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Federal Reserve Bank of Kansas City

Economic Benefits and Social Costs of Legalizing Recreational Marijuana

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Abstract

We analyze the effects of legalizing marijuana for recreational use on state economic and social outcomes using difference-in-differences estimation robust to staggered timing and heterogeneity of treatment. We find moderate economic gains accompanied by some social costs. Post-legalization, average state income per capita grew by 3 percent, house prices by 6 percent, and population by 2 percent. However, substance use disorders, chronic homelessness, and arrests increased by 17, 35, and 13 percent, respectively. Early legalizing states experienced larger economic gains yet similar social costs, implying a potential first-mover advantage.

Keywords: marijuana, legalization, economic growth, social costs

JEL Classification Numbers: H71, I18, R52

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1 Introduction

Twenty-four states and the District of Columbia have passed legislation to legalize the use of marijuana for recreational purposes. The potential economic benefits of recreational legalization include additional tax revenue and job creation resulting from the establishment of a new regulated industry and the indirect effects of goods and services demanded by the industry which could spur further economic growth (Krane, 2020). At the same time, legalization may also have economic and social costs. On the social side, legalization may lead to an increase in the number of heavy marijuana users, an increase in self-reported dependence, and knock-on effects such as rising homelessness and crime. These social costs could potentially lead to economic costs as well, including lower labor force participation and worker productivity (Anderson and Rees, 2023).

While thirty-nine states and the District of Columbia have already legalized marijuana for medical use, legalization of marijuana for recreational use likely creates the conditions for the broadest set of effects on both the local economy and its constituents. Recreational markets broaden marijuana access to the entire adult population of the state, eliminating barriers such as criminilization and obtaining a medical license in some cases, and thus increase the extent and scope of potential benefits and costs. It also has the potential to increase marijuana sales to a greater degree, leading to more businesses and jobs than in a purely medical market. Moreover, tax revenue collections are likely to be more substantial as tax rates are typically much higher for recreational sales compared to medical sales (Felix and Shampine, 2022).[1]

Most research on marijuana legalization has studied the potential benefits and costs separately, considered a limited number of states, or primarily focused on outcomes from medical marijuana legalization. A main reason for the lack of a comprehensive analysis of legalization is that quantifying the potential benefits and costs of legalization is challenging due to

[1] Every state that has legalized recreational marijuana thus far, legalized medical marijuana beforehand. However, this paper abstracts from the timing of the decision to legalize medical marijuana and focuses on the effect of legalizing recreational marijuana without distinguishing its incremental effect.

data limitations and small sample sizes. In particular, the availability of data directly linked to the marijuana industry varies considerably across states due in part to the non-federal nature of the industry. In addition, much of the data on social costs relies on self-reported outcomes or data that is difficult to link directly to legalization such as homelessness and crime. Nevertheless, a few studies have examined different effects of marijuana legalization in recent years. One body of research focuses on the possible economic benefits of legalization, including its effect on state tax revenues, employment levels, labor force participation, net migration, and workers' compensation benefits (Miller and Seo, 2018; Zambiasi and Stillman, 2020; Chakraborty et al., 2021; Abouk et al., 2021), while a separate field of research investigates the potential social costs of legalization in the form of increased substance abuse among young people; use of opioids, alcohol and tobacco; suicide; traffic fatalities; workplace health; and crime (Anderson and Rees, 2023). Given the significant increase in the number of states that have legalized recreational use over the past decade, this paper fills a gap in the literature by considering both a large array of potential benefits and costs using state-level data from every U.S. state.

We investigate the impact of recreational marijuana legalization on a large set of social and economic outcomes using state-level data from multiple publicly available sources and a difference-in-differences estimator robust to staggered timing of treatment and heterogeneity in treatment developed by Callaway and Sant'Anna (2021). While previous research has focused on evaluating the impact of legalization on one given outcome at a time or for limited geographies, our paper investigates a more comprehensive set of both potential social costs and economic benefits of legalization. We provide an empirical assessment of a broad range of first-order state-level impacts on communities and their economies post-legalization using all legalization events to date. However, our analysis does not provide a comprehensive cost-benefit analysis of recreational marijuana legalization – such an analysis would need to investigate a much larger set of potential benefits and social costs that are presently unobservable or unmeasurable, and take into account potential behavioral responses to legalization

such as moral hazard and adverse selection.

We find moderate and significant increases for some measures of social costs as well as economic benefits. Post-legalization, self-reported marijuana usage increased by 28 percent, while substance use disorders also increased significantly. Although overall crime rates did not significantly change, arrest rates for both violent and property crimes rose, suggesting a potential increase in law enforcement activity. Moreover, chronic homelessness, though just outside of statistical significance, increased by 35 percent, consistent with frequent anecdotes from residents and policymakers in states with legalized marijuana.

On the economic side, we find, unsurprisingly, that tax collections related directly to marijuana sales increased, but tax collections from alcohol and tobacco sales declined following legalization. On net, we do not find a significant effect on overall tax revenues or general sales tax revenues. However, average state income per capita rose 3 percent, driven mainly by increases in proprietors' income. In addition, population growth picked up and housing prices increased more in states allowing recreational marijuana.

Our analysis further suggests that there are significant first-mover advantages in terms of the potential benefits that a state experiences from legalizing marijuana for recreational purposes, while the magnitude and significance of potential costs that result from it seem to be more uniform regardless of timing of legalization. We find that Colorado and Washington, the first states who legalized marijuana for recreational use in 2012, collected larger tax revenues from marijuana sales and experienced a significant increase in GDP, population, job creation, and house prices. At the same time, the estimated impact of legalization on potential social costs such as substance use disorders, crime, and homelessness, were not considerably different for states that legalized earlier or later.

Although some of our estimates are noisy, our results suggest that economic benefits of recreational legalization are relatively modest but are widely distributed. At the same time, costs are more likely to accrue to heavy-user individuals and are not easily found in aggregate state-level data. Widely distributed benefits versus more concentrated costs indicate that

policymakers should be cautious in discounting the existence of potential costs of recreational legalization. In addition, states which recently legalized recreational use or are considering it may likely experience more muted potential benefits relative to the first-mover states, but still have to deal with higher social costs of increased marijuana usage.

2 Background on Legalization and Pathways of Economic Effects

2.1 Legalization timeline

Historically, the legality of cannabis has evolved over time in the United States. In the late 1800s, industrial hemp was a common crop grown predominantly in Kentucky (United States Census Bureau, 1913). However, opposition to the plant grew in the early 1910s as individual states slowly began to ban cannabis, and the federal government put restrictions on the plant through the Uniform State Narcotic Drug Act in 1935 and the Marihuana Tax Act of 1937 (Drug Enforcement Administration, 2023). With the exception of a brief campaign in the early 1940s to boost hemp production to create goods needed for World War II efforts, cannabis remained heavily restricted until it was made federally illegal in 1970 (Hudak, 2018; Johnson et al., 2013).

Despite being illegal at the federal level, many states have taken independent actions regarding the use of marijuana. California became the first state to legalize medical marijuana in 1996, with several other states following during the first decade of 21st century (National Conference of State Legislatures, 2020). However, starting in 2009, the U.S. Department of Justice changed its enforcement policies by issuing guidance to defer marijuana regulation and enforcement to states that had legalized medical marijuana, which helped establish confidence in the industry's sustainability (Stout and Moore, 2009). A few years later, Colorado and Washington became the first states to legalize recreational marijuana.

Since then, states have been adopting legislation to create legal marijuana markets at a rapid pace. As of the end of 2023, 39 states and the District of Columbia have legalized medical marijuana, with 24 of those states and the District of Columbia also passing legislation to legalize recreational marijuana (MJBizDaily, 2022; Ballotpedia, n.d.). The timeline between voter or legislative approval and the opening of recreational retail stores varies considerably across states, ranging from less than three months in Arizona to four years in Maine. On average, states have taken about 16 months to open stores (Ward, 2022). In addition to the 40 states that have legalized some form of marijuana, several other states have decriminalized the first-time possession of small quantities of marijuana or legalized the limited sale and use of low-THC CBD oil, a non-psychoactive product from the cannabis plant often used for medical purposes.

Legalization looks poised to expand more broadly in the coming years as efforts are currently underway in many states to introduce ballot initiatives related to medical and recreational marijuana legalization. More than two-thirds of Americans support legalizing marijuana, up from just 50% a decade ago, and polling suggests that the majority of constituents support marijuana legalization in every U.S. state (Gallup, 2021).

2.2 Pathways of Economic Effects

The primary pathways for marijuana legalization to affect the economy are through the consumption channel, additional tax revenue, and externalities of marijuana consumption, most of which have social implications. Foundational work by Becker et al. (2006) considers the role of enforcement effort by government on the production and consumption of illegal drugs. They focus on goods with negative externalities for which a prohibition or a tax is a potential way of reducing consumption. In their model, prohibition operates through raising the costs of suppliers which either increases the market price or raises the full cost of the drug to consumers. Similarly, Jacobi and Sovinsky (2016) investigate the idea that legalizing marijuana reduces search costs to consumers and removes the stigma associated

with illegal consumption. The implication of this previous work, as well as Jacobson (2004), is that legalization increases consumption by lowering costs to suppliers and consumers mainly because they no longer risk the same legal punishment. The decrease in costs leads to lower prices, which in turn induces higher consumption of marijuana. However, since demand is likely inelastic - lower prices can lead to a decrease in spending on the intensive margin but an increase in total spend on the extensive margin if more people begin consuming marijuana post-legalization.[2]

State governments may have different objectives in legalizing recreational marijuana that range from maximizing tax revenue to increasing tax revenue but also limiting negative externalities that may come from increased marijuana consumption. Legalization creates a new source of revenue through taxation, primarily through bringing previously untaxed consumption in the illegal market to the legal market. The use of taxes can regulate the increase in marijuana consumption post-legalization and hence limiting the negative externalities associated with increased use of marijuana.[3] We discuss these potential negative externalities that are viewed as social costs of legalization as well as the broader economic effects through the consumption channel in the sections below. The pathways we discuss are informed by previous research and guide our decisions about what outcomes to focus on in our empirical assessment of how states are affected by legalizing recreational marijuana.

Social Implications

The legalization of recreational marijuana has the potential to create numerous social costs that could create challenges for state and local governments and their constituents. Many public officials have emphasized issues related to legalization's effect on public health, homelessness, and crime, among others, and these areas have been the focus of most of the prior

[2] Jacobson (2004) predict that legalizing recreational marijuana would increase its use by around 48 percent. Consistent with this model prediction, Auriol et al. (2023) note that recreational legalization in Colorado and Oregon diverted consumers from the black market but increased consumption of marijuana by almost 60 percent.

[3] Becker et al. (2006) show that policies attempting to regulate drug use via taxes are more efficient than quantity reductions through prohibition.

academic research.

The most direct effect of marijuana legalization is the resulting greater ease of obtaining marijuana and therefore the possible increase in usage. In turn, marijuana usage could impact the usage of other drugs, including alcohol and tobacco, and substance use disorders. In a comprehensive review of the literature, Anderson and Rees (2023) report that most academic research has not found evidence that marijuana legalization increases teen usage, while several studies find substitution away from alcohol and tobacco post-legalization of medical marijuana (Anderson et al., 2013; Dragone et al., 2019; Miller and Seo, 2018). Most studies examining public health outcomes related to marijuana legalization have focused on the effects of medical marijuana legalization, while fewer studies have looked at recreational legalization. One persistent challenge in examining marijuana usage is the reliance on self-reported data which could be impacted by both actual usage and the willingness of individuals to accurately report their usage. While legalization may increase individual's willingness to report usage, it likely also increases actual usage by creating easier access to the product.

Some public officials have also noted concerns over increasing homeless populations, stemming either from substance abuse, in-migration among homeless individuals interested in using marijuana, or rising housing prices. For example, Colorado experienced an 8 percent increase in homelessness between 2013 and 2016 although it is an open debate about whether this rise was due to marijuana legalization (Hesse, 2017). Sanderson (2022) provides some evidence that recreational marijuana legalization increases homelessness, particularly for early adopting states, and that these effects may compound as more years pass post-legalization. In earlier work but in the setting of more and more states legalizing gambling over time, Grinols and Mustard (2006) found the entrance of new casinos led to an increase in crime that built up over time attributed to gambling addicts.

