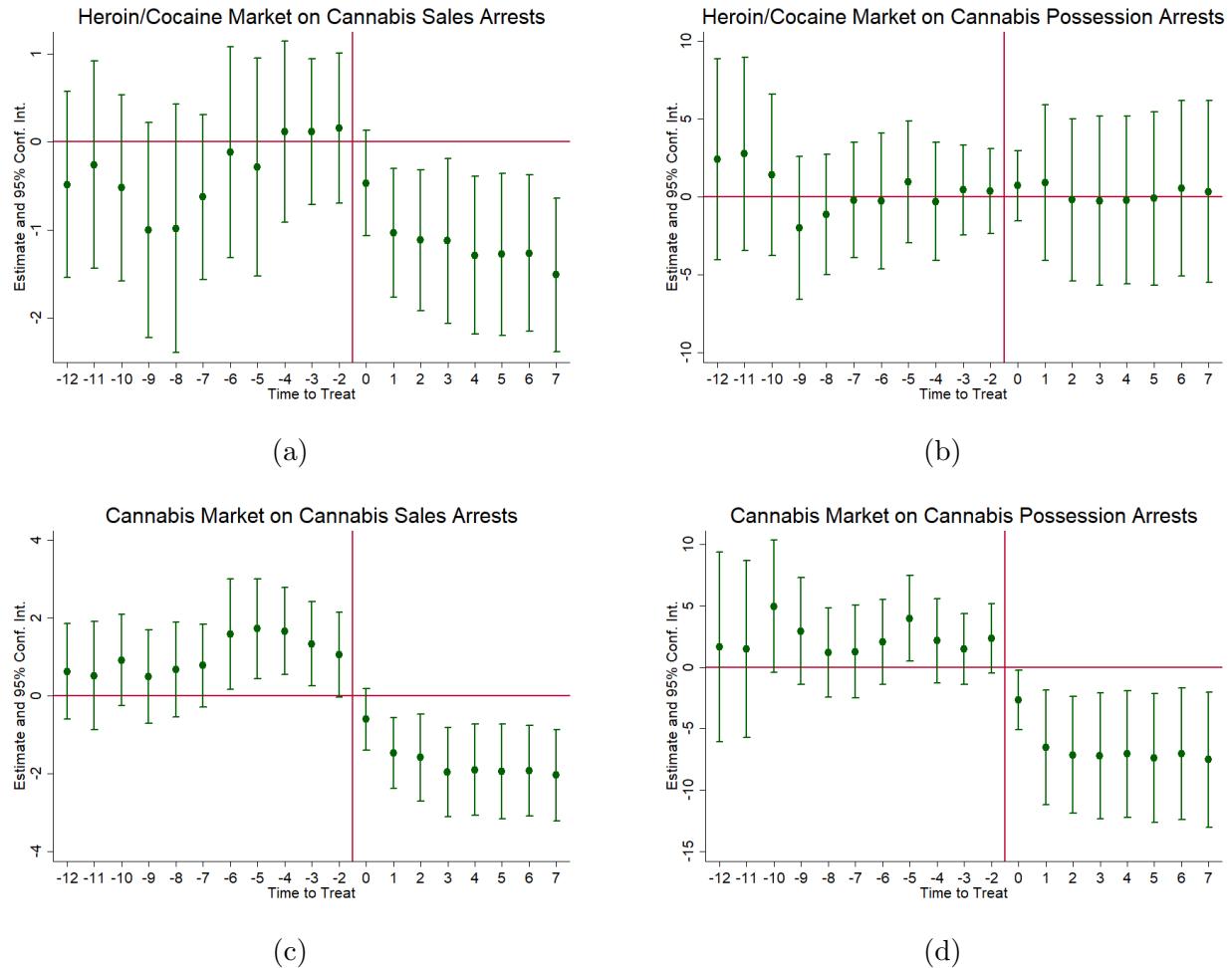


Figure 7: Event Study for Washington Results: Both Heroin/Cocaine Market Design and Cannabis Market Design. Source: FBI Uniform Crime Report.

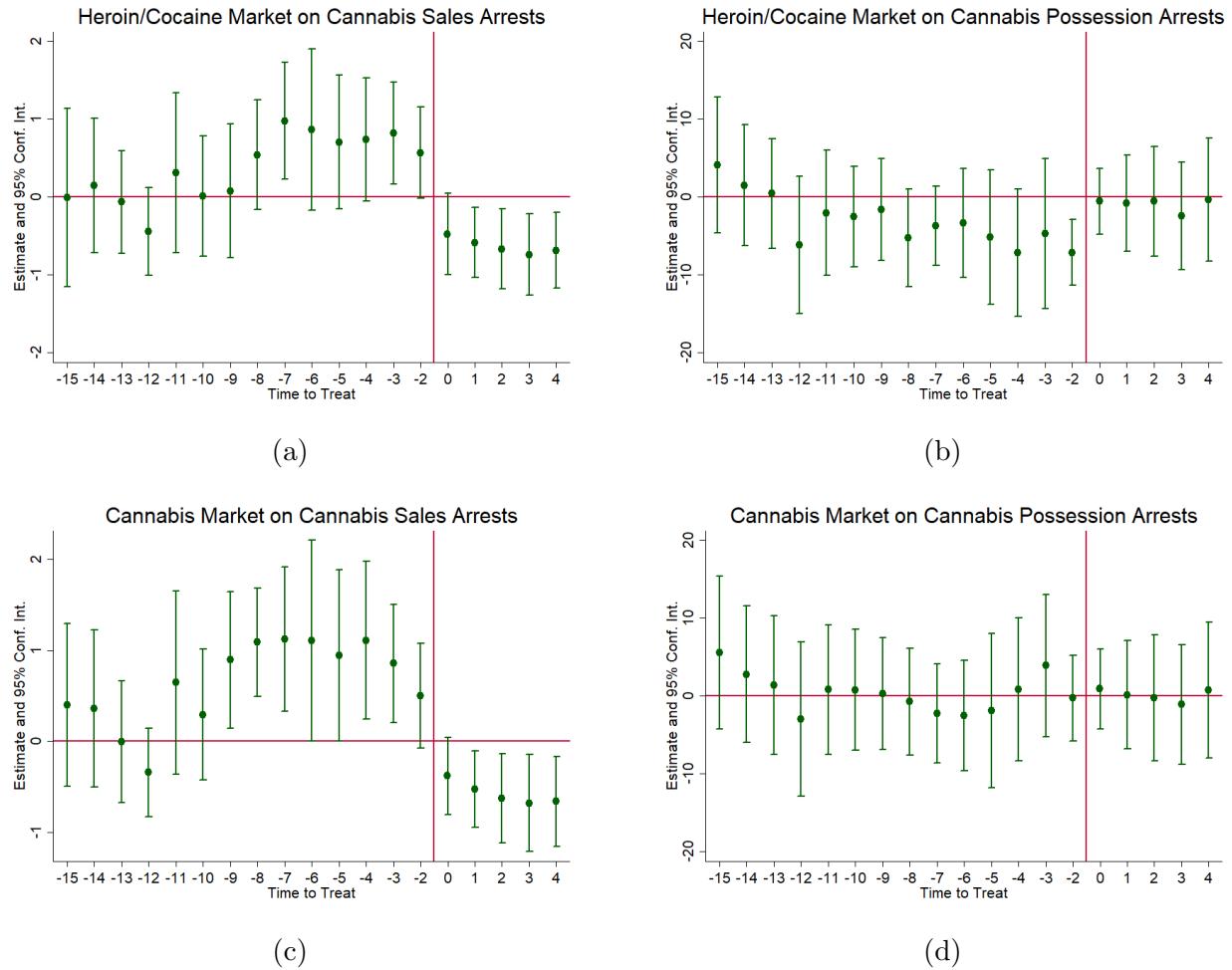


Figure 8: Event Study for Oregon Results: Both Heroin/Cocaine Market Design and Cannabis Market Design. Source: FBI Uniform Crime Report.

