

# The Cascading Effects of Drug Legalization: Evidence from U.S. Border Counties

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December 2023

## **Abstract**

In this paper, I use the difference-in-difference estimator to determine the causal effects of bordering a state that has legalized either medical or recreational marijuana. I look at three different outcomes: possession of marijuana, hard drugs, and driving under the influence of alcohol (DUI). The outcomes are proxies for marijuana use, hard drug use, and substitution possibilities between alcohol and marijuana. Using a novel dataset and the FBI's UCR panel data from 1990–2020, I find that within non-legal states, counties that border legal states had about 22 additional hard drug possession cases. I found no evidence of an increase in marijuana consumption or a decrease in alcohol consumption.

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\*AQRD writing sample. This is also intended as a writing sample for another purpose, so the format is a little different. Thank you for your understanding; it was nice to learn from you all.

# 1 Introduction

In 1996, California made history as the first state to legalize medical marijuana. By 2012, Colorado and Washington State led the way in recreational marijuana legalization. As of 2023, 38 states and D.C. have adopted medical marijuana laws (MMLs), and 21 states plus D.C. have enacted recreational marijuana laws (RMLs). Advocates for further legalization say it has the potential to mitigate racial disparities in arrests, particularly given that minorities are disproportionately affected by marijuana-related arrests (Edwards and Greytak 2020). Some also argue that the legalization could induce individuals using substances like alcohol to shift their preference towards marijuana (Bachhuber et al. 2014; Powell, Pacula, and Jacobson 2018).

The ongoing discourse on legalization also faces staunch opposition, with the opposing side highlighting the potential dangers to society. Critics argue that legalization may serve as an incentive for non-users to turn to marijuana due to increased accessibility (Groce 2018). A major concern is also that marijuana’s addictive nature could potentially pave the way for the consumption of harder drugs like cocaine, meth, and heroin. Critics additionally express concerns about the spillover effect of medical marijuana laws (MMLs) or recreational marijuana laws (RMLs) into jurisdictions without such laws, potentially exporting some of the associated consequences across borders. For the sake of brevity, I use the term “states with any marijuana law” (AML), “legalized states,” or “states with AMLs” to collectively refer to states that have adopted either RMLs or MMLs.

In this study, I investigate the impact of bordering a state with any marijuana law (AML) after the adoption of AML in that state in order to comprehensively address concerns and assertions from both sides. I look at various outcomes, including direct crimes such as marijuana possession as well as indirect or “consequential” crimes like possession of hard drugs and driving under the influence of alcohol (DUI). The reason being that people in counties that border AML states could easily have access to marijuana by crossing their state border, so they should experience similar effects as though they were in the AML state. Leveraging a novel county-level dataset from 1990 to 2020 from different sources, including the Uniform Crime Reports and the US Census Bureau, I implement a robust difference-in-differences identification strategy. This method carefully controls for county-linear time trends, with standard errors clustered at the county level, thereby mitigating concerns related to county-level confounding. From the standpoint of the supporters, one would anticipate a decline in DUIs due to the suggested “shift” from alcohol to marijuana. Conversely, from the perspective of opponents, an increase in marijuana possession crimes (used as a proxy for marijuana use) and hard drug crimes (used as a proxy for hard drug use) might be expected.

Ultimately, I find that counties bordering states with any marijuana law experienced an increase of approximately 22 possession of hard drugs arrests following the enactment of either of the marijuana laws. I found no conclusive evidence suggesting that bordering a state that has legalized any marijuana law (AML) had any significant impact on marijuana crimes (indicative of marijuana use) or DUIs (shifting from alcohol to marijuana). This research contributes to the growing literature on the spillover effects of recreational and

medical drug legalization. To my knowledge, this is the first study to comprehensively examine the bordering counties of all states that have not legalized any type of marijuana law to investigate potential spillovers. Most studies usually focus on a subset of states at the time.

The rest of the paper proceeds as follows: Section 1.1 summarizes the existing literature on the effects of both medical and recreational marijuana legalization. Section 2 describes the data sources, how the data was constructed, and the variables used in the study. Section 3 shows the identification strategy used and the results found, while Section 4 presents the possible extensions of this study, further limitations, and concluding remarks.