As marijuana usage rises, it may also impact labor market outcomes such as labor force participation, labor productivity, or workplace injuries. Research in this area has been

limited and finds contrasting results. Abouk et al. (2021) find that states that legalized marijuana for recreational purposes saw declines in worker compensation claims, non-traumatic workplace injury rates, and the incidence of work-limiting disabilities. Others have found increases in work hours among older adults already working, especially those with a health condition that would qualify for legal medical marijuana use (Nicholas and Maclean, 2019). Combined with reduced workers-compensation claims, the improvement in work capacity is interpreted as likely due to access to an additional form of pain management therapy. In contrast to these general findings, Maclean et al. (2021) find an increase in social security disability post-legalization of recreational marijuana.

With the potential increase in marijuana usage and the new prevalence of a largely cash-dependent industry, many researchers and industry opponents have looked at the effects of marijuana legalization on crime. Researchers in this area have generally relied on either leveraging the legalization of marijuana as a well-defined natural experiment or used the spatial and temporal variation from openings and closings of marijuana dispensaries (Anderson and Rees, 2023). Several studies have found a negative association between crime rates of various kinds and medical or recreational legalization (Chu and Townsend, 2019; Brinkman and Mok-Lamme, 2019; Dragone et al., 2019). Most studies have focused their research on the effects of medical legalization and have generally considered one state or one metropolitan area within a state when looking at the effect of legalization on crime.

Economic Implications

In addition to the potential social costs, the legalization of recreational marijuana can have numerous economic implications for states and their constituents including raising tax revenues; generating economic activity including new businesses, jobs, and income; and potentially altering migration patterns and demand for real estate.

One of the most direct effects of legalizing recreational marijuana is new legal sales of marijuana. Most states impose relatively heavy tax rates on the recreational marijuana

industry, which suggests that legalization not only widens the overall tax base but also generates more substantial tax collections for state and local governments. State tax collections from the recreational marijuana industry totaled more than $3.7 billion in 2021, not including licensing and permitting fees or local taxes (Figure 1). Tax rates and schedules vary considerably across states, with some taxing sales at the wholesale level, retail level, or both, and others imposing tax based on product weights. For example, Washington imposes a 37% retail tax on marijuana sales in addition to the standard 6.5% state retail tax and local taxes. By contrast, Michigan imposes just a 10% retail tax on marijuana in addition to the state sales tax of 6% (Marijuana Policy Project, 2022).

These additional tax collections create higher levels of government spending, which can increase the economy's demand for goods and services. Many states earmark at least a portion of marijuana-related tax revenues for special projects such as education, public health, community services, and law enforcement. However, some states also allocate a portion of these revenues toward the general fund, which can be used more broadly. In addition, marijuana sales generate revenue and spending for many local governments.

In addition to generating tax revenue, the launch of newly legal marijuana sales, requires a surge in hiring and new establishments as companies open retail stores, cultivation facilities, and edible manufacturing plants. Leafly, a marijuana industry advocate and retailer, estimates that direct employment in the marijuana industry has grown from less than 125,000 workers in 2017 to over 425,000 in 2022 due to the expansion of legalization in more states and rising employment in existing states where the industry continues to expand (Barcott and Whitney, 2022) (Figure 2). While this still makes up less than 0.3% of total U.S. employment, the industry did make up more than 4% of total employment growth between 2017 and 2022.

As new jobs and their associated wages are created in the marijuana industry, this can lead to broader gains in other industries as this newly generated income and tax revenues are spent. For example, Chakraborty et al. (2021) found a 4.5 percent increase in the overall

number of employees in any Colorado industry after recreational dispensaries were legalized, with effects concentrated in manufacturing and services. In addition, the legalization of recreational marijuana may lead to stronger marijuana-related tourism activity, particularly in early-adopting states, which could boost consumer spending and jobs in the services sector. For example, researchers found that recreational marijuana legalization increased hotel occupancy in both Colorado and Washington post-legalization (Meehan et al., 2020).

More robust labor demand, new sources of income, and personal viewpoints on legalization can also affect people's desire to live in an area, potentially impacting both migration and the demand for housing. Zambiasi and Stillman (2020) provide evidence that recreational legalization can be viewed as a local amenity due to a significant increase in in-migration but no significant change in out-migration post-legalization by analyzing the effects of recreational legalization on migration in Colorado. Cheng et al. (2018) also use Colorado as a test case for looking at legalization's effect on housing prices. Their paper compares municipalities in Colorado that legalized recreational dispensaries and find an average 6 percent increase in housing values caused by the rise in housing demand in those areas. Conklin et al. (2020) and Burkhardt and Flyr (2019) find that housing prices increased by around 8% more in areas located near a recreational dispensary. In addition, 23% of realtors in states where recreational marijuana was legalized before 2016 reported that housing inventories had tightened due to all-cash purchases (Yun et al., 2020).

3 Empirical Strategy and Data

3.1 Identification

Legalization of marijuana for different uses evolved gradually over time and in a staggered fashion between states. Table 1 provides a timeline of states' marijuana policies by showing the year in which marijuana was legalized for medical use, medical sales, recreational use, and recreational retail sales for each state, with blank cells indicating that no such

legalization happened in the state. Two points are worth noting from the table. First, marijuana legalization evolved gradually within state, where it was approved for medical use first, followed by authorization of retail sales for medical users, and only then authorized for recreational use and retail. Second, states legalized marijuana use in a staggered fashion. For our study, Table 1 shows that while states such as Colorado and Washington legalized marijuana for recreational purposes as early as 2013, other states, such as Delaware, Maryland, and Missouri, legalized recreational marijuana only recently in 2023.

We estimate the effects of recreational marijuana legalization using a difference-in-differences (DID) framework using the staggered timing of the year of legalization:

$$y_{it} = \alpha_i + \gamma_t + \beta M_{it} + X_{it}\delta + \varepsilon_{it} \tag{1}$$

where y_{it} is the outcome of interest for state i in year t, M_{it} indicates whether marijuana in state i in year t is legal for recreational use, X_{it} is a set of time-varying state controls, α_i and γ_t are state and time fixed-effects, respectively, and ε_{it} is the residual. The coefficient β estimates the impact of recreational marijuana legalization on the state outcome.

As can be inferred from Table 1, treated states have two different legalization states: legalization with and without retail sales. On the other hand, control states have three different legalization states: no legalization at all, and medical use legalization with and without retail sales. Our estimates compare the average outcomes of states with different levels of legalization to states that did not legalize marijuana for recreational purposes. The identification assumption of the model we are estimating is that in the absence of recreational legalization, states that have legalized would be on the same trend as states that did not legalize marijuana for recreational purposes.

Recent work has called into question the common practice of estimating β by employing state and time fixed-effects in staggered difference-in-differences models – the two-way fixed effects (TWFE) implementation (Goodman-Bacon, 2021). TWFE is most problematic when the treatment effect emerges gradually over the sample period and when there is substantial

heterogeneity in the treatment effect. Since both of these features are likely to occur in our setting, we employ a recently developed difference-in-differences estimator by Callaway and Sant'Anna (2021) that is designed to accurately estimate treatment effects from the difference-in-differences framework in the presence of these conditions.

The underlying intuition for why the TWFE implementation is problematic is that TWFE's estimation of β is based partly on comparisons of late-treated states to early treated states. These early-treated states are not valid controls for late-treated states because those states contain part of the treatment effect itself. Depending on heterogeneity in the treatment effect and its post treatment dynamics, this aspect of TWFE can either lead to a positive or negative bias in the estimated coefficient. The Callaway and Sant'Anna (2021) estimator avoids this issue by constructing group-time treatment effects based on a 2x2 comparisons (i.e., before versus after treatment, control versus treated) that are not implicated by this critique. These group-time fixed effects are then the building blocks for constructing the overall average treatment effect, as well as for estimating how the treatment evolves dynamically using an event study framework. In each case, these aggregates are weighted averages of the group-time fixed effects with the appropriate weights described in Callaway and Sant'Anna (2021).

Table 2 describes the treated and non-treated states in our analysis in detail. Overall, 24 different states and the District of Columbia have legalized marijuana for recreational use (treated states) while 26 states did not (never-treated states). However, only 11 states and DC among treated states have legalized marijuana for recreational use by 2020, and the other 13 states have legalized it post 2020. Since our analysis uses data up to 2021, we consider the 13 late-treated states as not yet treated and use them as control states to construct the counterfactual for the treated states in the case of no legalization.[4]

Table 2 and Figure 3a present the staggered fashion in which states legalized marijuana for recreational use. Overall, there are 9 different treatment cohorts grouped by year of

[4] In Appendix A, we check the robustness of our findings by using only never-treated states as controls and by adding a set of time-varying state level control variables.

legalization, ranging from 2013 to 2023. A treatment cohort can contain one state (2018, 2019, 2020, and 2022), two states (2013), three states (2015), four states (2017), five states (2023) and seven states (2021). Figure 3a highlights the treated states versus the not-yet-treated states in our sample by showing the number of states in each legalization cohort for treated states in blue bars, while showing the number of states in the not-yet-treated cohorts in our data in red bars. Panel B of Figure 3a shows the cumulative number of treated states, which is 12 by 2020 and 23 by 2023.

In addition to estimating an overall average treatment effect for treated states, the Callaway and Sant'Anna (2021) method allows us to compute event-study type estimators that allows us to test for pre-trends and to learn about treatment dynamics. An important feature of these event-study type estimators is that the staggered adoption of treatment implies that different states would contribute to different event-studies based on their timing of treatment. Table 3 shows the contribution of treatment cohorts to event-study estimators by showing the minimum and maximum pre- and post-treatment period for which a 2x2 treatment effect can be estimated relative to the control states. For example, we can estimate an event-study coefficients for each period from 12 years pre-treatment to 8 years post-treatment for the 2013 treatment cohort. However, as treatment year increases, the possible pre-treatment event study coefficient becomes larger while the post-treatment coefficient becomes smaller. For example, for the 2015 treatment cohort, pre-treatment event-study coefficients can be estimated up to 14 years pre-treatment, while post-treatment event-study coefficients can be estimated only up to 6 years after treatment. This implies that the 2013 treatment cohort does not contribute to the -13 and -14 pre-treatment event-study coefficients, while the 2015 treatment cohort does not contribute to the +7 and +8 post-treatment event-study coefficients. Hence, the composition of states that generate different event-study coefficients does not remain constant over time due to the staggered adoption of policies, and Table 3 shows which states contribute to which coefficients.

3.2 Data

We construct panel data that follows states over time in their marijuana legalization status and a large collection of outcomes related to marijuana use, use of other substances such as tobacco, alcohol, and illicit substances, state tax revenues, residential real estate prices, homelessness, crime, labor market participation and earnings, and state GDP. Table B.1 provides a detailed overview of the data sources, outcomes and measures we construct using them, and the time period covered by each data source. In this section, we summarize the data sources and key outcomes used in our analysis.

Marijuana Legalization Status. We use data compiled and verified by the RAND Corporation as part of their Opioid Tools and Information Center Resources (RAND-OPTIC). This dataset provides a comprehensive list of dates of cannabis policies at the state level from 1990 to 2019, and we extended it manually through 2023. The data allows the identification of legalization for medical and recreational purposes and retail sales of medical and recreational cannabis. In our sample, from 2000 to 2020, 12 states have legalized marijuana use for recreational purposes, with the first states legalizing in 2013 (Colorado and Washington), and more states legalizing in the following years. We focus on legalization for recreational use as the treatment time instead of retail sales of marijuana for recreational purposes since retail sales are very likely to follow legalization, but many states still oppose legalization for recreational purposes altogether.

Marijuana and Other Substances Use Rates. Our research draws on data from the National Survey on Drug Use and Health (NSDUH), which is managed by the Substance Abuse and Mental Health Services Administration (SAMHSA). This survey provides valuable insights into a range of health-related issues, including use rates of cannabis, tobacco, alcohol, drug use, and mental health. Specifically, we are analyzing publicly available state estimates of substance use among the general adult population for marijuana, alcohol, tobacco, and other illicit substances. This data spans from 2002/3 to 2018/9 and 2021, with the exception

of 2020 due to the COVID-19 pandemic. To estimate values for that year by state, we are utilizing linear interpolation.