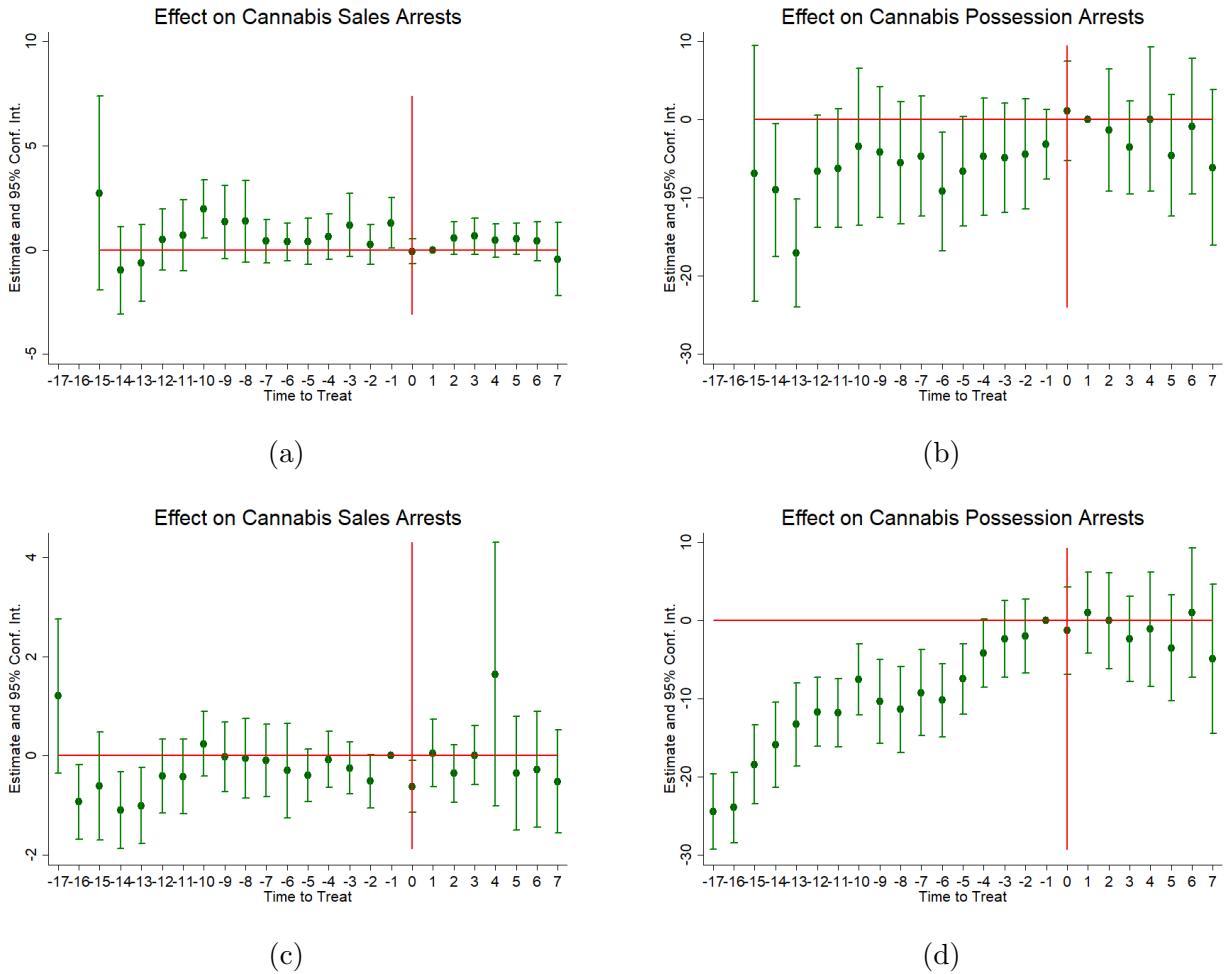


Figure 9: Event Study for Idaho Results: Both Heroin/Cocaine Market Design and Cannabis Market Design. Source: FBI Uniform Crime Report.

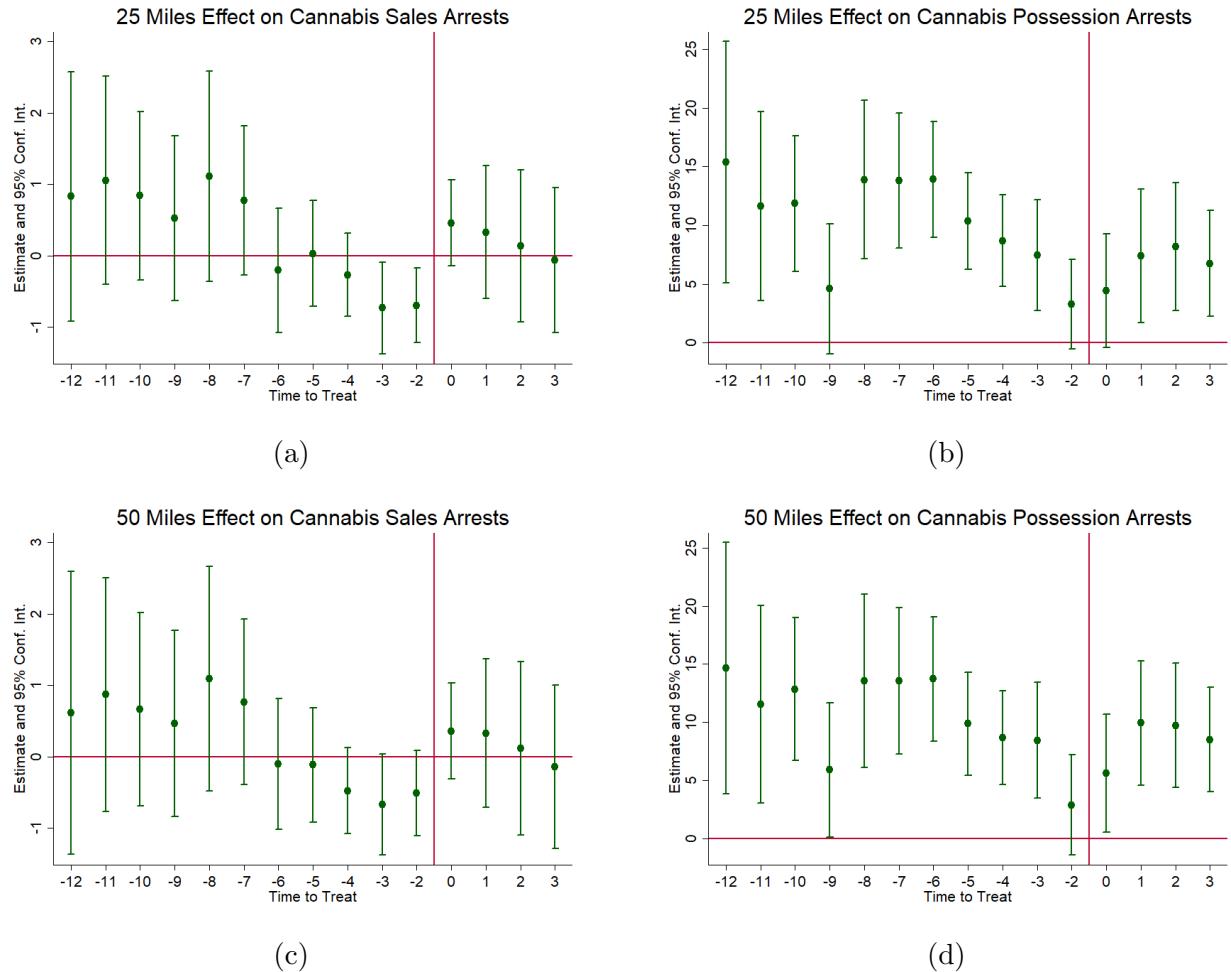


Figure 10: Event Study for Oregon Results: Both Heroin/Cocaine Market Design and Cannabis Market Design. Source: FBI Uniform Crime Report.

Table 1: Effect of Being A Robust Market for Drugs on Arrests Post-Legalization - Washington

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Sales on Major Heroin Markets	-0.9162* (0.5168)	-2.4490*** (0.6897)	-0.9070* (0.5482)	-2.2073*** (0.5991)
Possession on Major Heroin Markets	-0.2297 (2.9327)	-5.9965** (2.8408)	-2.5268 (2.8410)	-7.7533*** (2.4705)
Sales on Major Cannabis Markets	-2.6542*** (0.3959)	-4.3822*** (0.6369)	-2.6399*** (0.3623)	-4.1344*** (0.5502)
Possession on Major Cannabis Markets	-8.8068*** (2.4441)	-11.3157*** (2.7541)	-8.5913*** (2.3466)	-10.9345*** (2.4114)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in high drug market versus minor drug market municipalities. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. High versus low illegal markets are determined based on whether a municipality exceeds the median for arrests for selling heroin or cocaine or marijuana pre-recreational legalization. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Source: FBI Uniform Crime Report.

Table 2: Effect of Being A Robust Market for Drugs on Arrests Post-Legalization - Oregon

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Sales on Major Heroin Markets	-0.9949*** (0.1421)	-0.7108*** (0.1675)	-0.8371*** (0.1460)	-0.5915*** (0.1387)
Possession on Major Heroin Markets	1.6800 (3.3937)	-3.4866 (5.4297)	0.6991 (3.2746)	-6.3712 (4.3567)
Sales on Major Cannabis Markets	-1.2033*** (0.1252)	-1.2184*** (0.1383)	-1.1925*** (0.1174)	-1.0868*** (0.1104)
Possession on Major Cannabis Markets	-0.3979 (3.3868)	2.3580 (5.3671)	-0.0362 (3.4934)	-6.7999* (4.0334)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in high drug market versus minor drug market municipalities. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. High versus low illegal markets are determined based on whether a municipality exceeds the median for arrests for selling heroin or cocaine or marijuana pre-recreational legalization. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Source: FBI Uniform Crime Report.