## 1.1 Marijuana Laws, Marijuana and Hard Drug Use, and DUIs

Earlier studies have generally found no link between marijuana use and MMLs. State variation in marijuana use was usually attributed to state-specific usage before any law was passed (Cerdá et al. 2012). More recent studies that account for state and time differences reach conflicting conclusions, with some citing no effect (Lynne-Landsman, Livingston, and Wagenaar 2013), while others find increases (Kelly and Rasul 2014), and decreases (Harper, Strumpf, and Kaufman 2012). There are fewer studies that assess the effect of RMLs on marijuana use, simply because the adoption of RMLs came relatively sometime after the adoption of MMLs. Studies have found that states with RMLs tend to prescribe fewer opioid medications (Wen and Hockenberry 2018) and have fewer deaths involving opioid prescriptions (Shover et al. 2019). Numerous studies do indeed emphasize the correlation between recreational drug legalization and increased usage of harder substances (Olfson et al. 2018; Wong and Lin 2019; Bleyer and Barnes 2018).

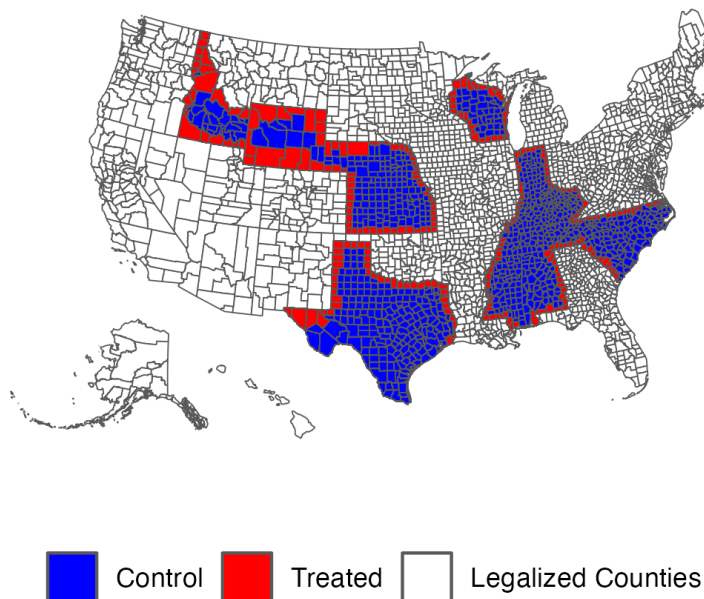
As for the effects on DUIs, literature has largely found a negative association between medical marijuana laws (MMLs) and DUIs (Anderson, Hansen, and Rees 2013; Santaella-Tenorio et al. 2017), though some studies report a significant increase in driving under the influence of marijuana in MML states (see Fink et al. 2020). There is conflicting literature regarding the effects of recreational marijuana laws (RMLs) on dui cases. For example, Lane and Hall (2019) showed that recreational cannabis sales in Colorado and Washington were associated with an increase and then a decrease in traffic fatalities involving alcohol, yet Santaella-Tenorio et al. (2017) reported only a slight increase in traffic fatalities in Colorado, with Washington showing no effect at all. The handful of studies that explored the impact of RMLs on alcohol use mostly found that enacting an RML led to a decrease in binge drinking and a decline in alcohol sales (Dragone et al. 2019; Miller and Seo 2021).

While there is an array of medical studies that examine and consequently find substitution possibilities between alcohol and marijuana use (see Lucas et al. 2020), very few studies examine the switch from alcohol to marijuana as a result of when legalization policies occur. Former alcohol users who use marijuana as a result of policy changes differ from those who would have substituted to marijuana usage regardless of any policy change. Thus, inferences cannot be drawn from studies that do not take policy legalization into account. Studies that look at substitution policies within the context of policy enactment find conflicting results (see Pacula 2022).

Relatively few studies analyze the effect of legalization on neighboring states. Most studies look at the spillover effects of other region-specific policies on surrounding areas, like gun laws (Knight 2013); minimum drinking age laws (Figlio 1995); and cigarette pricing laws (Lovenheim 2008). The paper most similar to mine is by Hao and Cowan (2017), which examined the spillover effects of recreational marijuana legalization in Colorado and Washington on neighboring states using a difference-in-differences estimator. They found an increase in marijuana possession arrests and marijuana usage in counties that border states that have legalized marijuana. They found no impact on DUI or hard drug arrests.