Public Health Measures. We collect several state-level public health measures on homelessness, traffic accident fatalities, drug related deaths, substance abuse treatment admissions, and hospitalizations. Data on homelessness comes from the United States Department of Housing and Urban Development (HUD) Point-in-Time (PIT) annual homeless count for each year between 2007 and 2020 and provides us with state-level estimates of the overall, sheltered, and unsheltered homeless population. We use data on traffic accident fatality rates per 100 million vehicle miles traveled from 2000 to 2020 using state-level data from the National Highway Traffic Safety Administration (NHTSA). We obtain hospitalizations and drug-related deaths from the Center for Disease Control and Prevention (CDC) for 2000 to 2020. Data on substance abuse treatment admissions at the state-level is obtained using the Treatment Episode Data Set: Admissions (TEDS-A) collected by the Substance Abuse and Mental Health Services Administration (SAMHSA).

Arrests and Crime. State-level crime and arrest information were taken from the Federal Bureau of Investigation's Crime Data Explorer, which produces annual figures on various categories of crime and arrests.[5] We normalize the number of crimes and arrests by 100,000 population to make the incidence of each comparable across states. We separate overall crime and arrests into violent, property, and 'other' categories.

State Tax Revenues. We collect data on state tax revenues from different sources using the Annual Survey of State and Local Government Finances. We focus on 2000-2020 and look at overall, income, sales, tobacco, and alcohol tax revenues. In addition, we use the Marijuana Policy Project (MPP) and state department of revenues reports data on cannabis tax revenues in states that regulated cannabis for adult use using to get a measure of direct increase in tax revenues from legalization (Marijuana Policy Project, 2022).

Economic Activity, Labor Market, and Business Dynamics. We use state-level

[5] Available at: https://cde.ucr.cjis.gov/

data on gross domestic product, income per capita, wages per capita, and proprietors' income per capita as our measures of overall economic activity using publicly available data from the Bureau of Economic Analysis (BEA). We supplement these measures with two traditional labor market measures: labor force participation rate and unemployment rate. To get an idea of the impact of legalization on the growth of the cannabis industry and its labor demand, we use the universe of online job postings using the Lightcast database of online job postings to measure the number of online job postings in a state that contain cannabis-related keywords in them (i.e., cannabis, marijuana). Last, we use the Census Business Dynamics Statistics (BDS) to gather data on the creation of new businesses and jobs at the state-level in order to learn about the impact of legalization on business dynamics.

Residential Real Estate. Analysis of residential real estate prices is conducted utilizing data from Zillow's Home Value Index (ZHVI), a meticulously crafted and seasonally adjusted measure of the typical home value and market changes in each state. The ZHVI is a reflection of the typical value for homes in the 35th to 65th percentile range, offering a comprehensive view of the residential real estate market. The research involved tracking this measure for most states from the year 2000 to 2020, ensuring that the data is both reliable and up-to-date.

Population, Migration and Demographic Data. We use data from the Current Population Survey (CPS) to measure state annual population and log population for population growth. Our state-level data on in- and out-migration rates come from the American Community Survey (ACS) 1-year estimates of the population who moved between states from 2005 through 2019. The CPS and Census Bureau data are used to account for demographic composition, and economic conditions (unemployment rate, median household income). We use these measures as controls in robustness checks of our main findings.

4 Estimated Effects of Recreational Legalization

4.1 Marijuana and Other Substances Use

Recreational legalization of marijuana significantly increases the self-reported use of marijuana. Column 1 of Table 4 presents the overall average treatment effect of post-legalization on the rate of adults reporting using marijuana in the previous month from estimating equation (1) via the Callaway and Sant'Anna (2021) estimator. The estimated coefficient is a significant 2.2 percentage points increase in the use rate, suggesting a 28 percent increase relative to the mean rate under no legalization (column 2), implying that legalization increases use in the past month rate by 28 percent relative to baseline mean (column 3). The treatment effect on marijuana use in the past year is similar. Panels a-c of Figure 4 show additional results that indicate that legalization increases the use of marijuana. It shows event study estimates of the average treatment effects for the outcomes of use in the past month rate (panel a), use in the past year rate (panel b), and first-time use in the past year rate (panel c). The event-study estimates are consistent with no significant effect in the years prior to legalization and a substantial increase in the rates in the years following legalization.

The increase in the use of marijuana because of legalization may have an indirect effect on the use of other substances. Panel B of Table 4 presents the estimates of the average treatment effect of legalization on the use of other substances except for marijuana. The findings suggest that legalization has no effect on adults using alcohol and tobacco and a non-significant positive effect on using illicit substances other than marijuana.

One potential effect of increased use of marijuana due to legalization might be substance use disorder. Heavy users of cannabis might become addicted, or the use of cannabis can be a gateway for the use of other more addictive illicit substances. The last row of Panel B in Table 4 shows that the rate of adults reporting substance use disorder in the past year increases by a statistically significant one percentage point post-legalization on average, indicating a 17

percent increase relative to the mean rate under no legalization. Panel d of Figure 4 shows the event study estimates for the effect of marijuana legalization on substance user disorder rate. It suggests that while the rate increases post-legalization, it becomes larger and more significant over time, consistent with a channel in which legalization introduces cannabis to consumers, which serves as a gateway to use of more addictive illicit substances.

Another concern from the legalization of marijuana is increased usage of marijuana by youth. Panel C of Table 4 presents the estimates of the average treatment effect of legalization on the use rate of marijuana among youth age 12 to 17 years old. While the estimates are positive, they are not statistically significant and are an order of magnitude smaller compared to the estimated effects among adults reported in Panel A. Thus, the data suggests that marijuana use rates among youth does not increase significantly as a result of legalization.

A possible concern with self-reported drug use surveys is under-reporting. Moreover, the under-reporting of marijuana usage may change over time and in states that have legalized recreational use compared to states that have not. Some studies in public health suggests that under-reporting may only be around 5 percent (Le et al., 2022). Others studies have found high levels of agreement between self-reported survey data and biological tests, concluding that self-reported survey data are valid for use in research (Bharat et al., 2023). While we cannot know the level of under-reporting, our baseline specification makes the assumption that no such under-reporting exists. We then relax this assumption by considering various levels of under-reporting and make the assumption that once a state legalizes recreational use the under-reporting goes to zero. Table B.2 in the appendix shows that marijuana usage remains higher and statistically significant compared to states that have not legalized up to 10 percent under-reporting in the data.

4.2 Public Health and Crime

Legalization of marijuana for recreational purposes can lead to undesired public health outcomes such as substance abuse related mortality, homelessness, traffic accident fatalities, and

crime. Increased substance use disorders, like the one in Table 4, might increase these various public health related measures. Table 5 shows the effect of legalization on a selection of public health outcomes. Panel A shows the estimated effects on homelessness, which we hypothesize might increase through increased addiction and substance use disorders that result from legalization. We first find that the effect of legalization on overall homelessness rate is negative, implying that legalization reduces homelessness by 9 percent relative to the mean rate under no legalization. However, the effect is statistically insignificant. Rows 2-4 look at different sub-populations of the overall homeless population. Row 2 suggests that most of the estimated reduction in homelessness comes from a reduction in sheltered homelessness: individuals who reside in emergency shelters or temporary housing programs. In contrast, the estimates for street homelessness is positive. In addition, row 4 shows that legalization positively affects the chronic homeless rate, that is, homeless individuals with a disability or substance abuse problem, with legalization increasing it by as much as 35 percent relative to the mean rate under no legalization (although not significant). An important caveat with these estimates is that they are all statistically insignificant. Panel A of Figure 5 shows the event study estimates of the effect of legalization on the chronic homelessness rate, and we can see that the effect is positive and increasing over time.

Panel B of Table 5 presents the estimates of the effect of legalization on traffic accident fatality rates. While the estimate is positive, it is insignificant. However, it implies a 4% increase in fatalities as a result of legalization. Panel C of Figure 5 shows the event study estimates of the effect of legalization on the traffic accident fatality rate, and we can see that it is increasing in magnitude over time and even turning significant towards the end of the event-study, suggesting that as use rates increase, the likelihoods of traffic accident fatalities and hence fatalities that result from DUI are increasing. Next, we examine whether legalization has an impact on drug-related mortality (panel C of Table 5), substance abuse treatment (panel D of Table 5), and hospitalizations (panel E of Table 5). All of our estimates are statistically insignificant, suggesting that there is no strong correlation between

legalization and these public health measures at the state-level. Interestingly, the estimates are mostly negative, suggesting drug-related deaths, substance abuse treatment admissions, and hospitalizations tend to decline following legalization. Panel D of Figure 5 presents the event study estimates for hospitalizations and shows that lower hospitalizations are only significant in years 4 and 5 following legalization.

Table 6 shows the effect of recreational marijuana legalization on crime and arrests. Panel A shows the effects of legalization on overall crime, violent crimes, and property crimes (in rates). All the estimates are statistically insignificant but are positive for overall crime and property crime rates, while they are negative for the violent crimes rate. Panel A of Figure 6 shows the event study estimates of the effect of legalization on the overall crime rate, and we can see that the effect is positive and increasing over time, although noisy.

Panel B of Table 6 reports the effect of legalization on the rate of arrests, total and by type. The estimate for overall arrests shows that legalization significantly increases total arrests by 465 arrests per capita per year, a 12.8 percent increase relative to the mean arrest rate under no legalization. The second and third rows of Panel B show that legalization increased both violent and property crime related arrests by 18 and 15 percent relative to the meant arrest rate under no legalization, both estimates being statistically significant at the 1 percent level.

The results in Panel B of Table 6 suggest that a large increase in arrests occurred in offenses that are not related to violent or property crimes. To examine that result further, Panel C of Table 6 examines the impact of legalization on arrests that are not related to violent or property crimes. We find that legalization reduces drug-related arrests and marijuana possession arrests, consistent with the legalization of cannabis for recreational purposes. On the other hand, we find that legalization increases DUI and disorderly conduct offenses. Finally, we note that the majority of the increase in arrests were in non-violent and non-property related crimes, suggesting that police activity has increased following legalization. The event studies on marijuana possession and DUI arrests can be seen in panels C and D

of Figure 6.

At first observation, it seems puzzling why we find no significant effect of legalization on crime yet substantial effects on arrests. One potential explanation is that legalization increases law enforcement efforts. This explanation seems likely for two reasons. First, marijuana legalization critics often claim that it could lead to increase in crime, so policymakers might address their concerns by putting more emphasis on law enforcement following legalization. Second, many states allocate a significant portion of their cannabis tax revenues to law enforcement agencies, increasing their budgets and hence their efforts, which are proxied by the number of arrests they make.[6]

4.3 Tax Revenue

The legalization of marijuana for recreational purposes does not seem to generate substantial tax revenues yet. We collected data on sales tax revenues and tax revenues on legal substitutes for marijuana, such as alcohol and tobacco. Panel A of Table 7 presents the estimated effects on tax revenues per capita. Rows 1-2 show that legalization had a small and insignificant impact on total tax and sales tax revenue. Rows 3-6 break down sales tax revenues to different categories. We find that legalization leads to reductions in tax revenues from potential legal substitutes such as tobacco and alcohol in the order of $5 per capita combined, representing a 7 percent decrease relative to mean revenue under no legalization. Panel B of Table 7 examines the impact of legalization on cannabis sales and tax revenues. We find that legalization generates an average increase in sales of $98 per capita per year and a $19.3 average increase in tax revenue from cannabis sales per capita per year, which is significant but not large enough to affect the overall state's tax revenues.

Figure 7 shows event study estimates of legalization on sales tax revenue per capita (panel A) and the tobacco sales tax revenue per capita (panel B). Consistent with the result from Table 7, we see that the effect of legalization on sales tax revenue is positive and increases

[6] https://www.mpp.org/issues/legalization/cannabis-tax-revenue-states-regulate-cannabis-adult-use/

over time, yet it is not statistically significant. For tobacco, we find that legalization reduces tobacco tax revenues over time, with the effect turning negative two years after legalization and significant four years after, suggesting that substitution between marijuana and tobacco might be gradual and that the increased revenue from marijuana tax might be offset by reductions in revenue from tobacco.

Figure 8 shows event study estimates of legalization on marijuana sales and tax revenue per capita. Consistent with the result from Table 7, we see that the effect of legalization on overall sales and tax revenue is positive and increases significantly over time. In particular, we estimate a $150 per capita increase in sales and a corresponding $30 per capita increase in tax revenues 4-years post legalization, and these effects grow to more than $250 and $70 increases in sales and tax revenues per capita 7 years after legalization, respectively.