Table 3: Effect of Being Close to a Dispensary on Possession and Sale of Marijuana Arrests in Idaho pre-Legalization

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Within 25 Miles on Sales Arrests	-0.3744 (0.4603)	-0.4549 (0.4185)	-0.4026 (0.4539)	-0.4892 (0.3604)
Within 25 Miles on Possession Arrests	2.9517 (4.1532)	6.3793 (5.1216)	2.8228 (4.0591)	5.2471 (4.3272)
Within 50 Miles on Sales Arrests	0.7131* (0.4091)	0.3776 (0.3232)	0.6913* (0.4027)	0.3211 (0.2924)
Within 50 Miles on Possession Arrests	7.3647** (3.0999)	6.6219 (4.3408)	7.2550** (3.0679)	6.2666 (3.8140)

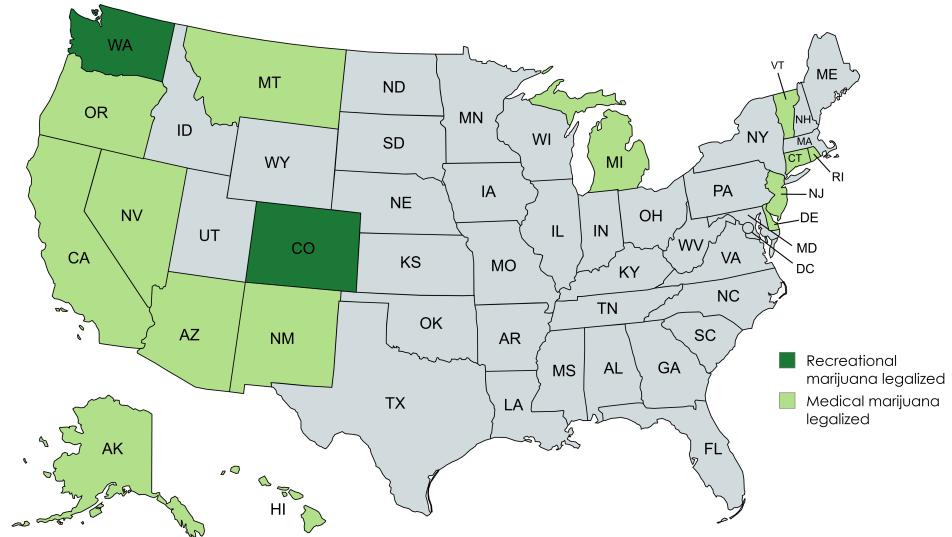
Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in municipalities where a marijuana dispensary is within a certain amount of miles. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Sources: FBI Uniform Crime Report; Nevada Cannabis Compliance Board; Washington State Liquor and Cannabis Board; and Oregon Liquor and Cannabis Commission.

Table 4: Effect of Being Close to a Dispensary on Possession and Sale of Marijuana Arrests in Oregon pre-Legalization

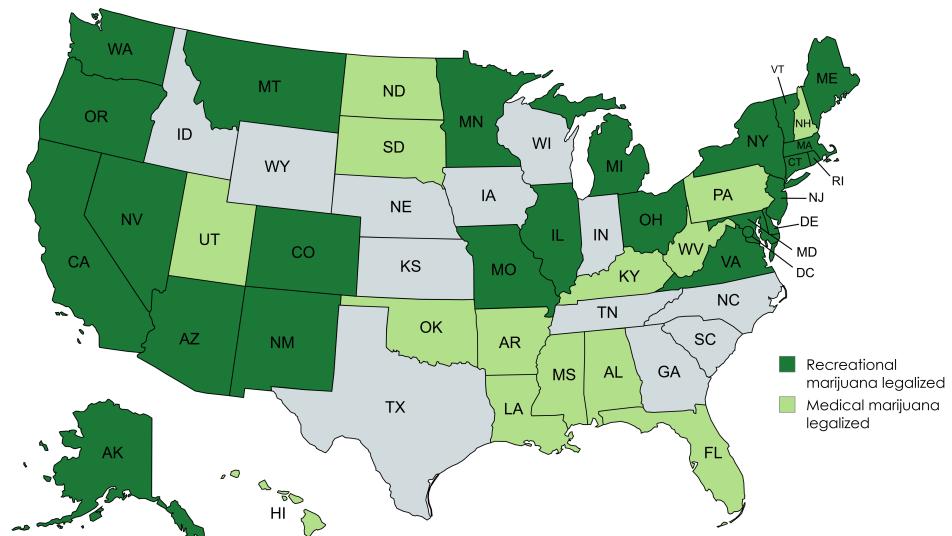
	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Within 25 Miles on Sales Arrests	-0.0453 (0.2662)	-0.0569 (0.1753)	-0.0496 (0.2614)	-0.0586 (0.1742)
Within 25 Miles on Possession Arrests	-1.4606 (1.6815)	-0.6108 (2.7537)	-1.6382 (1.6804)	-0.6242 (2.7449)
Within 50 Miles on Sales Arrests	-0.0181 (0.2880)	0.1415 (0.1985)	-0.0144 (0.2889)	0.1391 (0.1966)
Within 50 Miles on Possession Arrests	0.3587 (1.6857)	4.3664 (2.8321)	0.5291 (1.6812)	4.5403 (2.8076)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in municipalities where a marijuana dispensary is within a certain amount of miles. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Sources: FBI Uniform Crime Report and Washington State Liquor and Cannabis.

8 Appendix



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Figure A1: Maps of Loosening Marijuana Regulations - 2012 to 2024.

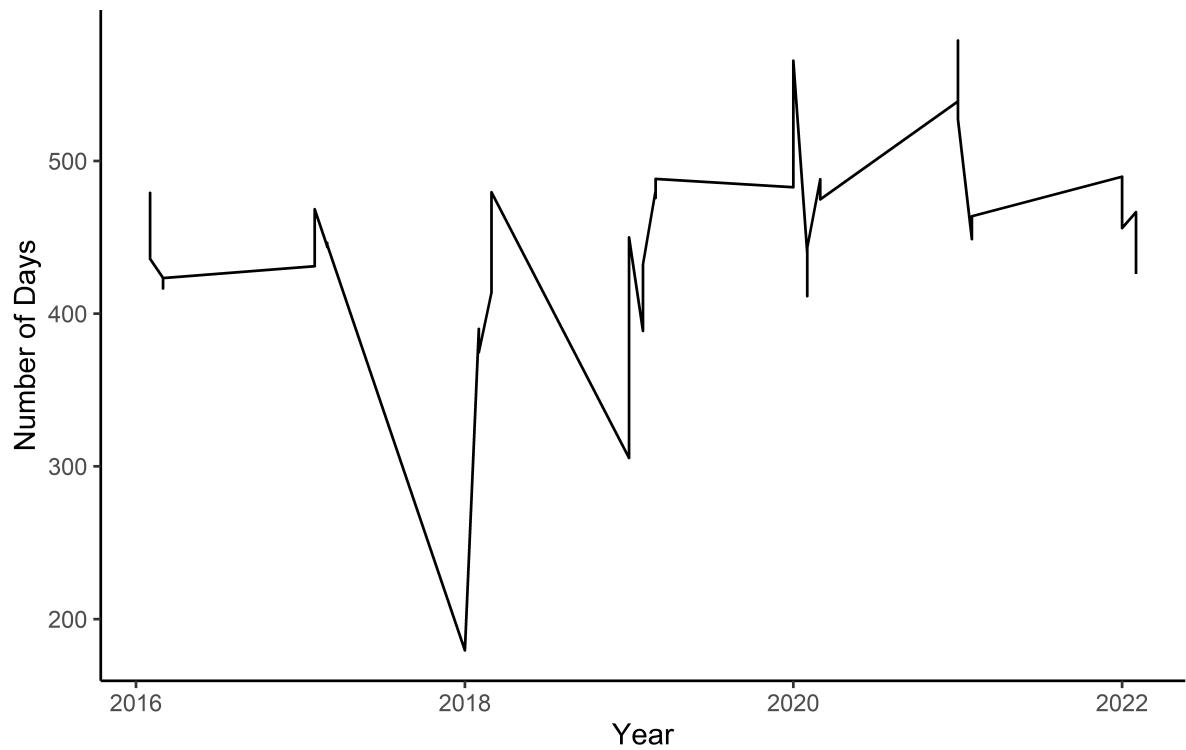


Figure A2: Total Number of Days Individuals Used Marijuana in the Past 30 Days, Idaho and Nevada - 2016-2021. Source: BRFFS.