## 2 Data

In order to capture where and when border counties were “exposed” to recreational or medical marijuana laws from their adjacent counties, I constructed a novel dataset using data from the US Census Bureau, public records, and the FBI’s Uniform Crime Reports (UCR). The initial step involved obtaining data on counties that share borders in all 50 states from the US Census Bureau. Subsequently, I refined this dataset to include only counties that share borders with counties in different states. Within this subset, I further identified border counties located next to states that had legalized medical or recreational marijuana. I manually collected data on legalized states and the respective years these laws were enacted, using information available in public records. All non-legal states share a border with a state that has legalized some form of marijuana law. Figure 1 visualizes this. This study exclusively focuses on states where marijuana is not currently legalized. Furthermore, any state that legalized marijuana after the year 2020 is still categorized as non-legalized within the scope of this study.



**Figure 1:** Treated, Control, and Excluded Counties

I then collected data from the FBI’s Uniform Crime Reports (UCR), which tracks the number of different crimes in each state and county from 1974 to 2020. Specifically, I used the total number of arrests for marijuana possession, hard drug possession, and driving under the influence from 1990 to 2020. My first dependent variable of interest is “direct” crimes, like the possession of marijuana cases, which is a proxy for marijuana use. With legalization comes increased access to marijuana, so one can expect possession of marijuana crimes to go down within the state that legalized it<sup>1</sup>. I, on the other hand, look at this variable to determine if the increased access or “use” made its way into counties that have not legalized it. If it did, then one can expect marijuana possession cases to go up within those counties.

My second and third variables of interest are “indirect” crimes, which include hard drug possession, which is a proxy for drug use, and driving under the influence (DUI), which is a proxy for switching to marijuana from alcohol. The rationale here is that with more potential access to marijuana from border counties, a subsequent demand for more addictive drugs (like hard drugs) should follow, thus increasing the possession of hard drug crimes (opposing view). Despite the potential for an alternative scenario, where legalization of marijuana would result in substituting away from illegal hard drugs towards marijuana, the hypothesis of this study leans towards the former perspective. The objective is to examine whether the claims of those opposing further legalization hold true. I use the indirect crime of DUIs to test the claims of those in favor of further legalization. If substitution effects exist between alcohol and marijuana, bordering counties, with easier access to marijuana, should experience fewer DUI cases as individuals would consume more marijuana in place of alcohol.

My independent variable of interest is a dummy variable takes a value of 1 if a county within a non-legalized state shares a border with a state that has legalized either medical or recreational marijuana. If the county in a non-legalized state does not border a legalized state, the dummy variable takes a value of 0. A border county can be under the control group if it does not border a legalized state. If a county borders multiple legalized states, only the state that legalized marijuana earliest is considered. Counties bordering both legalized and non-legalized states are included in the treatment group. For states that have legalized both medical and recreational marijuana, the year selected for the analysis is based on the larger of the two years. For example, if a state adopted medical marijuana laws (MMLs) in 2012 and recreational marijuana laws (RMLs) in 2019, the selected year for analysis is 2019. This is done to capture more of the recreational legalization effect, since RMLs are adopted in the years following an MML adoption.<sup>2</sup> The reasoning for this is that states with RMLs generally provide greater access to marijuana compared to states with MMLs, where a doctor’s prescription is required.

Table 1 shows the descriptive statistics. On average, control counties have 262 arrests for driving under the influence of alcohol arrests, which is significantly higher than treated counties, which had 167 arrests. Interestingly, control counties also had higher possession of marijuana cases, at an average of 125 cases per year, in comparison to treated counties, at

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<sup>1</sup>Even in states where marijuana is legalized, individuals can face arrest for possession or sale. In recreational states, selling without a license is prohibited, and in medical states, possessing marijuana without a doctor’s prescription is illegal.

<sup>2</sup>All states that have legalized recreational adopted medical first

119 per year. Hard drug possession arrests were higher on average in treated counties (120) than in non-treated counties (90). The treatment group comprises 1,301 counties located within states that have not legalized marijuana but are adjacent to a state where either medical or recreational marijuana is legal. Meanwhile, the control group consists of 35,682 counties, which are also in non-legalized states.