We investigated whether the decrease in estimated tax revenues from alcohol and tobacco is substantial relative to the increased tax revenues from sales of marijuana products. Using cannabis tax revenue data in states that legalized it for adult use, we find that cannabis tax revenue per capita in the years following legalization was, on average, $19 per capita per year. Our estimates for the reductions in alcohol and tobacco tax revenues suggest a $5 reduction (-$2 alcohol, -$3 tobacco) in tax revenue per capita per year. Combining our estimates with the implied increase in tax revenue from cannabis sales suggests a "net" increase in tax revenue from cannabis of approximately $14 per capita per year, implying that after accounting for substitution between alcohol and tobacco and cannabis, legalization generates a modest increase in tax revenues.[7]

4.4 Economy, Labor Market, and Business Dynamics

Legalization of marijuana for recreational purposes might lead to economic growth due to the introduction of a new industry which can create more jobs and establishments translating

[7] Cannabis tax revenue data in states that legalized cannabis for adult use was obtained from the following website: https://www.mpp.org/issues/legalization/cannabis-tax-revenue-states-regulate-cannabis-adult-use/

into increases in personal income and overall output. Row 1 of Table 8 shows the effect of the legalization of the log of GDP per capita, and Panel a of Figure 9 shows the event study estimates. Both results suggest that legalization positively affects the state's GDP, with the coefficient in Table 8 indicating a 1.2 percent increase. However, this effect is not statistically significant. The event study estimates suggest that the effect can increase over time, although that result is driven mostly by the early treatment cohorts.

Rows 2-4 of Table 8 show the average treatment effect estimates of legalization on personal income per capita. The estimate in column 2 shows that legalization increases personal income per capita (in logs) by 2.6 percent, and columns 3 and 4 show that this increase is driven mainly by proprietors' income and not wages. Panel b of Figure 9 shows the event study estimates of legalization on income per capita (in logs) and suggests that this effect increases over time, consistent with the marijuana and cannabis industry growing over time after legalization.

Panel B of Table 8 examines the effect of recreational marijuana legalization on two labor market outcomes. Row 5 shows that legalization has a positive impact on labor force participation, however, the estimated coefficient is very small (0.15) compared to the dependent mean under no legalization (65.63). Similarly, the estimate in row 6 shows a positive yet small and insignificant impact of legalization on the state's unemployment rate. In addition, the estimate in row 7 shows that legalization increases the number of cannabis-related job postings online by 37 percent, but this effect is not significant. Overall, legalization seems to impact employment positively, yet this effect does not seem to be strong or large enough to impact the aggregate state level statistics.

Panel C of Table 8 examines the impact of recreational marijuana legalization on business dynamics. The table shows that legalization increases establishment creation (row 1) and decreases establishment exit rate (row 2). However, the estimated magnitudes are small, and the effects are insignificant. Rows 3-5 of Table 8 show the average treatment effect estimates of legalization on job creation and destruction. The estimates in row 3 (job creation rate) and

5 (net job creation rate) are marginally significant and positive, suggesting that legalization creates new jobs. Specifically, the estimate indicates that legalization increases the net creation rate by 0.49, or a 63 percent increase relative to the mean job creation rate under no legalization. Panel D of Figure 9 shows the event study estimates of legalization on job creation rate and suggests that this effect is concentrated in the first year of legalization and decreases in magnitude as time from legalization increases, and then increases again in years 7 and 8 after legalization, driven by the 2013 treatment cohort.

4.5 Housing Prices

The marijuana industry is known to be a largely cash industry. Many residents, especially where the industry has a visible presence, believe that the large amount of cash encourages companies to invest in real estate via all-cash purchases. Such a dynamic may place additional upward pressure on prices, especially in areas with a tight supply of homes. It is not obvious how this dynamic may play out at the state-level and whether higher house prices as a result of legalization is a "benefit" or "cost". From a general equilibrium perspective, if legalization positively impacts house prices, it suggest that it is considered desirable by residents since its positive impacts outweigh its negative impacts. The opposite is true if legalization has a negative effect on house prices. Panel A of Table 9 shows the estimates of the effect of legalization on house prices, measured using Zillow's Home Value Index (ZHVI). Row 1 shows that legalization increases the median house price in the state by 6.4 percent, and this effect is similar in both low- and high-tiered houses (rows 2 and 3, respectively). The estimates are all significant. Panel A of Figure 10 shows the event study estimates of legalization on the median home value index and suggests that this effect increases over time and significantly large for the 7 and 8 years after legalization, which correspond to the 2013 treatment cohort. Overall, these results suggest that legalization is conceived as a positive amenity increasing property values and is consistent with the findings of Zambiasi and Stillman (2020) in Colorado.

4.6 Population Growth and Domestic Migration

Another way to examine whether legalization of marijuana for recreational use is a desired amenity in aggregate is to examine its impact on population growth and domestic migration. If large groups of individuals value the legal use of marijuana for recreational purposes, some might decide it is worthwhile for them to move to a state that legalized. In addition, the new business opportunities offered by the introduction of a new industry might attract entrepreneurs from other places who are interested in starting a business in that industry. On the other hand, it is also possible that individuals would view the legalization as a dis-amenity that would cause some to leave the state altogether. It is not obvious a priori how this dynamic may play out at the state-level and whether population change as a result of legalization is a "benefit" or "cost".

Panel B of Table 9 shows the estimates of the effect of legalization on log total state population and on in- and out-migration rates. We first find that legalization increases a state's population by 1.65 percent on average. This effect is primarily driven by a lower out-migration rate, although insignificant. This suggests that legalization increases the state's population growth rate where one channel is that fewer residents decide to move out of the state following legalization, suggesting many individuals consider legalization to be an amenity. Panel B of Figure 10 shows the event study estimates of legalization on the log state's population and suggests that this effect increases over time and is again significantly large for the 7 and 8 years after legalization, which correspond to the 2013 treatment cohort. Overall, these results are consistent with the increased house prices, as more population translates into a higher demand for housing.

4.7 Robustness

In the appendix of the paper we report results of robustness checks to our main specification. The first robustness check adds additional time-varying controls to the differences-in-differences estimation. Our event study figures suggest that the parallel trends assumption

holds over the nearly two decades of pre-treatment. However, adding additional controls allows us to condition our estimates further. We add to our base specification state population shares for non-Hispanic whites, males, and three age groups (18-24, 25-64, and 65 and older year olds), state unemployment rate, median household income, and beer and cigarette tax rates. Our results remain quantitatively similar. However, the control variables are omitted from our preferred specification because they could also be responding endogenously to legalization.

A second robustness check we consider is the possibility of spatial interactions and spillovers from neighboring states depending upon legalization status. Activity, particularly marijuana recreational sales might change when a neighboring state legalizes. However, activity along the state border is likely more impacted than in the interior of the state (Hansen et al., 2020). We control for this by using a spatial lag of recreational legalization status of neighboring states, where we define a "neighbor" as sharing a border. We consider two specifications of the spatial lags, where one measures the effect of any neighboring state having legalization status and the other measures the share of neighboring states with legalization status. In both cases, the neighboring status changes over time as more states legalize in our sample. The third and fourth columns of Tables B.3-B.8 show that controlling for neighboring states' legalization status yields similar results, where most coefficients are only slightly smaller or larger. Across all of the outcomes, none of the coefficients controlling for spatial spillovers from legalization status are significantly different from the baseline specification.

We also consider the robustness of our control sample criteria using three different specifications. In our baseline specification, never-treated and not-yet-treated states where used as controls. As a robustness check, we first only use never-treated (no recreational legalization) as the set of possible control states. The results in the 5th column of the tables are nearly unchanged with the stricter control criteria of never-treated. This finding is also supported by unreported results of the Goodman-Bacon decomposition, which showed 80-90 percent of our identification in the treatment effects across outcomes come from differences in treated

versus never-treated states. We then consider the effects of only using states that legalized medical marijuana (6th column) and states that neither legalized medical or recreational usage as possible control states (7th column). Results across Tables B.3-B.8 show that the additional changes to the control sample generate similar results as our baseline specification. In some instances under the restriction of no legalization of any kind, statistical precision diminishes due to the smaller sample size of fewer possible control states.

5 Heterogeneous Effects by Year of Legalization

The effects on potential costs and benefits of legalization might vary across states and especially by the timing of legalization. For example, it is possible that recreational legalization generates substantial first-mover advantages with states who legalize earlier experiencing larger effects, e.g., Colorado and Washington. This could be true for both costs and benefits. The first states to legalize recreational marijuana would have been more likely to receive "cannabis tourism" from other states. Such tourism is estimated to be responsible for around 18 percent of total cannabis revenue.[8] The increased activity from cannabis tourism would aid in potentially faster development of the industry and therefore generate more economic output. At the same time, it might also attract heavier users of marijuana who wish to reside in a state where recreational use is legal, bringing with it higher potential costs of substance abuse, crime, and homelessness. However, as subsequent states legalize the effects may be smaller compared to early treated states as people would have more options at their disposal.

To examine whether there are heterogeneous treatment effects by timing of legalization, we estimate the average treatment on the treated effects as suggested by Callaway and Sant'Anna (2021) for different treatment cohorts according to their year of legalization. As can be seen in Table 2, there are nine treatment cohorts or years in which states legalized

[8] https://www.forbes.com/sites/willyakowicz/2022/05/29/cannabis-tourism-is-now-a-17-billion-industry-and-its-just-taking-off/

marijuana for recreational use. In this study, we focus on the pre-2020 cohorts due to data constraints, estimating cohort-specific treatment effects for the 2013, 2015, 2017, 2018, 2019, and 2020 treatment cohorts. The number of states in each treatment cohort ranges from one to four.

Table 10 presents a summary of the main findings of our heterogeneous treatment effects by treatment cohort. We divide the findings into costs in panel A and benefits in panel B. Rows 1 and 2 show that marijuana use in the past month and first time use of marijuana in the last year both increase significantly across treatment cohorts. For example, the rate of marijuana use in the past month increased by 3, 2.7, and 1.7 percentage points for the 2013, 2015, and 2020 treatment cohorts, respectively.

Besides marijuana use, we looked at heterogeneous effects of marijuana legalization by treatment cohort for substance use disorder rate, overall crime rate, overall arrests rate, chronic homelessness rate, traffic accident fatality rates, and substance abuse treatment admissions rate for marijuana. The estimated treatment effects for the first three are similar across cohorts. The noteworthy exception is the 2020 cohort, which includes the state of Illinois, which experienced a drop in substance use and crime rate. It is worth noting that only one post-treatment period estimate is available for this cohort, which might make it noisy. Next, we see that the estimated increase on chronic homelessness was 2 to 4 times larger for the 2013 cohorts compared to the other cohorts, suggesting that cumulative treatment effects might be contributing to exacerbating homelessness problem in the early treated states. We find mixed results on traffic accident fatalities, with the 2013, 2019, and 2020 having a significant increase, while the 2015, 2017, and 2018 actually experiencing a decline. Finally, we note that substance abuse treatment admissions for the 2013 cohort increase considerably compared to the rest of the cohorts, and note that Colorado and Washington, the 2013 cohort states, have allocated a significant amount of the cannabis tax revenue to substance abuse treatment compared to other states that legalized marijuana for recreational purposes, which might be one reason for the large impact this cohort has relative

to the rest of the cohorts.

Panel B of Table 10 examines various potential benefits from legalization. The first outcome we consider is cannabis sales tax revenue per capita. We find that the 2013 cohort gained $60 per capita per year from this tax source, compared an average of around $15 per capita per year in later treated cohorts. The estimated effect on overall sales tax revenue is also positive and an order of magnitude larger for the 2013 cohort, although insignificant, while it is negative for all cohorts but 2017 cohort, for which the estimated impact on sales tax revenue is small and insignificant. Next, we look at state's GDP per capita and income per capita. We find positive and significant effect for the 2013 cohorts, while much smaller or even negative effects for later treated cohorts. For example, GDP per capita increased by 5.25 percent for the 2013 cohort, by 2.3 percent for the 2017 cohort, and declined for the other cohorts. We also find a considerably sizable effect on net job creation rate and house prices compared to the later treatment cohorts. Finally, we find a significant and large positive impact of legalization on population size for the 2013 cohort, while this effect is smaller and insignificant for the 2015 and 2017 cohorts, and negative and significant for the 2018-2020 cohorts, suggesting that fewer people consider legalization an amenity or are willing to move states because of it once more states are legalizing marijuana for recreational use.