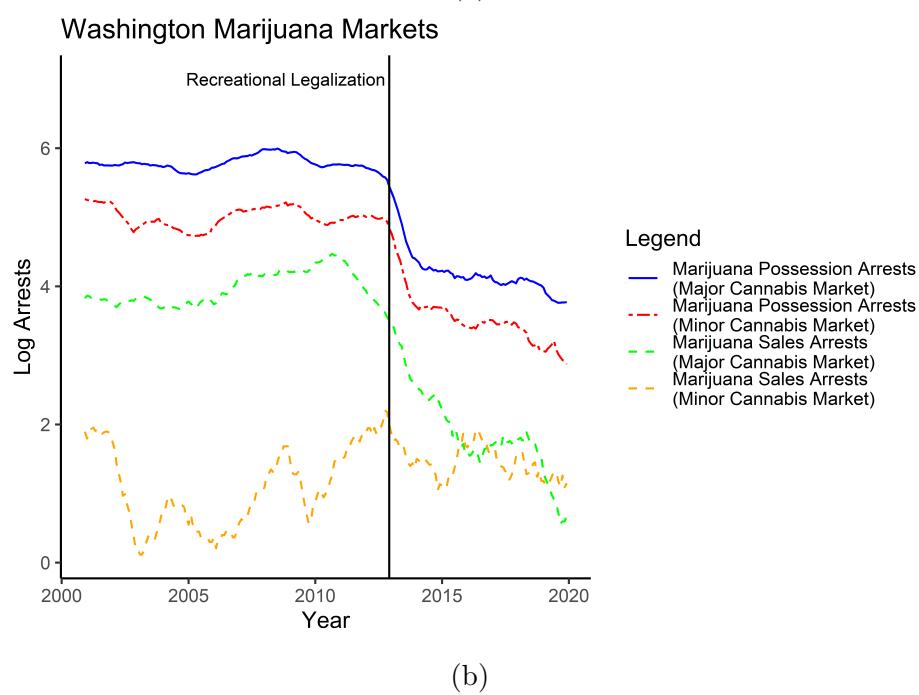
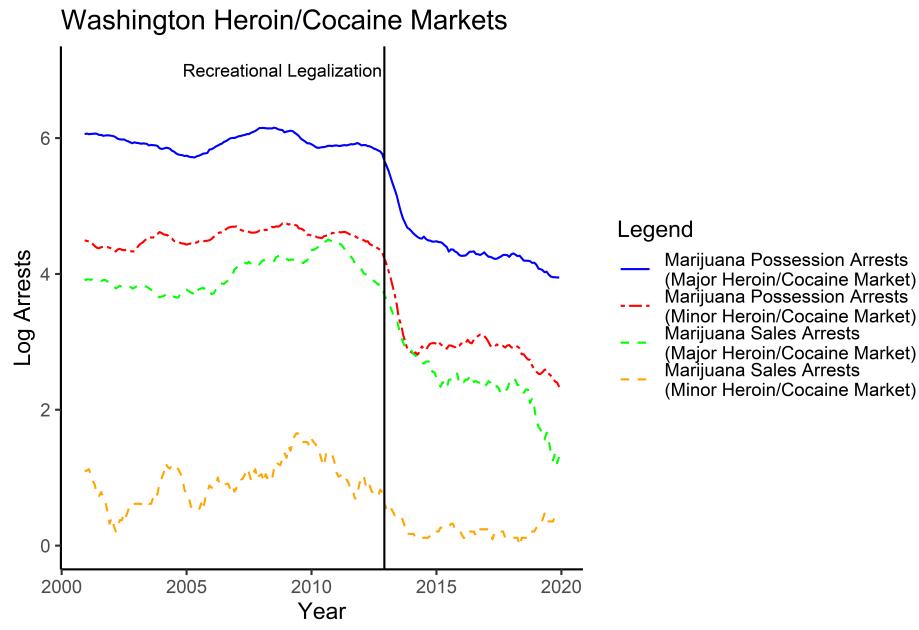
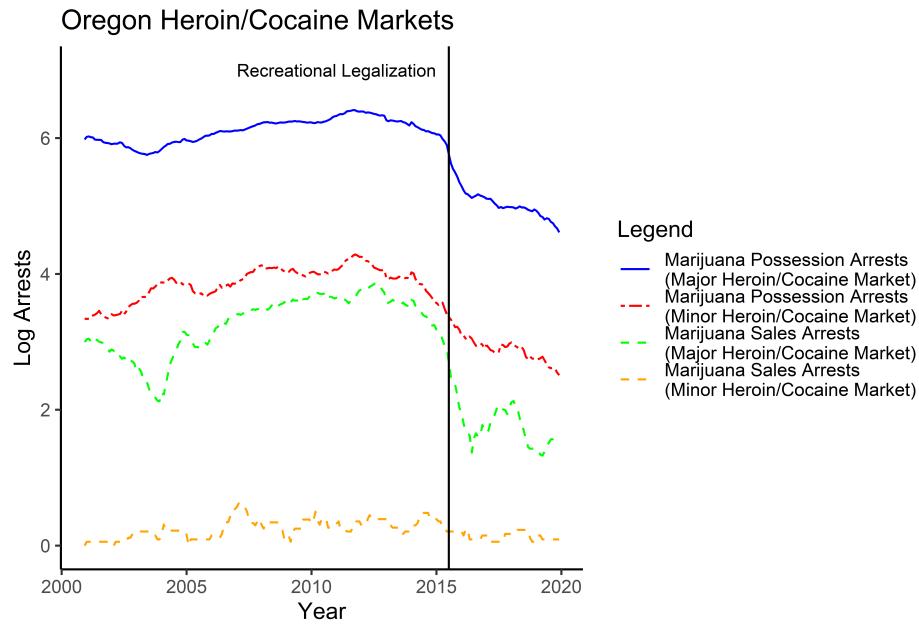
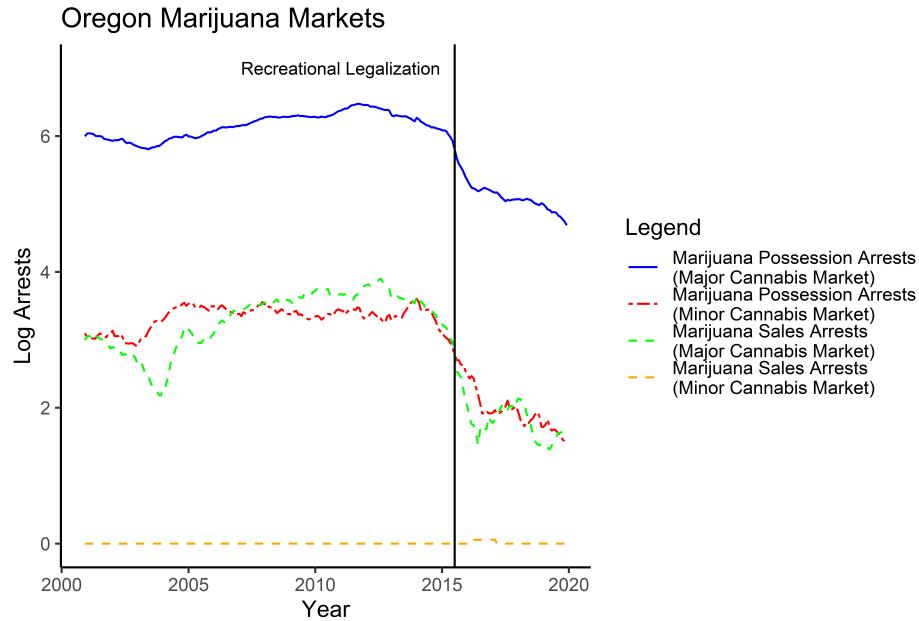


Figure A3: Pre-Trends for Within-State Difference-in-Difference: Rolling Average of Monthly Drug Arrests in Washington by Type of Municipality. Source: FBI Uniform Crime Report.