**Table 1:** Descriptive Statistics

	Mean	Std. Dev	n
Control			
Driving Under the Influence (Alcohol)	261.95	1,260.43	35,682
Possession of Hard Drugs	90.06	572.84	35,682
Possession of Marijuana	125.23	581.98	35,682
Treatment			
Driving Under the Influence (Alcohol)	167.18	420.09	1,301
Possession of Hard Drugs	120.86	282.56	1,301
Possession of Marijuana	119.44	337.02	1,301

### 3 Empirical Analysis and Results

#### 3.1 Identification Strategy

To distinguish the effect of marijuana legalization from confounding factors, I exploit the within-state variation induced by the fact that 38 states enacted MMLs between 1990 and 2020 and 21 enacted RMLs passed the law during that same time period. More specifically, I used a difference-in-differences research design to ask whether outcomes change more in counties that border legalized states than in counties that do not. My main specification is summarized in the following regression equation:

$$Y_{it}^j = \delta \mathbb{1}(Border_i * AML_t) + \alpha_i + \gamma_t + \lambda_i * t + \epsilon_{it} \quad (1)$$

where  $j$  represents a set of outcomes, including the number of cases of marijuana possession, possession of hard drugs, and driving under the influence of alcohol.  $Y_{it}^j$  is the outcome  $j$  for county  $i$  in year  $t$ .  $\alpha_i$  captures county fixed effects, while  $\gamma_t$  captures year-fixed effects.  $\lambda_i * t$  flexibility controls for county-specific linear time trends whereas  $\epsilon_{it}$  is a stochastic error term. The  $\mathbb{1}(Border_i * AML_t)$  term is an indicator that is equal to 1 when county  $i$  borders a state that adopted any marijuana law (AML) in year  $t$ . It takes the value of 0 otherwise, and  $\delta$  is our variable of interest. If the pre-trends assumption holds, then  $\delta$  captures the average treatment effect on the treated (ATT) of bordering a state with AML. Standard errors are clustered at the county level.

### 3.2 Event Study Design

To ensure that Equation 1 effectively captures the average treatment effect on the treated (ATT), the parallel trends assumption must hold. This assumption suggests that, counties that border other counties which never adopt AML are on the same trend in terms of their DUIs, marijuana offenses, and hard drug offenses, as counties that border other counties which did adopt AML. In essence, this assumption requires that the outcomes in these two groups of counties were comparable before the neighboring state implemented AML. However, it is plausible that even after accounting for county-by-year fixed effects in Equation 1, treated counties may have followed a distinct outcome trajectory compared to the non-treated counties before the bordering state adopted AML. I test this by examining whether trajectories prior to the AML adoption were parallel. To do this, I use the following event-study model:

$$Y_{it}^j = \sum_{k=-5; k \neq -1}^{k=5} \theta_k \mathbb{1}(Border_i * AML_{t+k}) + \alpha_i + \gamma_t + \lambda_i * t + \epsilon_{it} \quad (2)$$

In this model,  $\mathbb{1}(Border_i * AML_{t+k})$  is a series of lags and leads for the years before and after a border state adopts AML. Periods before the legalization are the pre-trends, with the parameters of interest being  $\theta_k$  for  $k < 0$ . If the estimates on those parameters are close to zero, this suggests trajectories in counties that border an AML state were similar to untreated counties prior to when the AML was adopted.

### 3.3 Results

Table 2 shows the results of a difference-in-differences estimate of Equation 1. Columns 1 and 2 look at the direct effect, which is marijuana possession. Column (1) reports a negative coefficient, but when I allow for counties to follow their own trends, as in Column (2), the coefficient becomes positive. This suggests that controlling for county time trends mitigates some omitted variables. Ultimately, I find no evidence of an effect on the possession of marijuana. Columns 3–6 look at the indirect effects, which are possession of hard drugs and driving under the influence arrests. Column (4) shows that when controlling for country-time trends, on average, counties that border AML states had 22 additional possession of hard drug cases. This result is statistically significant at the 0.1 level. Columns 5–6 report positive coefficients with DUI as the dependent variable, though they are not statistically insignificant, and thus I cannot make valid inferences.