The cohort-specific treatment effects from Table 10 are hard to compare because of the different number of years that each cohort had experienced treatment. To address this problem, we estimate cohort-specific treatment effects for a given number of post-treatment periods and compare them to the overall average treatment effects for the same number of post-treatment periods. Figure 11 plots ratios of cohort specific 3-year cumulative average treatment effects (ATT) to the full sample 3-year cumulative ATT for a set of selected outcomes. Each horizontal row has three ratios, corresponding to the three treatment cohorts in our analysis for which we can estimate 3-year cumulative treatment effects (2013, 2015, and 2017). We list the outcomes related to social costs of legalization in the top and outcomes

related to economic benefits at the bottom of the figure. Large circles indicate that a ratio is statistically different from one, while small circles indicate that it is not. In addition, a circle with a black outline indicates that the cohort specific 3-year treatment effect is statistically different from zero. We note that the estimated effects on various social costs measures are not consistently different across treatment cohorts and hence not statistically different from the overall estimated treatment effect. In contrast, the estimates for various economic benefits measures are consistently larger than one for the 2013 treatment cohort (although only two are statistically different from one), while the estimates for the rest of the cohorts are generally smaller than one and insignificant, suggesting that later-treated states had considerably smaller benefits compared to the first treatment cohort of 2013.[9]

Overall, our findings suggest that there are significant first-mover advantages in terms of the potential benefits that states experienced from legalizing marijuana for recreational purposes, while the magnitude and significance of potential costs that result from it seem to be more uniform regardless of timing of legalization. The policy implications of our findings are that states which recently legalized recreational use or are considering it may likely experience more muted potential benefits relative to Colorado and Washington, but still have to deal with higher social costs of increased marijuana usage.

6 Conclusion

Even as more and more states take steps toward legalizing marijuana for recreational use, the public debate over the potential costs and benefits of legalization continues. Opponents often point to the potential social costs of increased substance abuse, with the idea that marijuana may be a gateway drug to more addictive and harmful substances. With widespread usage, an additional concern is that workers may become more detached from the labor force or that other social costs, such as increased crime or homelessness, will occur. Conversely,

[9] We also show similar patterns when examining the 1-year and 2-year treatment effects in A.1 and A.2, respectively.

proponents tout the economic gains of a new industry that emerges following legalization, along with the additional tax revenue collected by states from marijuana sales. One view is that legalization offers an amenity that is desired, and therefore, will act as a traditional demand shock.

Previous research has often attempted to isolate one specific channel of these costs or benefits for a limited number of states. Relative to the existing literature, we undertake a more holistic analysis of legalization's potential costs and benefits considering a large set (although not comprehensive) of potential costs and benefits. On the potential cost side, we look at changes to marijuana usage, substance abuse disorder, labor force participation, crime, homelessness, traffic accident fatalities, drug overdose deaths, and hospitalizations. Concerning possible benefits, we consider changes in GDP and income per capita, tax revenue, establishment entry, job creation rates, housing prices, and population. We select states which legalized recreational usage as our designation of treatment. Our state-level analysis covers the period from 2000 to 2020.

Utilizing a difference-in-differences strategy robust to staggered timing of treatment and heterogeneity in treatment, we find that self-reported marijuana usage increased by 28 percent. Moreover, substance use disorders and arrests increased by 17 and 13 percent, and chronic homelessness increased by 35 percent, though not significant. The increase in arrests, however, occurred without significant increases in crime possibly due to more funding to public safety from marijuana tax revenue. On the economic benefit side, we find an average increase in state income per capita of 3 percent, driven mainly by increases in proprietors' income. Recreational legalization appears to have an amenity effect as states that legalized experienced higher housing price (6 percent) and population (2 percent) growth.

Overall, our results suggest that the distribution of economic benefits of recreational legalization are likely shared more widely compared to the costs. Widely distributed benefits versus more concentrated costs indicate that policymakers should be cautious in discounting the existence of potential costs of recreational legalization. While we do not undertake

a formal benefit-cost analysis of recreational legalization, the size of economic benefits we estimate could be used to approximate the amount of funding that could be set aside for social programs that would help offset the costs. For example, we find a 3 percent increase in income per capita post-legalization. Using this and sample averages, $1,400 per capita would correspond to potential costs that would offset the estimated benefits in our study.

One important finding is that the estimated economic benefits appear larger for states who legalized earlier, suggesting a first-mover advantage. States that legalized later had smaller estimated benefits in our analysis perhaps due to it being less novel or less of a perceived amenity or actual demand shock from "marijuana tourism" compared to the first states that legalized recreational use. At the same time, our estimates of social costs are more similar for cohorts of states that legalized earlier versus later.

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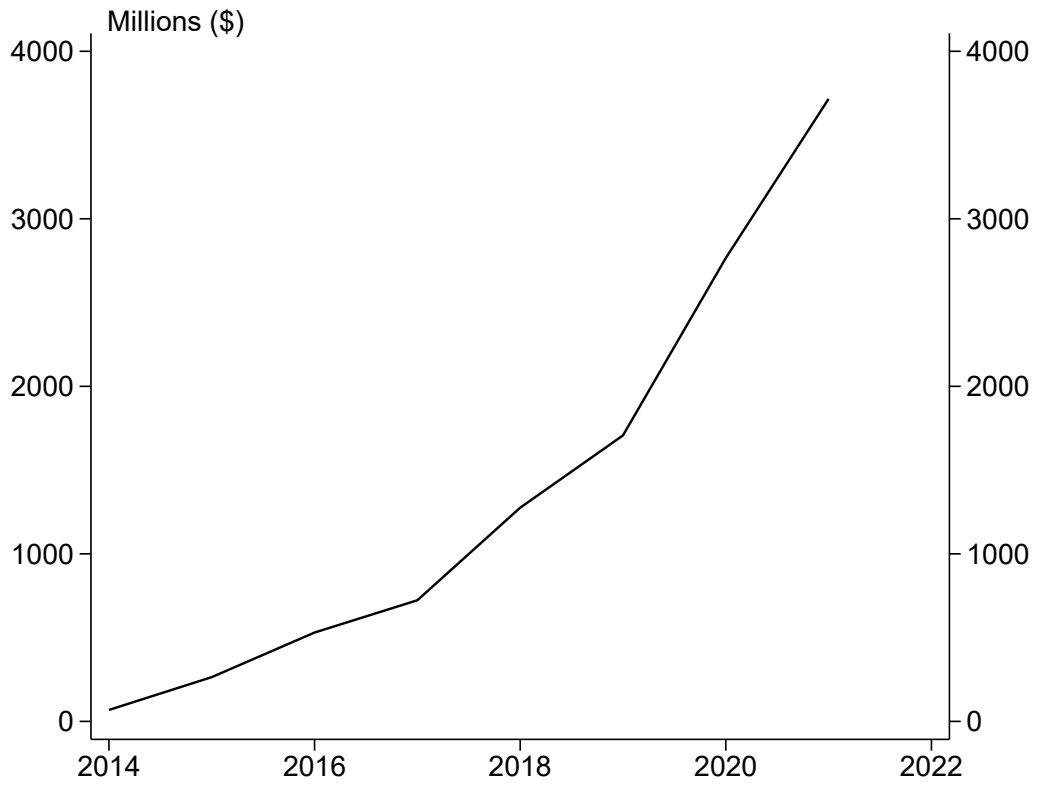
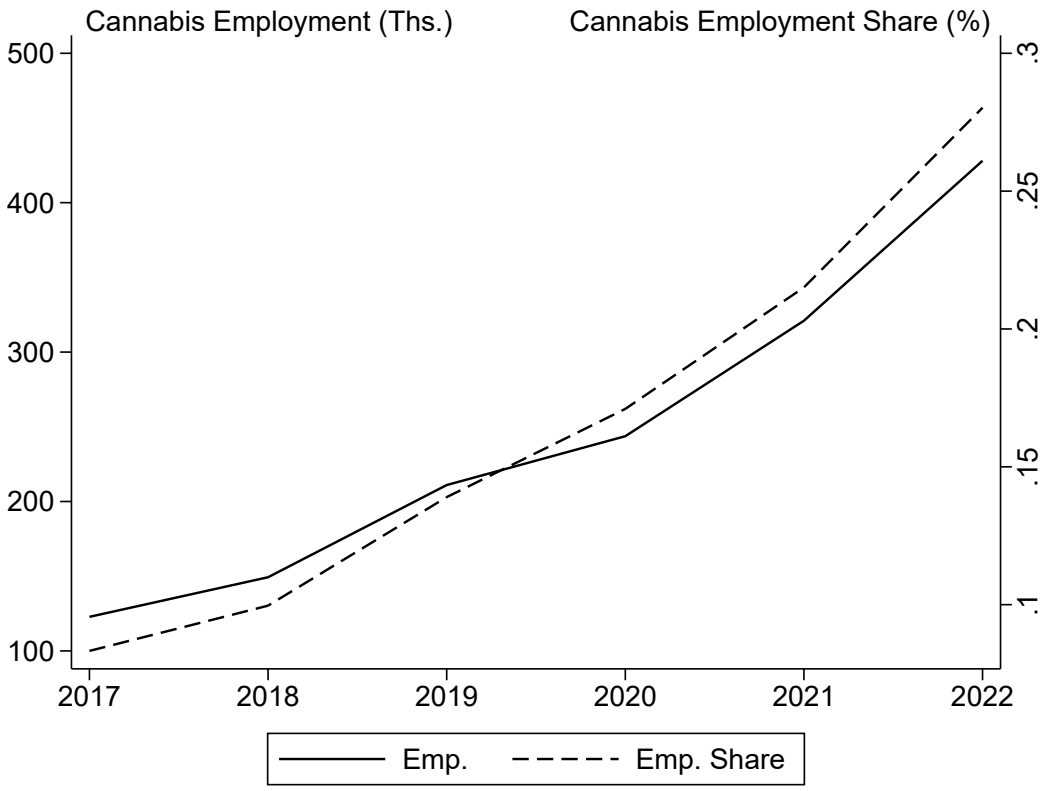


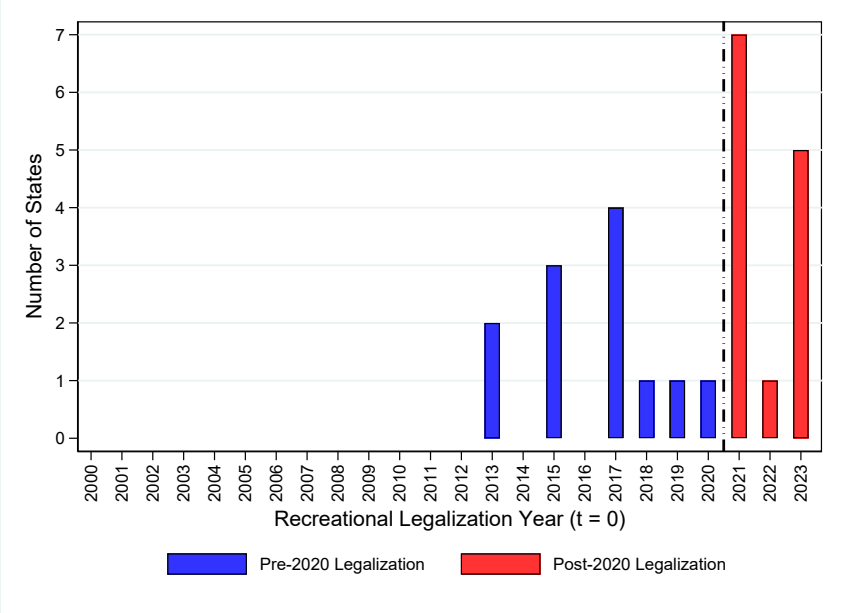
Source: Marijuana Policy Project

Figure 1: Direct State Tax Revenue from Recreational Marijuana, All States

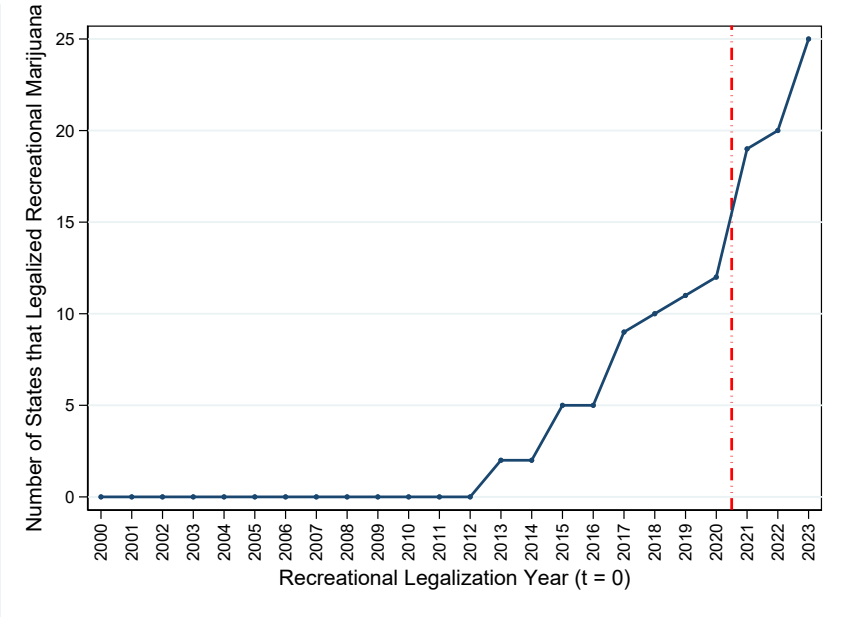


Source: U.S. Bureau of Labor Statistics and Leafly

Figure 2: Employment in the Cannabis Industry, 2017 – 2021



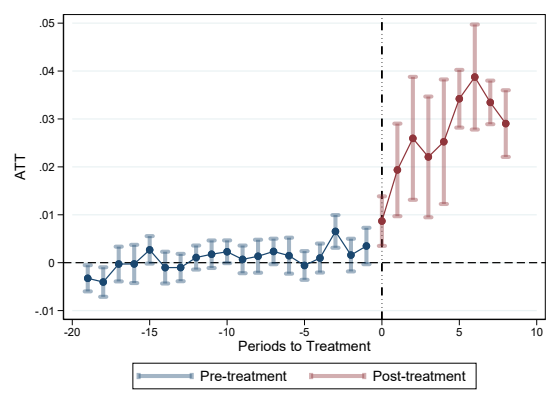
(a) Number of States Treated in Each Year