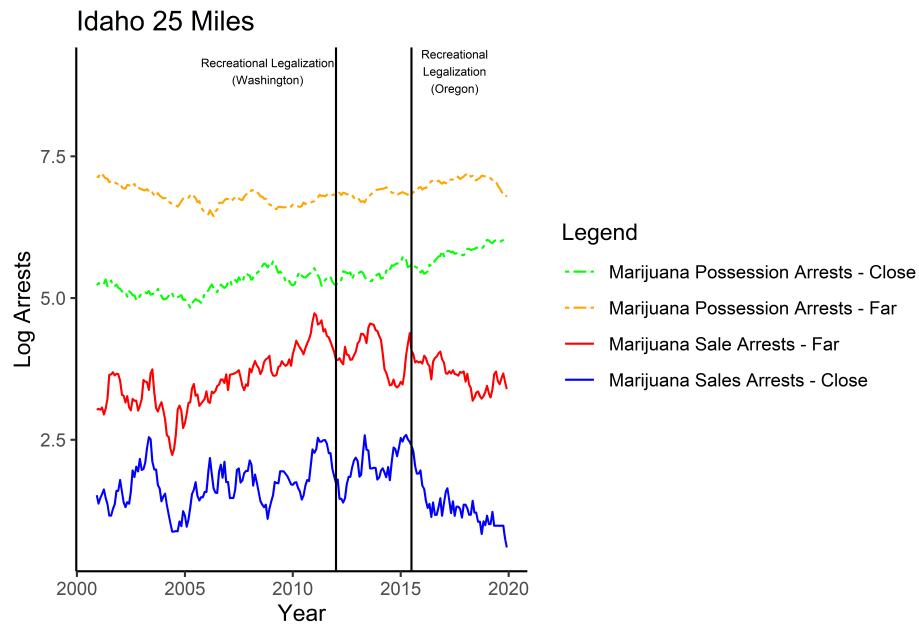


(a)

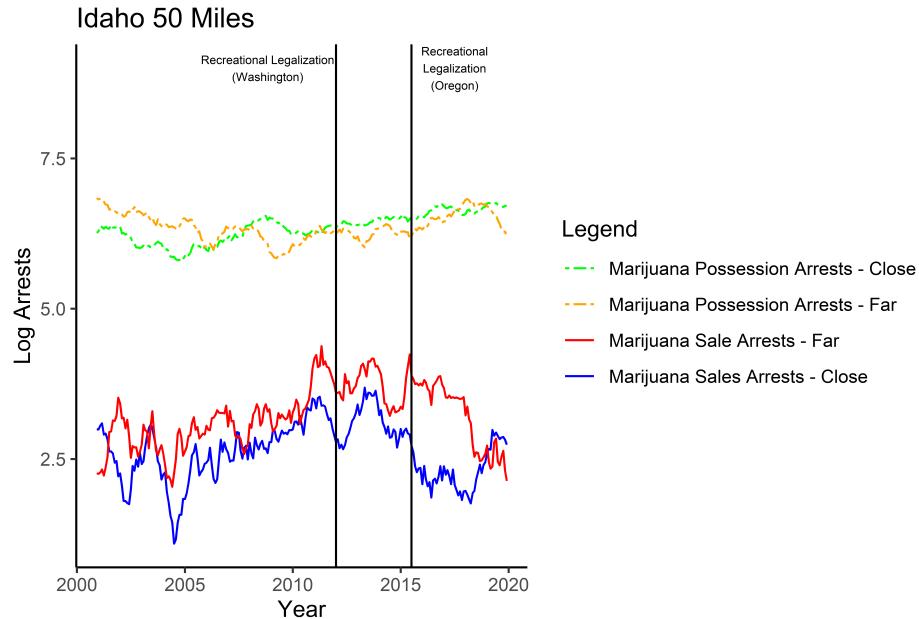


(b)

Figure A4: Pre-Trends for Within-State Difference-in-Difference: Rolling Average of Monthly Drug Arrests in Oregon by Type of Municipality. Source: FBI Uniform Crime Report.



(a)



(b)

Figure A5: Pre-Trends for Border State Difference-in-Difference: Rolling Average Monthly Marijuana Arrests in Idaho by Type of Municipality from 2000 to 2019. Sources: FBI Uniform Crime Report; Nevada Cannabis Compliance Board; Washington State Liquor and Cannabis Board; and Oregon Liquor and Cannabis Commission.

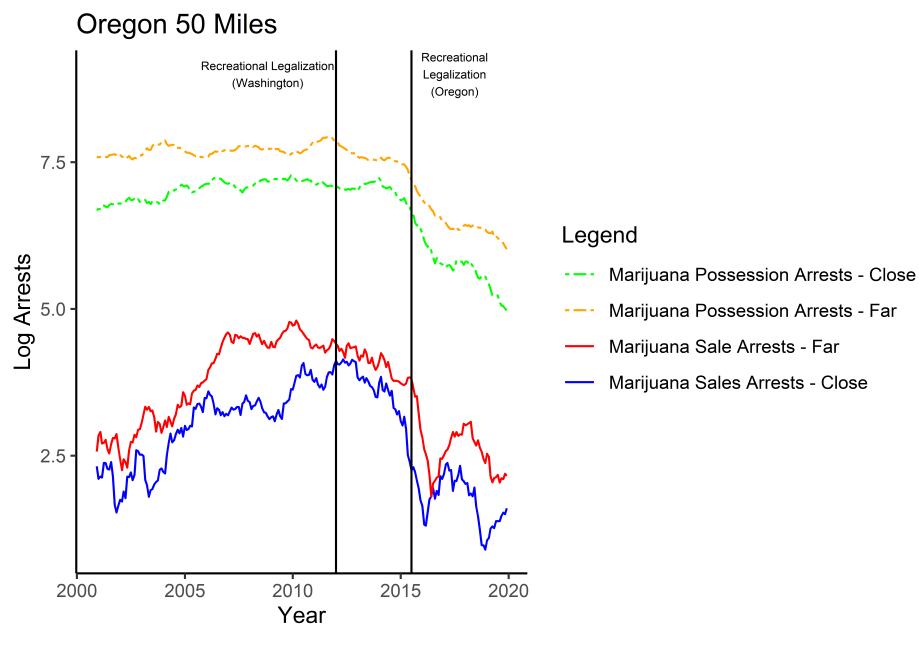
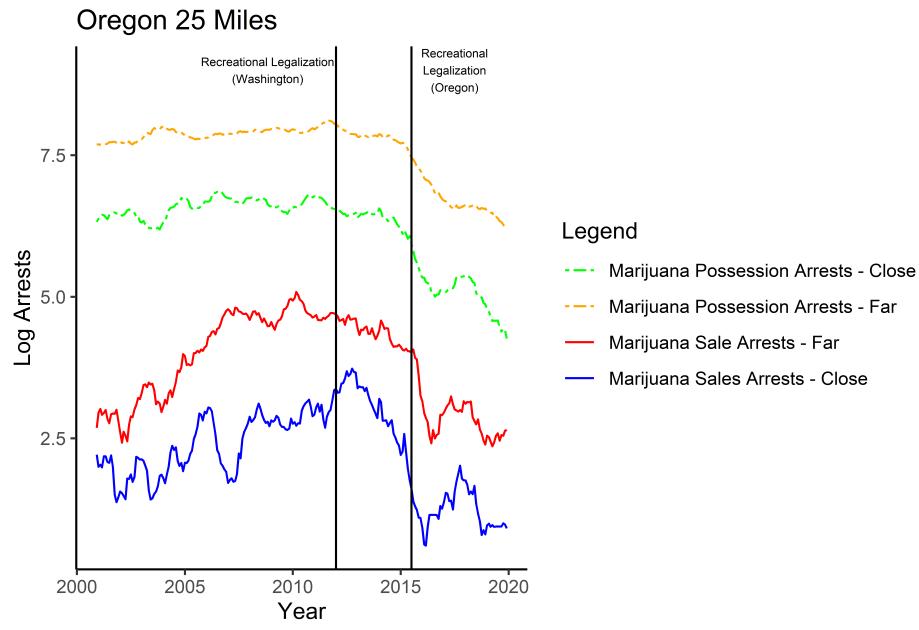


Figure A6: Pre-Trends for Border State Difference-in-Difference: Rolling Average Monthly Marijuana Arrests in Oregon by Type of Municipality from 2000 to 2019. Sources: FBI Uniform Crime Report and Washington State Liquor and Cannabis Board.

Table A1: Effect of Being A Robust Market for Drugs on Arrests Post-Legalization - Pooled

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Sales on Major Heroin Markets	-0.8586** (0.3688)	-1.8633*** (0.4979)	-1.0957*** (0.2619)	-1.7657*** (0.3942)
Possession on Major Heroin Markets	0.0159 (2.5192)	-4.4971* (2.6481)	-2.3645 (2.6227)	-6.5820*** (2.1466)
Possession on Major Cannabis Markets	-7.1872*** (2.4092)	-6.3208** (2.6230)	-7.6500*** (2.2682)	-10.5832*** (2.0728)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in high drug market versus minor drug market municipalities. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. High versus low illegal markets are determined based on whether a municipality exceeds the median for arrests for selling heroin or cocaine or marijuana pre-recreational legalization. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Source: FBI Uniform Crime Report.