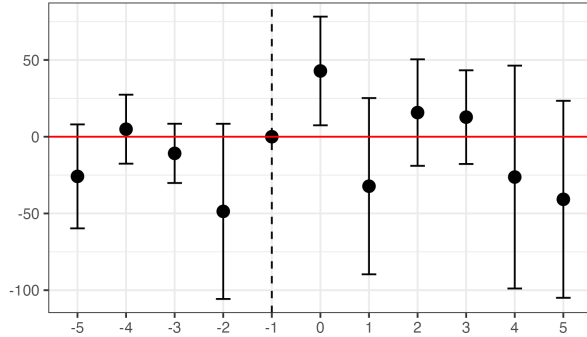
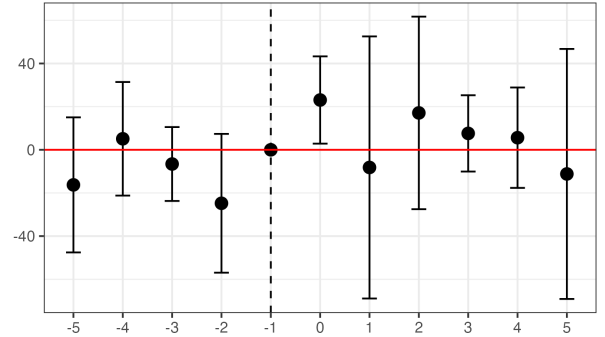
Figure 2, Figure 3, and Figure 4 visualize Equation 2 for our outcomes of interest. The leads in all our models were not statistically different from 0, which means that there’s no evidence that trends in direct or indirect outcomes were different between treated and untreated counties before the bordering state enacted any marijuana law. During the treatment year, there was a statistically significant increase in the possession of marijuana crimes. This may be due to the fact that people in counties that border AML states could easily have access to marijuana by crossing their state border, but the effect is short-lived. Similarly,

**Table 2:** The Direct and Indirect Effects of Bordering an AML State

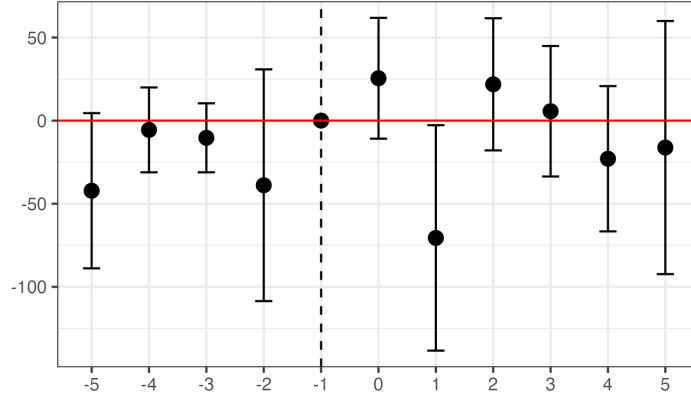
	Marijuana		Hard Drugs		DUIs	
	(1)	(2)	(3)	(4)	(5)	(6)
Border County (AML)	-1.416 (11.052)	25.518 (19.112)	9.858 (11.242)	22.424* (11.783)	10.341 (23.646)	17.610 (17.233)
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
County-Linear Time Trends	No	Yes	No	Yes	No	Yes
R Squared	0.470	0.517	0.514	0.543	0.720	0.801
Observations	36983	36983	36983	36983	36983	36983

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors are in parenthesis

for hard drug possession crimes, Equation 2 estimates a jump on the treatment year and no statistically significant differences in the years after. There is a statistically significant decrease in DUI cases for border counties in the year after it was treated, which falls in line with the theory that people substitute marijuana for alcohol, which consequently leads to a decrease in DUIs. Again, this effect seems to be temporary.

**Figure 2:** Marijuana**Figure 3:** Hard Drugs





**Figure 4: DUIs**

## 4 Conclusion

In this study, I investigated the impact of bordering a state that has legalized recreational or medical marijuana within states that did not adopt any form of marijuana law (AML). Within non-legalized states, I used counties that directly border AML states as my treatment group and counties that do not border a state with AML as my control group. Using a difference-in-differences design, I found that counties that border AML states had an increase in the total number of hard drug crimes by 22 cases. I found no evidence of an effect on possession of marijuana or DUI cases.

To my knowledge, this is the first study to estimate the effect of both recreational and medical marijuana within a state on the counties closest to them using within-state variation of when the laws were passed. Furthermore, the existing literature is prone to bias from confounding trends at the county level. In my approach, I use county-by-year fixed effects to flexibly control for unobserved time-varying effects that differ by county to eliminate bias. This study also uses all non-legalized states and spans a longer period of time than past studies.

There are, however, limits to my study design. First, the outcome data lists arrests by county and not individual; thus, there is the possibility of repeat offenders and double counting, which could lead to overestimated results. I do not include control variables because of a lack of data availability, but it's possible that controlling for population or other covariates could decrease or increase my magnitude. This paper also ignores the fact that police in counties that border legalized states may be more or less active in making marijuana-related arrests after the law is passed because they anticipate a higher level of marijuana in circulation. Thus, I recommend future studies account for this by including additional controls. Further analysis may also look at various forms of treatment, i.e., non-AML counties that border only recreational states or counties within states that have legalized medical marijuana that border states that have legalized recreational marijuana.

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