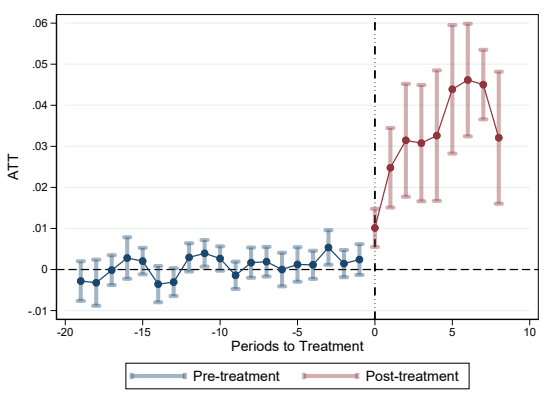
(b) Cummulative Number of Treated States

Notes: The figure shows the number of states that legalized marijuana for recreational use in each year from 2000 to 2023. States that we consider treated in this analysis based on our data are those states that legalized marijuana for recreational use until 2020, while states that legalized post-2020 are not considered treated in our analysis. Panel b shows the cumulative number of states that have legalized marijuana for recreational purposes in each year up to 2023.

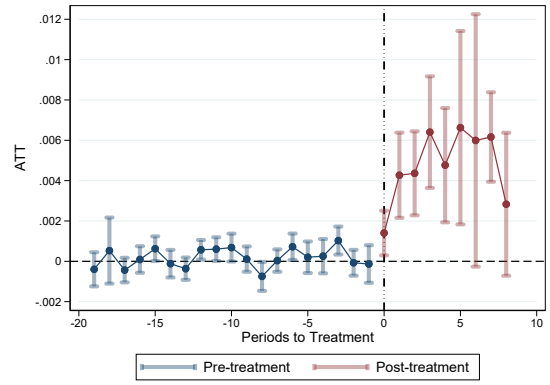
Figure 3: Timeline of Recreational Marijuana Legalization



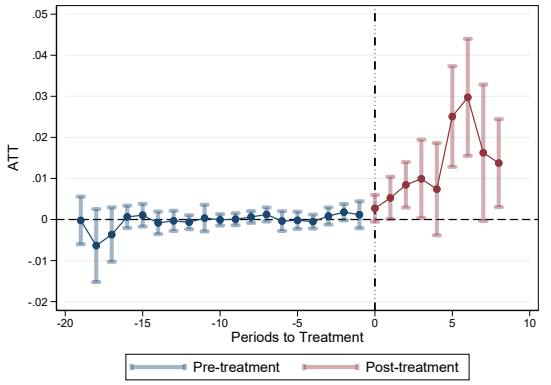
(a) Marijuana Use – Past Month



(b) Marijuana Use – Past Year



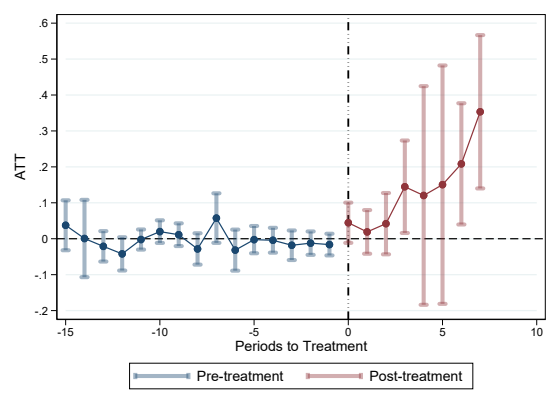
(c) Marijuana Use – First Time



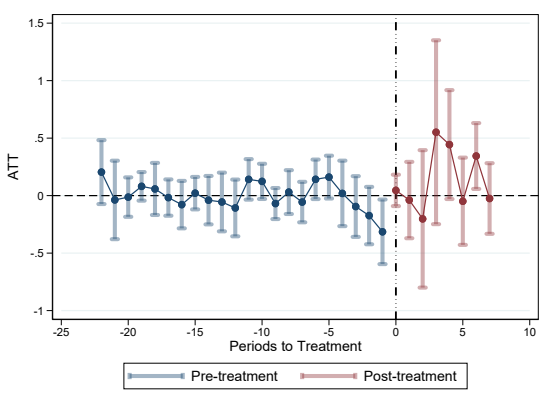
(d) Substance Use Disorder

Notes: The figure shows the dynamics in the effect of recreational marijuana legalization using an event window centered on the first year of legalization. The dynamic estimates are drawn from the dynamic Callaway and Sant'Anna (2021) treatment effects aggregated from group-time treatment effects. The outcome variable is marijuana use in the past month rate (panel a), marijuana use in past year rate (panel b), first time use of marijuana rate (panel c), and substance use disorder rate (panel d). 95% confidence intervals computed using state-level clustered standard errors included in the figure..

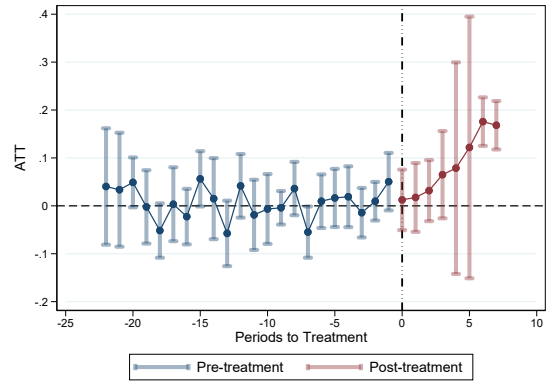
Figure 4: Event Study Estimates of Recreational Marijuana Legalization on Substance Use Rates



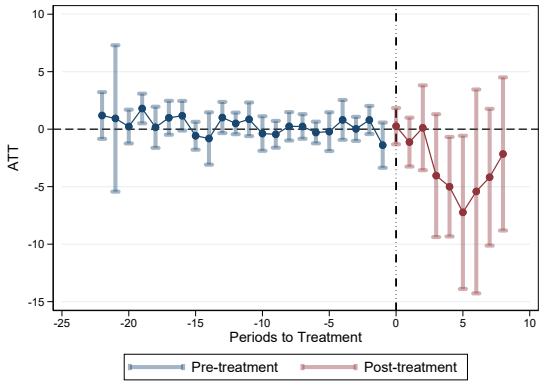
(a) Chronic Homelessness Rate



(b) Substance Abuse Treatments (MJ)



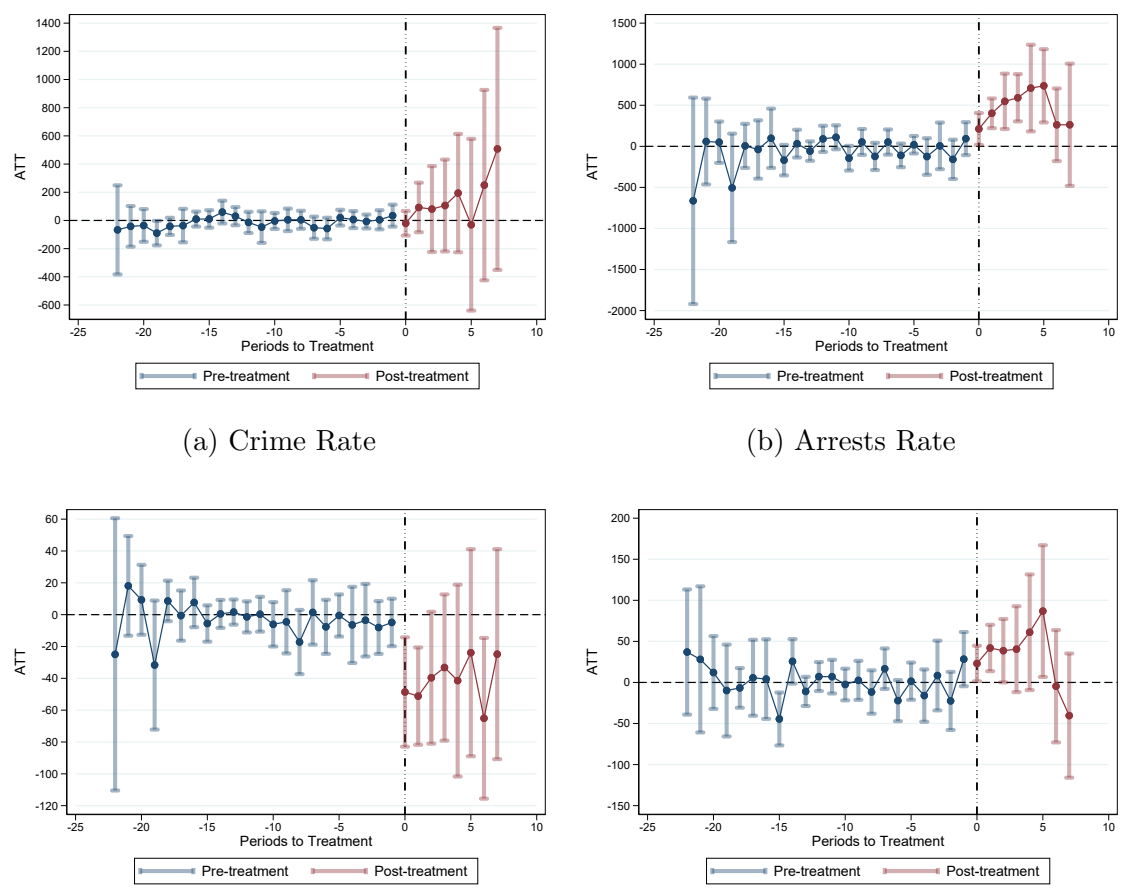
(c) Traffic Accidents Fatality Rate



(d) Hospitalizations Rate

Notes: The figure shows the dynamics in the effect of recreational marijuana legalization using an event window centered on the first year of legalization. The dynamic estimates are drawn from the dynamic Callaway and Sant'Anna (2021) treatment effects aggregated from group-time treatment effects. The outcome variable is chronic homelessness rate (panel a), substance abuse treatments for marijuana (panel b), traffic accident fatality rate (panel c), and hospitalizations rate (panel d). Standard errors are clustered at the state level. 95% confidence intervals are displayed in the figure.