Table A2: Effect of Being Within 100 Miles of a Dispensary on Arrests Post-Legalization

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Idaho Sales Arrests Results	0.5035 (0.4220)	0.1991 (0.3800)	0.5094 (0.4208)	0.2388 (0.3777)
Idaho Possession Arrests Results	5.4894* (2.9711)	8.6916** (3.9054)	5.4927* (2.9572)	8.2482** (3.8110)
Oregon Sales Arrests Results	-0.4675** (0.2260)	0.1590 (0.1850)	-0.4630** (0.2253)	0.1603 (0.1837)
Oregon Possession Arrests Results	2.2909 (2.0920)	6.4346* (3.5695)	2.4121 (2.0923)	6.4210* (3.5563)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in municipalities where a marijuana dispensary is within a certain amount of miles. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Sources: FBI Uniform Crime Report; Nevada Cannabis Compliance Board; Washington State Liquor and Cannabis Board; and Oregon Liquor and Cannabis Commission.

Table A3: Effect of Being A Robust Market for Drugs on Officers and Employees Post-Legalization - Washington

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Officers on Major Heroin Markets	-1.2059 (4.0078)	16.7066** (8.0602)	-3.5249 (4.2722)	21.2142** (8.5543)
Employees on Major Heroin Markets	-5.2062 (7.1320)	11.9254 (9.3204)	-11.4406 (7.6270)	13.6461 (9.8107)
Officers on Major Cannabis Markets	-3.5580 (3.6539)	-15.6049* (8.8366)	-2.7618 (3.6231)	-13.0531 (8.5365)
Employees on Major Cannabis Markets	-6.9069 (5.9321)	-19.0185* (9.9102)	-5.0323 (5.7822)	-15.8632 (9.7273)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in police officers and other police staff employed before and after legalization in high drug market versus minor drug market municipalities. The dependent variable here is officers or total staff employed per 100,000 individuals. High versus low illegal markets are determined based on whether a municipality exceeds the median for arrests for selling heroin or cocaine or marijuana pre-recreational legalization. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Source: FBI Uniform Crime Report Arrests and Law Enforcement Officers Killed and Assaulted.

Table A4: Effect of Being A Robust Market for Drugs on Officers and Employees Post-Legalization - Oregon

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Officers on Major Heroin Markets	65.4168 (78.6234)	92.5766 (113.8753)	141.9452 (145.1348)	121.6778 (127.0282)
Employees on Major Heroin Markets	80.9825 (93.9930)	116.8018 (135.1339)	171.9912 (173.8404)	150.2507 (151.4590)
Officers on Major Cannabis Markets	37.0854 (56.5326)	88.7991 (114.8594)	-30.5070 (20.5504)	-153.8810 (142.5874)
Employees on Major Cannabis Markets	48.9393 (67.4220)	115.4674 (136.4321)	-32.7030 (24.1009)	-172.5707 (170.4204)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in police officers and other police staff employed before and after legalization in high drug market versus minor drug market municipalities. The dependent variable here is officers or total staff employed per 100,000 individuals. High versus low illegal markets are determined based on whether a municipality exceeds the median for arrests for selling heroin or cocaine or marijuana pre-recreational legalization. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Source: FBI Uniform Crime Report Arrests and Law Enforcement Officers Killed and Assaulted.

Table A5: Effect of Being Near a Dispensary on Officers and Employees Post-Legalization - Idaho

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Within 25 Miles on Employees	16.8007** (6.7093)	32.1809*** (11.8490)	14.3239** (6.6463)	-9.0916 (36.2144)
Within 25 Miles on Officers	12.7450*** (3.5180)	10.9764 (8.5409)	10.3401** (4.1655)	-26.6146 (35.0869)
Within 50 Miles on Employees	-2.2379 (4.8492)	11.9505 (13.1653)	-5.3717 (5.4816)	-42.0075 (50.6870)
Within 50 Miles on Officers	1.8537 (3.2784)	1.0592 (10.9374)	-1.2581 (4.8721)	-50.2685 (49.8191)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in police officers and other police staff employed before and after legalization in municipalities where a marijuana dispensary is within a certain amount of miles. The dependent variable here is officers or total staff employed per 100,000 individuals. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Sources: FBI Uniform Crime Report Arrests and Law Enforcement Officers Killed and Assaulted; Nevada Cannabis Compliance Board; Washington State Liquor and Cannabis Board; and Oregon Liquor and Cannabis Commission.

Table A6: Effect of Being Near a Dispensary on Officers and Employees Post-Legalization - Oregon

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Within 25 Miles on Employees	31.4030 (30.1482)	94.9808 (86.6850)	29.6007 (29.1562)	94.2414 (84.3886)
Within 25 Miles on Officers	28.4933 (25.3254)	78.5454 (72.5177)	26.8881 (24.4698)	77.7862 (70.5978)
Within 50 Miles on Employees	-33.9476 (25.7957)	-168.6157 (152.1040)	-32.1958 (24.9726)	-162.4345 (149.1384)
Within 50 Miles on Officers	-28.8762 (22.3519)	-142.1802 (127.1703)	-27.3776 (21.5961)	-137.1266 (124.6908)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in police officers and other police staff employed before and after legalization in municipalities where a marijuana dispensary is within a certain amount of miles. The dependent variable here is officers or total staff employed per 100,000 individuals. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Sources: FBI Uniform Crime Report Arrests and Law Enforcement Officers Killed and Assaulted and Washington State Liquor and Cannabis Board.

Table A7: Within-State Results Washington - No Seattle

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Sales on Major Cannabis Markets	-2.5956*** (0.3953)	-4.3794*** (0.6370)	-2.6044*** (0.3667)	-4.1597*** (0.5542)
Possession on Major Cannabis Markets	-6.5601*** (2.0652)	-11.1861*** (2.7568)	-6.2732*** (1.9665)	-10.9318*** (2.4235)
Sales on Major Heroin Markets	-1.3130*** (0.4462)	-2.4396*** (0.6908)	-1.2735** (0.4904)	-2.2372*** (0.6025)
Possession on Major Heroin Markets	-2.6408 (2.2905)	-5.8336** (2.8448)	-4.9943** (2.1957)	-7.9271*** (2.4792)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in high drug market versus minor drug market municipalities. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. High versus low illegal markets are determined based on whether a municipality exceeds the median for arrests for selling heroin or cocaine or marijuana pre-recreational legalization. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Source: FBI Uniform Crime Report.

Table A8: Within-State Results Oregon - No Portland

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Sales on Major Cannabis Markets	-1.2702*** (0.1535)	-1.2169*** (0.1390)	-1.1883*** (0.1530)	-1.0845*** (0.1115)
Possession on Major Cannabis Markets	-2.4648 (3.8384)	2.1324 (5.4505)	-1.5259 (3.7772)	-6.9116* (4.0726)
Sales on Major Heroin Markets	-0.9928*** (0.1795)	-0.6948*** (0.1688)	-0.7956*** (0.1747)	-0.5866*** (0.1400)
Possession on Major Heroin Markets	0.0637 (3.7852)	-3.6076 (5.4434)	-0.5979 (3.5008)	-6.4978 (4.4032)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in high drug market versus minor drug market municipalities. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. High versus low illegal markets are determined based on whether a municipality exceeds the median for arrests for selling heroin or cocaine or marijuana pre-recreational legalization. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Source: FBI Uniform Crime Report.

Table A9: Border Results Oregon - No Portland

	(1) Weighted and Balanced	(2) Balanced	(3) Weighted	(4) Neither
Within 25 Miles on Sales Arrests	-0.0057 (0.2319)	-0.1546 (0.2236)	-0.0021 (0.2143)	-0.1099 (0.1654)
Within 25 Miles on Possession Arrests	-5.8905*** (1.6910)	-4.4108 (2.8387)	-5.0454*** (1.6371)	-1.7754 (2.2830)
Within 50 Miles on Sales Arrests	-0.0083 (0.2603)	0.1530 (0.2653)	-0.0076 (0.2458)	0.0877 (0.1887)
Within 50 Miles on Possession Arrests	-3.6282** (1.8254)	2.1511 (3.0193)	-2.6410 (1.7841)	2.9272 (2.3525)

Note: *** p<0.01, ** p<0.05, * p<0.1. The models above are difference-in-difference models comparing the change in arrests for sale or possession of marijuana before and after legalization in municipalities where a marijuana dispensary is within a certain amount of miles. The dependent variable here is arrests for marijuana sale or possession per 100,000 individuals. Each model includes fixed effects for both the year and municipality. Additionally, weighted and balanced panel models are used, where the model is weighted by population or only municipalities that appear in all months of the time frame are used respectively. Sources: FBI Uniform Crime Report and Washington State Liquor and Cannabis.

Table A10: Washington Major Market Placebo Regressions

	(1)	(2)	(3)	(4)
dui on Major Heroin Markets	0.9860 (4.7921)	-7.7669 (5.7464)	-0.9101 (5.2360)	-8.0190 (5.1112)
agg_assault on Major Heroin Markets	1.7318 (1.6984)	0.1353 (0.8728)	0.3696 (1.6167)	-0.0076 (0.7791)
burglary on Major Heroin Markets	1.3285 (1.2318)	0.8798 (0.9166)	0.5411 (1.2093)	0.6879 (0.8392)
robbery on Major Heroin Markets	-0.2836 (0.6008)	0.0183 (0.2186)	-0.7263 (0.6016)	-0.0854 (0.1955)
heroin_sales on Major Heroin Markets	-1.1847** (0.5818)	-1.8600*** (0.4312)	-1.1099** (0.5181)	-1.5473*** (0.3565)
heroin_poss on Major Heroin Markets	-0.7070 (0.8885)	0.1419 (0.7428)	-0.3451 (0.7965)	0.3836 (0.6208)
dui on Major Cannabis Markets	-8.8410** (3.7135)	-13.8336** (5.6893)	-8.6445** (3.6242)	-15.7667*** (4.9819)
agg_assault on Major Cannabis Markets	-3.8284** (1.5393)	-1.3053 (0.8676)	-4.2290*** (1.5238)	-1.6634** (0.7709)
burglary on Major Cannabis Markets	-2.9312*** (1.1132)	0.3193 (0.9193)	-3.0388*** (1.0829)	-0.2536 (0.8335)
robbery on Major Cannabis Markets	-1.4350*** (0.3977)	-0.1292 (0.2184)	-1.3837*** (0.3928)	-0.1222 (0.1955)
heroin_sales on Major Cannabis Markets	-2.2512*** (0.6156)	-1.0123** (0.4453)	-1.7807*** (0.6056)	-0.8006** (0.3766)
heroin_poss on Major Cannabis Markets	-2.2789* (1.2138)	-0.7182 (0.7399)	-1.2969 (1.1846)	-0.1765 (0.6346)

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report.

Table A11: Oregon Major Market Placebo Regressions

	(1)	(2)	(3)	(4)
dui on Major Heroin Markets	2.5624 (3.2180)	2.5934 (4.3866)	5.7288** (2.7726)	-0.5635 (3.7834)
agg_assault on Major Heroin Markets	-0.9378 (0.7965)	-1.1281 (0.9070)	-0.5646 (0.7821)	-0.9339 (0.8255)
burglary on Major Heroin Markets	2.0969** (1.0435)	1.5320* (0.8870)	0.8910 (0.8817)	0.3859 (0.8722)
robbery on Major Heroin Markets	-0.4221 (0.4684)	-0.4663** (0.2187)	-0.6731* (0.3755)	-0.4474** (0.1912)
heroin_sales on Major Heroin Markets	-0.9453* (0.4798)	-0.2191** (0.1101)	-0.7240 (0.4697)	-0.0957 (0.0892)
heroin_posse on Major Heroin Markets	-4.7806 (4.7886)	0.4713 (1.3041)	-3.5180 (4.2434)	0.7904 (1.0520)
dui on Major Cannabis Markets	-2.1707 (2.7064)	-5.5685 (4.3443)	-1.0871 (3.5513)	-7.6865* (4.0802)
agg_assault on Major Cannabis Markets	0.5650 (0.9734)	0.0748 (0.9080)	0.4298 (1.0262)	0.1875 (0.9037)
burglary on Major Cannabis Markets	0.7588 (0.8901)	-0.8637 (0.8929)	0.9950 (1.3079)	-0.7538 (0.7698)
robbery on Major Cannabis Markets	0.1075 (0.4712)	0.0352 (0.2230)	-0.2015 (0.4703)	-0.0716 (0.1799)
heroin_sales on Major Cannabis Markets	-0.9119* (0.5088)	-0.0417 (0.1119)	-0.8262* (0.4770)	-0.0767 (0.0862)
heroin_posse on Major Cannabis Markets	-5.0487 (5.3577)	2.4237* (1.2786)	-4.1899 (4.7804)	2.1995** (1.0490)

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report.

Table A12: Idaho Border Placebo Regressions

	(1)	(2)	(3)	(4)
dui on within 25 Miles	-1.2520 (5.2791)	-2.4780 (7.3696)	-1.5861 (5.2505)	-0.3969 (6.4422)
agg_assault on within 25 Miles	-0.6064 (1.4238)	-0.3107 (1.5243)	-0.5869 (1.3964)	0.0579 (1.2741)
burglary on within 25 Miles	-1.3718 (0.9847)	0.4847 (2.2332)	-1.4130 (0.9684)	-0.0474 (1.9190)
robbery on within 25 Miles	0.1114 (0.1206)	0.0273 (0.2134)	0.0956 (0.1192)	-0.0665 (0.1965)
heroin_sales on within 25 Miles	0.3830 (0.3059)	0.1187 (0.1661)	0.3707 (0.3009)	0.0944 (0.1416)
heroin_poss on within 25 Miles	1.1236 (1.2987)	1.7622 (1.1935)	1.1323 (1.2813)	1.5326 (1.0167)
dui on within 50 Miles	7.4254* (4.2567)	1.5086 (7.2502)	6.8427 (4.4256)	0.3265 (6.2794)
agg_assault on within 50 Miles	1.0074 (0.9289)	1.4014 (1.2196)	0.9814 (0.9134)	1.2622 (1.0456)
burglary on within 50 Miles	-1.0462 (0.8665)	2.2421 (1.8785)	-1.1190 (0.8530)	0.9436 (1.7855)
robbery on within 50 Miles	0.0510 (0.0903)	0.0836 (0.1763)	0.0402 (0.0925)	-0.0118 (0.1824)
heroin_sales on within 50 Miles	0.1987 (0.1669)	0.0529 (0.1112)	0.2035 (0.1636)	0.0965 (0.1002)
heroin_poss on within 50 Miles	0.1439 (0.8774)	1.1712 (1.2126)	0.1824 (0.8800)	1.0851 (1.0291)

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report.

Table A13: Oregon Border Placebo Regressions

	(1)	(2)	(3)	(4)
dui on within 25 Miles	1.0833 (2.9007)	-3.0614 (4.8811)	1.1788 (2.8807)	-2.8948 (4.8665)
agg_assault on within 25 Miles	-0.9806 (0.6118)	0.7835 (0.7019)	-0.9819 (0.6050)	0.7880 (0.6981)
burglary on within 25 Miles	1.6222*** (0.5672)	0.9580 (0.6953)	1.5602*** (0.5626)	0.9442 (0.6931)
robbery on within 25 Miles	-0.5429 (0.3727)	-0.1534 (0.1721)	-0.5509 (0.3690)	-0.1560 (0.1713)
heroin_sales on within 25 Miles	0.2832 (0.2387)	0.2146 (0.1658)	0.2700 (0.2404)	0.2113 (0.1657)
heroin_poss on within 25 Miles	-7.7110** (3.4238)	-2.0791** (0.9438)	-7.7210** (3.4047)	-2.0908** (0.9405)
dui on within 50 Miles	0.6783 (2.9848)	-0.4976 (4.5211)	0.6031 (2.9887)	-0.3863 (4.4789)
agg_assault on within 50 Miles	-0.7325 (0.6477)	1.2737* (0.7173)	-0.7172 (0.6448)	1.2834* (0.7116)
burglary on within 50 Miles	1.6230** (0.6335)	0.0196 (0.7134)	1.6552*** (0.6301)	0.0719 (0.7075)
robbery on within 50 Miles	-0.4209 (0.4132)	-0.0856 (0.1679)	-0.4077 (0.4137)	-0.0819 (0.1665)
heroin_sales on within 50 Miles	0.1972 (0.2263)	0.0830 (0.1128)	0.2051 (0.2238)	0.0877 (0.1115)
heroin_poss on within 50 Miles	-7.7211** (3.3089)	-2.4502*** (0.8154)	-7.6035** (3.3149)	-2.3839*** (0.8092)

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report.