Figure 5: Event Study Estimates of Recreational Marijuana Legalization on Public Health Outcomes



(a) Crime Rate

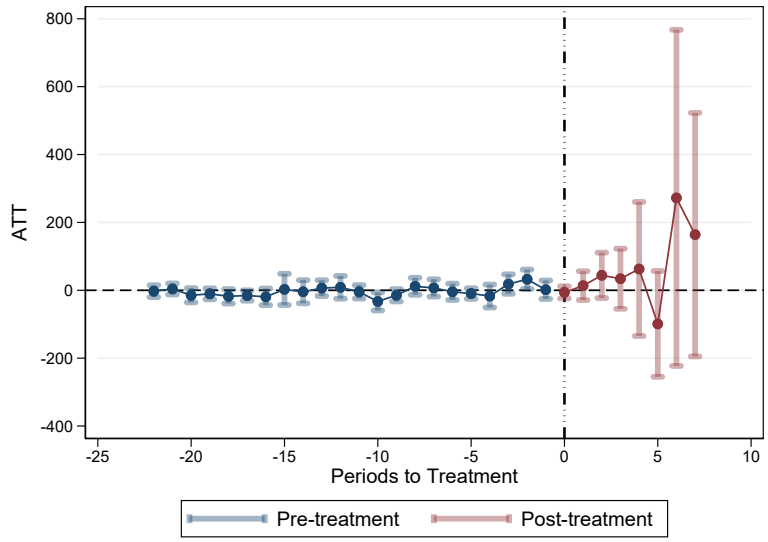
(b) Arrests Rate

(c) Marijuana Possession Arrests

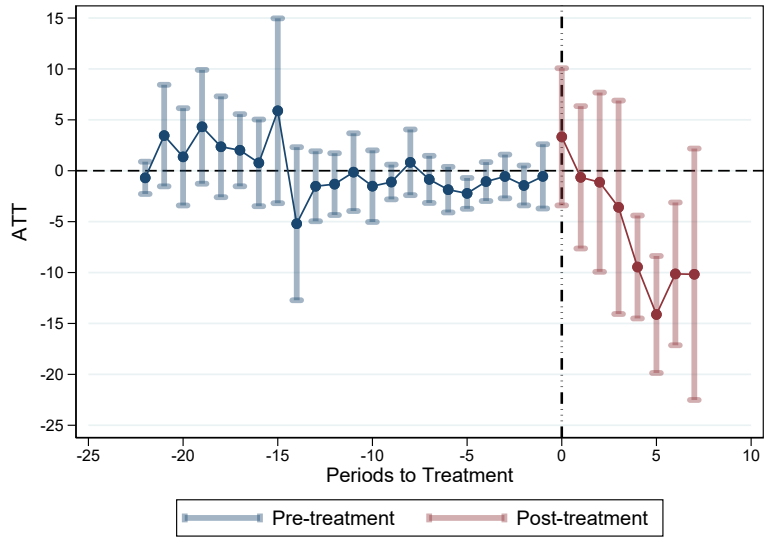
(d) DUI Arrests

Notes: The figure shows the dynamics in the effect of recreational marijuana legalization using an event window centered on the first year of legalization. The dynamic estimates are drawn from the dynamic Callaway and Sant'Anna (2021) treatment effects aggregated from group-time treatment effects. The outcome variable is crime rate (panel a), arrests rate (panel b), marijuana possession arrests (panel c), and DUI arrests (panel d). Standard errors are clustered at the state level. 95% confidence intervals are displayed in the figure.

Figure 6: Event Study Estimates of Recreational Marijuana Legalization on Crime and Arrests



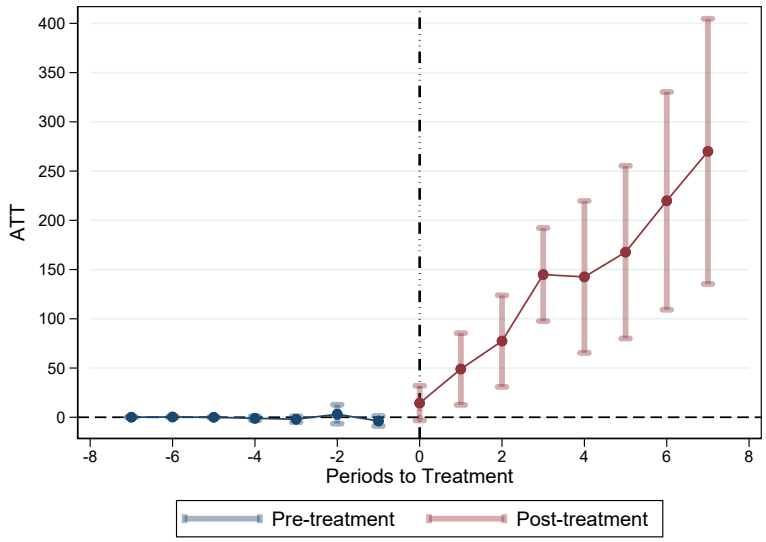
(a) Sales Tax Revenue per Capita



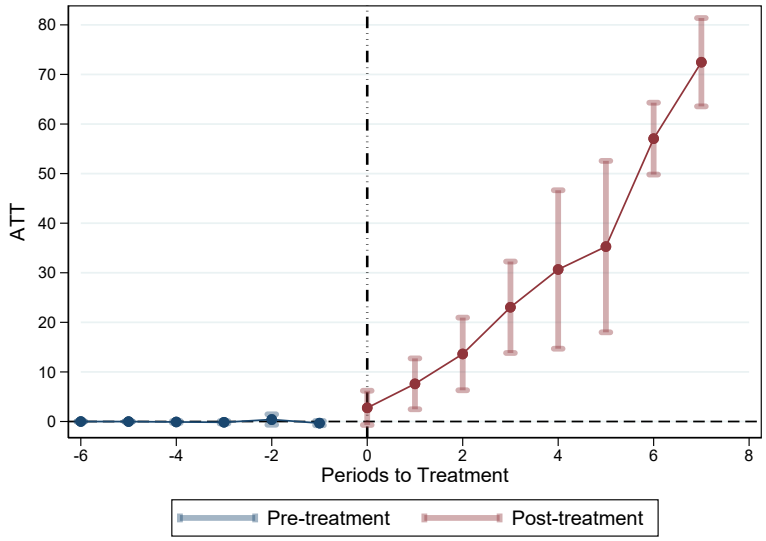
(b) Tobacco Sales Tax Revenue per Capita

Notes: The figure shows the dynamics in the effect of recreational marijuana legalization using an event window centered on the first year of legalization. The dynamic estimates are drawn from the dynamic Callaway and Sant'Anna (2021) treatment effects aggregated from group-time treatment effects. The outcome variable is state sales tax revenue per capita (panel a), and state tobacco sales tax revenue per capita (panel b). Standard errors are clustered at the state level. 95% confidence intervals are displayed in the figure.

Figure 7: Event Study Estimates of Recreational Marijuana Legalization on Selected Tax Revenues



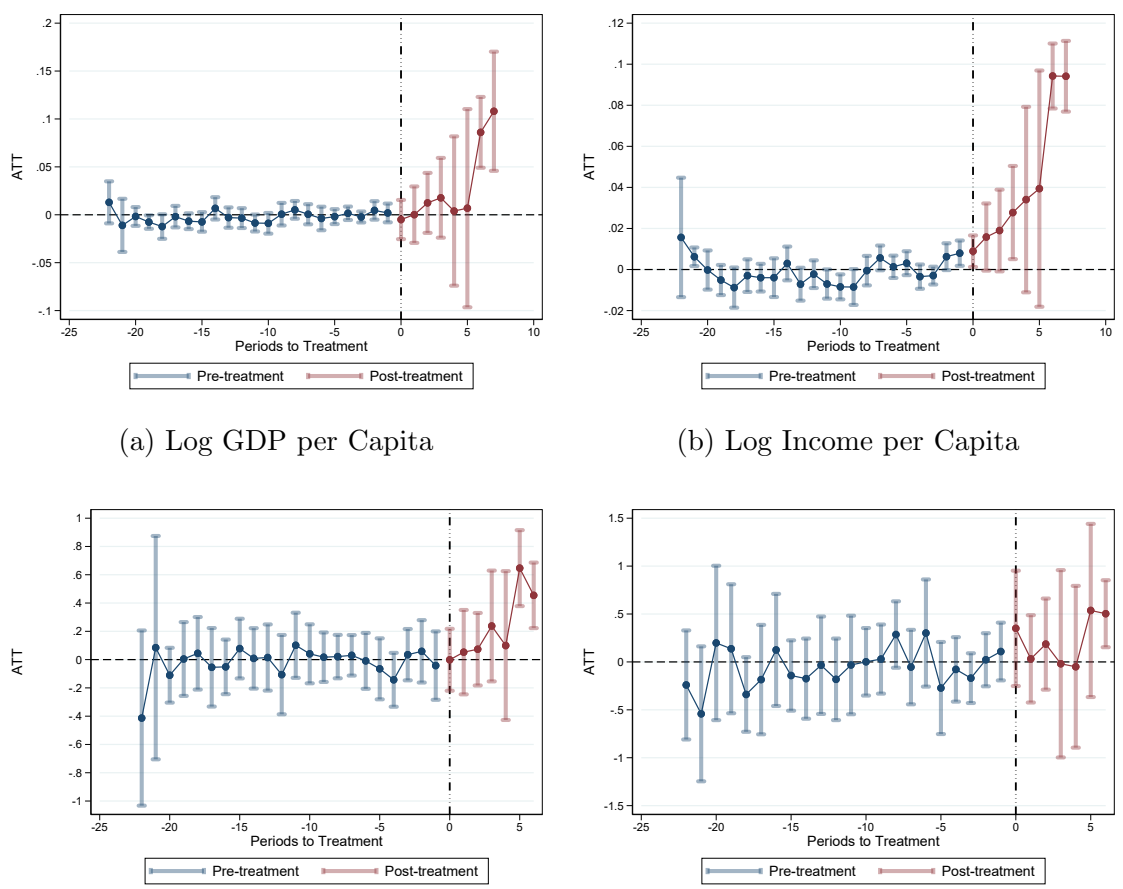
(a) Marijuana Products Sales per Capita



(b) Marijuana Sales Tax Revenue per Capita

Notes: The figure shows the dynamics in the effect of recreational marijuana legalization using an event window centered on the first year of legalization. The dynamic estimates are drawn from the dynamic Callaway and Sant'Anna (2021) treatment effects aggregated from group-time treatment effects. The outcome variable is state marijuana sales per capita (panel a), and state marijuana sales tax revenue per capita (panel b). Standard errors are clustered at the state level. 95% confidence intervals are displayed in the figure.

Figure 8: Event Study Estimates of Recreational Marijuana Legalization on Sales and Tax Revenues of Marijuana



(a) Log GDP per Capita

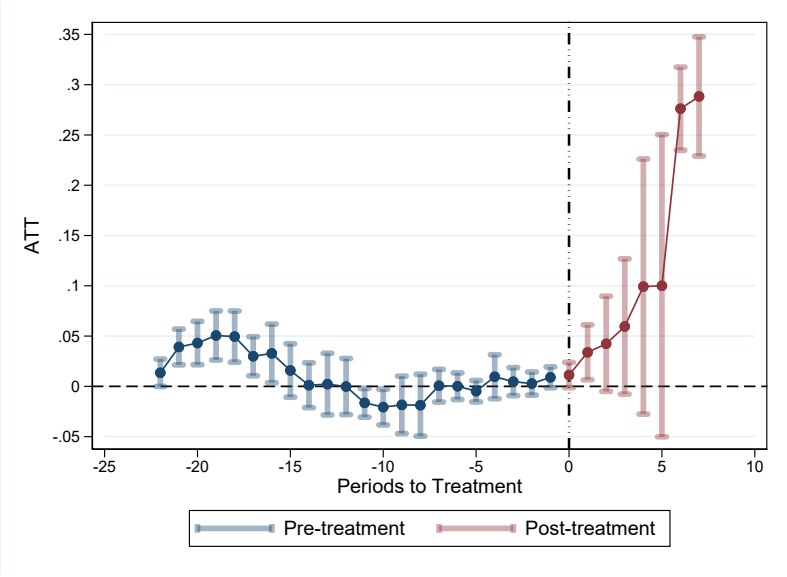
(b) Log Income per Capita

(c) Establishments Entry Rate

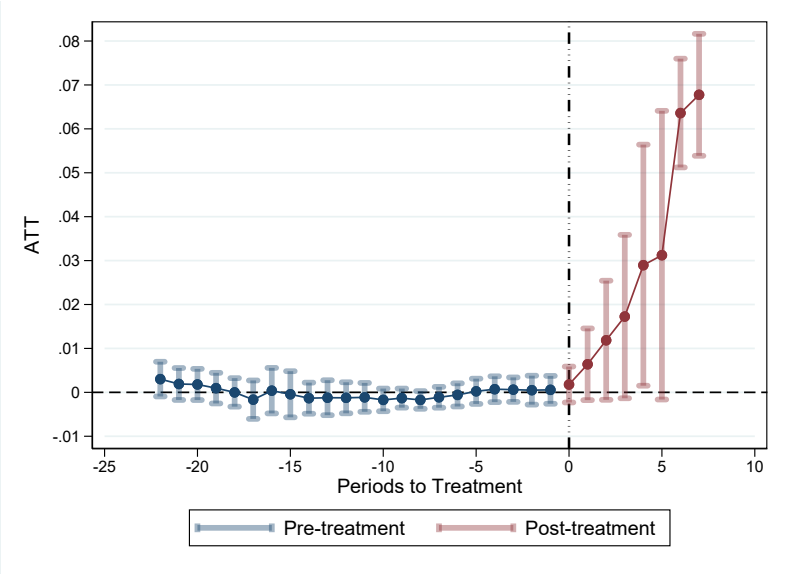
(d) Job Creation Rate

Notes: The figure shows the dynamics in the effect of recreational marijuana legalization using an event window centered on the first year of legalization. The dynamic estimates are drawn from the dynamic Callaway and Sant'Anna (2021) treatment effects aggregated from group-time treatment effects. The outcome variable is log state GDP per capita (panel a), log personal income per capita (panel b), establishments entry rate (panel c), and job creation rate (panel d). Standard errors are clustered at the state level. 95% confidence intervals are displayed in the figure.