Table A14: Summary Statistics For Washington Major and Minor Marijuana Markets

	<u>Major</u>		<u>Minor</u>		Difference	T-stat
	Mean	SD	Mean	SD		
Population	16609.87	31099.68	19599.58	63945.25	2989.71***	(6.94)
Number of Officers	207.26	119.78	177.11	112.96	-30.15***	(-30.32)
Number of Employees	244.39	128.85	210.48	142.07	-33.91***	(-29.25)
Marijuana Possession Arrests	17.78	16.79	8.53	9.24	-9.24***	(-80.07)
Marijuana Sale Arrests	3.10	3.77	0.15	0.21	-2.95***	(-130.00)
Heroin Possession Arrests	3.19	3.88	1.55	2.56	-1.64***	(-58.60)
Heroin Sale Arrests	1.32	2.36	0.40	1.18	-0.91***	(-57.50)
<i>N</i>	27696		27108		54804	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A15: Summary Statistics For Washington Major and Minor Heroin Markets

	<u>Major</u>		<u>Minor</u>		Difference	T-stat
	Mean	SD	Mean	SD		
Population	28384.58	67189.68	7569.46	15822.01	-20815.12***	(-50.16)
Number of Officers	182.45	81.81	202.46	144.35	20.01***	(19.91)
Number of Employees	223.22	97.54	232.11	167.23	8.89***	(7.58)
Marijuana Possession Arrests	17.04	16.28	9.28	10.74	-7.77***	(-66.04)
Marijuana Sale Arrests	2.50	3.71	0.77	1.84	-1.73***	(-69.57)
Heroin Possession Arrests	3.84	4.12	0.90	1.24	-2.94***	(-113.44)
Heroin Sale Arrests	1.65	2.47	0.06	0.15	-1.58***	(-106.41)
<i>N</i>	27696		27108		54804	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A16: Summary Statistics For Washington Balanced vs. Unbalanced Panels

	<u>Balanced Panel</u>		<u>Unbalanced Panel</u>	
	Mean	SD	Mean	SD
Population	18142.30	50484.19	18088.69	50135.15
Number of Officers	194.72	116.53	192.35	117.43
Number of Employees	230.75	135.55	227.62	136.60
Marijuana Possession Arrests	13.36	14.43	13.20	14.36
Marijuana Sale Arrests	1.61	3.02	1.65	3.06
Heroin Possession Arrests	2.42	3.42	2.38	3.39
Heroin Sale Arrests	0.87	1.95	0.86	1.93
<i>N</i>	53520		54804	

Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A17: Summary Statistics For Oregon Major and Minor Marijuana Markets

	<u>Major</u> Mean	SD	<u>Minor</u> Mean	SD	Difference	T-stat
Population	25774.24	68766.59	5240.81	9411.24	-20533.43***	(-41.74)
Number of Officers	271.70	3731.46	194.65	284.28	-77.05**	(-2.90)
Number of Employees	331.91	4463.75	231.10	298.55	-100.80**	(-3.18)
Marijuana Possession Arrests	24.89	28.42	9.34	13.17	-15.55***	(-70.04)
Marijuana Sale Arrests	1.05	0.76	0.07	0.11	-0.99***	(-182.15)
Heroin Possession Arrests	3.77	3.62	2.36	3.71	-1.40***	(-38.20)
Heroin Sale Arrests	0.29	0.43	0.04	0.09	-0.25***	(-80.06)
<i>N</i>	19908		19824		39732	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A18: Summary Statistics For Oregon Major and Minor Heroin Markets

	<u>Major</u> Mean	SD	<u>Minor</u> Mean	SD	Difference	T-stat
Population	31179.78	71984.04	2894.31	3468.00	-28285.47***	(-52.30)
Number of Officers	176.97	557.15	278.70	3525.51	101.74***	(4.21)
Number of Employees	225.02	559.14	327.30	4227.44	102.29***	(3.55)
Marijuana Possession Arrests	25.00	28.96	10.78	15.14	-14.22***	(-59.19)
Marijuana Sale Arrests	0.96	0.83	0.24	0.42	-0.73***	(-106.12)
Heroin Possession Arrests	5.13	4.13	1.41	2.28	-3.72***	(-107.48)
Heroin Sale Arrests	0.36	0.43	0.01	0.05	-0.35***	(-107.40)
<i>N</i>	17748		21984		39732	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A19: Summary Statistics For Oregon Close and Far Municipalities - 25 Miles

	<u>Close</u> Mean	SD	<u>Far</u> Mean	SD	Difference	T-stat
Population	29976.82	88990.78	10459.90	22920.44	-19516.92***	(-22.02)
Number of Officers	156.44	64.71	260.21	3078.41	103.78***	(5.78)
Number of Employees	185.05	79.71	315.49	3680.11	130.45***	(6.07)
Marijuana Possession Arrests	13.90	14.17	18.27	25.88	4.37***	(21.25)
Marijuana Sale Arrests	0.44	0.46	0.60	0.80	0.16***	(24.00)
Heroin Possession Arrests	4.26	4.05	2.65	3.52	-1.62***	(-36.06)
Heroin Sale Arrests	0.25	0.44	0.14	0.29	-0.11***	(-24.39)
<i>N</i>	10320		29412		39732	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A20: Summary Statistics For Oregon Close and Far Municipalities - 50 Miles

	<u>Close</u>		<u>Far</u>		Difference	T-stat
	Mean	SD	Mean	SD		
Population	21216.43	70920.62	11367.94	25317.87	-9848.50***	(-17.21)
Number of Officers	310.45	4067.98	176.78	194.76	-133.67***	(-4.25)
Number of Employees	359.09	4864.60	224.92	217.76	-134.17***	(-3.57)
Marijuana Possession Arrests	14.04	15.77	19.40	27.59	5.36***	(24.46)
Marijuana Sale Arrests	0.48	0.51	0.62	0.86	0.15***	(21.13)
Heroin Possession Arrests	3.59	4.23	2.68	3.26	-0.91***	(-23.30)
Heroin Sale Arrests	0.19	0.37	0.15	0.31	-0.04***	(-10.21)
<i>N</i>	16788		22944		39732	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A21: Summary Statistics For Oregon Balanced vs. Unbalanced Panels

	<u>Balanced Panel</u>		<u>Unbalanced Panel</u>		
	Mean	SD	Mean	SD	
Population	15485.07	50563.94	15529.23	50189.24	
Number of Officers	234.85	2669.76	233.26	2649.20	
Number of Employees	283.28	3191.66	281.61	3167.07	
Marijuana Possession Arrests	17.24	23.65	17.13	23.49	
Marijuana Sale Arrests	0.56	0.74	0.56	0.73	
Heroin Possession Arrests	3.08	3.75	3.07	3.73	
Heroin Sale Arrests	0.17	0.34	0.17	0.34	
<i>N</i>	39120		39732		

Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A22: Summary Statistics For Idaho Close and Far Municipalities - 25 Miles

	<u>Close</u>		<u>Far</u>		Difference	T-stat
	Mean	SD	Mean	SD		
Population	11000.81	13602.05	12010.79	29540.06	1009.98**	(3.06)
Number of Officers	165.49	79.28	203.50	178.99	38.01***	(19.36)
Number of Employees	200.92	93.65	233.24	197.44	32.32***	(14.43)
Marijuana Possession Arrests	17.41	30.80	15.22	35.78	-2.19***	(-3.68)
Marijuana Sale Arrests	1.02	6.97	0.99	7.78	-0.04	(-0.29)
Heroin Possession Arrests	1.26	6.38	0.88	7.20	-0.38**	(-3.13)
Heroin Sale Arrests	0.18	1.94	0.14	2.23	-0.04	(-1.06)
<i>N</i>	3456		15744		19200	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A23: Summary Statistics For Idaho Close and Far Municipalities - 50 Miles

	<u>Close</u>		<u>Far</u>		Difference	T-stat
	Mean	SD	Mean	SD		
Population	13383.36	21019.72	10779.19	30882.90	-2604.17***	(-6.95)
Number of Officers	187.72	100.25	202.70	198.47	14.98***	(6.88)
Number of Employees	219.88	115.38	232.51	217.72	12.64***	(5.22)
Marijuana Possession Arrests	19.07	35.73	13.28	34.22	-5.79***	(-11.20)
Marijuana Sale Arrests	0.90	6.32	1.06	8.42	0.16	(1.49)
Heroin Possession Arrests	1.18	7.84	0.79	6.47	-0.39***	(-3.66)
Heroin Sale Arrests	0.12	1.48	0.17	2.54	0.05	(1.73)
<i>N</i>	7740		11460		19200	

Note: *** p<0.01, ** p<0.05, * p<0.1. Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.

Table A24: Summary Statistics For Idaho Balanced vs. Unbalanced Panels

	<u>Balanced Panel</u>		<u>Unbalanced Panel</u>	
	Mean	SD	Mean	SD
Population	14740.79	30695.08	11829.00	27367.53
Number of Officers	204.58	105.34	196.66	166.18
Number of Employees	243.30	129.18	227.42	183.57
Marijuana Possession Arrests	19.17	36.58	15.61	34.95
Marijuana Sale Arrests	1.24	8.43	0.99	7.64
Heroin Possession Arrests	1.20	7.84	0.94	7.06
Heroin Sale Arrests	0.19	2.37	0.15	2.18
<i>N</i>	14640		19200	

Source: FBI Uniform Crime Report and FBI Uniform Crime Report LEOKA.