Figure 9: Event Study Estimates of Recreational Marijuana Legalization on Business and Labor Market



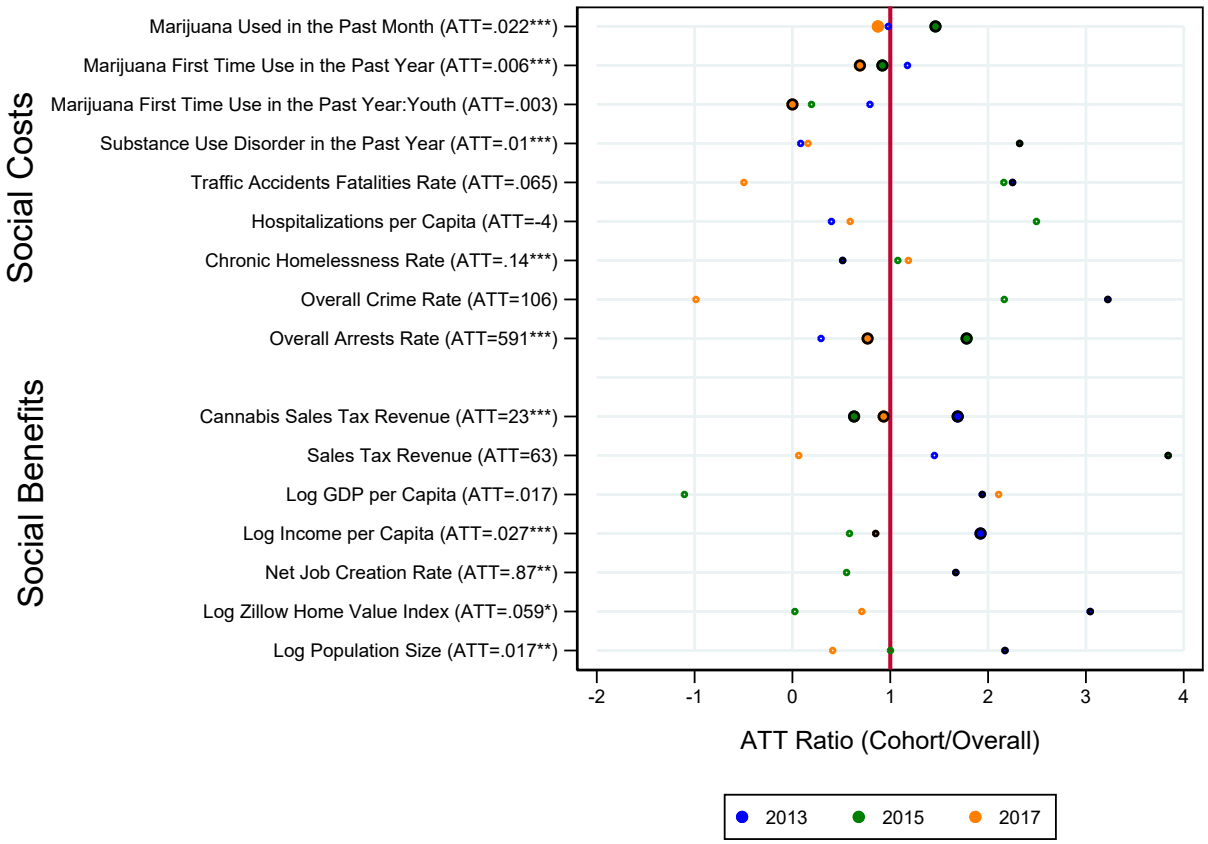
(a) Log Median House Value Index



(b) Log Total State Population

Notes: The figure shows the dynamics in the effect of recreational marijuana legalization using an event window centered on the first year of legalization. The dynamic estimates are drawn from the dynamic Callaway and Sant'Anna (2021) treatment effects aggregated from group-time treatment effects. The outcome variable is log Zillow median house value index (panel a), and log state total population (panel b). Standard errors are clustered at the state level. 95% confidence intervals are displayed in the figure.

Figure 10: Event Study Estimates of Recreational Marijuana Legalization on House Prices and Population



Notes: The figure plots ratios of cohort specific 3-year cumulative average treatment effect on the treated (ATT) to full sample ATT for a set of selected outcomes. Each horizontal row has three ratios, corresponding to three treatment cohorts in our analysis: 2013 (blue), 2015 (green), and 2017 (orange). We list outcomes related to social costs of legalization in the top of the figure and outcomes related to economic benefits at the bottom of the figure. Each outcome label also includes the 3-year ATT and its significance level is indicated by significance stars. Large circles indicate that a ratio is statistically different from one, and black outline indicates that the cohort-specific 3-year ATT is statistically different from zero. A ratio above one implies larger 3-year ATT for the cohort relative to the full sample, and vice versa for smaller than one ratios. We compute standard errors using 100 clustered bootstrap replications.

Figure 11: Relative 3-Year Cumulative Effects by Legalization Year

Table 1: Timeline of States' Marijuana Policies

State	Marijuana Policy First Year			
	Medical	Medical Sales	**Recreational**	Recreational Sales
(1)	(2)	(3)	(4)	(5)
Alabama	2021			
Alaska	1999	2017	**2015**	2017
Arizona	2011	2013	**2021**	2021
Arkansas	2017			
California	1997	2004	**2017**	2018
Colorado	2001	2010	**2013**	2014
Connecticut	2013	2014	**2021**	2023
Delaware	2011	2015	**2023**	
DC	2010	2013	**2015**	
Florida	2017	2019		
Georgia				
Hawaii	2000	2017		
Idaho				
Illinois	2014	2016	**2020**	2020
Indiana				
Iowa				
Kansas				
Kentucky	2025			
Louisiana	2019	2019		
Maine	2000	2011	**2017**	2021
Maryland	2014	2017	**2023**	2023
Massachusetts	2013	2015	**2017**	2019
Michigan	2009	2018	**2019**	2020
Minnesota	2014	2015	**2023**	
Mississippi	2022			
Missouri	2019	2021	**2023**	2023
Montana	2005	2017	**2021**	2022
Nebraska				
Nevada	2002	2015	**2017**	2017
New Hampshire	2013	2016		
New Jersey	2011	2013	**2021**	2022
New Mexico	2007	2009	**2021**	2022
New York	2014	2016	**2021**	2023
North Carolina				
North Dakota	2017	2019		
Ohio	2016	2019	**2023**	
Oklahoma	2018	2019		
Oregon	1999	2014	**2015**	2016
Pennsylvania	2016	2018		
Rhode Island	2006	2013	**2022**	2023
South Carolina				
South Dakota	2021			
Tennessee				
Texas				
Utah	2019	2020		
Vermont	2004	2013	**2018**	2023
Virginia	2020	2021	**2021**	
Washington	1999	2011	**2013**	2014
West Virginia	2021	2022		
Wisconsin				
Wyoming				

Notes: First year of marijuana policy is defined as the first year in which the policy was in effect for at least one quarter.

Table 2: State Recreational Marijuana Legalization Treatment Status

Summary			
Treated States			**25**
Before 2020			*12*
Post 2020			*13*
Never-Treated States			**26**
Detailed By State			
A. Treated States (N=25)			**B. Never-Treated States (N=26)**
	Legalization Date	**Legalization Year**	
A.1. 2013 Treatment Cohort (N=2)			Alabama
Washington	12/6/2012	**2013**	Arkansas
Colorado	12/10/2012	**2013**	Florida
A.2. 2015 Treatment Cohort (N=3)			Georgia
Alaska	2/24/2015	**2015**	Hawaii
DC	2/26/2015	**2015**	Idaho
Oregon	6/30/2015	**2015**	Indiana
A.3. 2017 Treatment Cohort (N=4)			Iowa
California	11/9/2016	**2017**	Kansas
Massachusetts	12/15/2016	**2017**	Kentucky
Nevada	1/1/2017	**2017**	Louisiana
Maine	1/30/2017	**2017**	Mississippi
A.4. 2018 Treatment Cohort (N=1)			Nebraska
Vermont	7/1/2018	**2018**	New Hampshire
A.5. 2019 Treatment Cohort (N=1)			North Carolina
Michigan	11/6/2018	**2019**	North Dakota
A.6. 2020 Treatment Cohort (N=1)			Oklahoma
Illinois	1/1/2020	**2020**	Pennsylvania
A.7. 2021 Treatment Cohort (N=7)			South Carolina
Arizona	11/30/2020	**2021**	South Dakota
Montana	1/1/2021	**2021**	Tennessee
New Jersey	2/22/2021	**2021**	Texas
New York	3/31/2021	**2021**	Utah
New Mexico	6/29/2021	**2021**	West Virginia
Connecticut	7/1/2021	**2021**	Wisconsin
Virginia	7/1/2021	**2021**	Wyoming
A.8. 2022 Treatment Cohort (N=1)			
Rhode Island	5/25/2022	**2022**	
A.9. 2023 Treatment Cohort (N=5)			
Missouri	12/8/2022	**2023**	
Delaware	4/23/2023	**2023**	
Maryland	7/1/2023	**2023**	
Minnesota	8/1/2023	**2023**	
Ohio	11/7/2023	**2023**	

Notes: First year of marijuana policy is defined as the first year in which the policy was in effect for at least one quarter.

Table 3: Data Structure and Event Study Periods Avaialble by Legalization Year

Treatment Cohort	**Potential Event Study Periods (2000-2021, 22 years)**	
	Minimum Pre-Treatment	**Maximum Post-Treatment**
2013	-12	+8
2015	-14	+6
2017	-16	+4
2018	-17	+3
2019	-18	+2
2020	-19	+1
2021	-20	0
2022	-21	-1
2023	-22	-2

Notes: For each treatment cohort (legalization year), we list the earliest pre-treatment period and the maximum post-treatment period for which we can estimate an event-study coefficient in columns 2 and 3, respectively, given that our data spans the years 2000-2021.

Table 4: Estimates of the Effect of Recreational Marijuana Legalization on Substance Use Rates

Outcome	**ATT**	**Dependent Mean (No Legalization)**	
		All States	**Implied % Effect**
	(1)	(2)	(3)
A. Marijuana			
Used in the Past Month	.0216***	0.076	28%
	(.0040)		
Used in the Past Year	.0272***	0.124	22%
	(.0046)		
First Time Use in the Past Year	.0041***	0.019	21%
	(.0007)		
B. Other Substances			
Alcohol Use in the Past Month	-.000	0.551	0%
	(.0036)		
Tobacco Use in the Past Month	-.005	0.296	-2%
	(.0044)		
Illicit Substance Use in the Past Month	.0009	0.034	3%
	(.0011)		
Substance Use Disorder in the Past Year	.0094***	0.056	17%
	(.0031)		
C. Marijuana - Youth (12-17)			
Used in the Past Month	.0025	0.071	4%
	(.0018)		
Used in the Past Year	.0045	0.135	3%
	(.0049)		
First Time Use in the Past Year	.0017	0.058	3%
	(.0026)		
Number of States		19	
Number of Time Periods		51	
Minimum Year		2003	
Maximum Year		2021	
Observations		969	

Notes: ATT estimates of recreational marijuana legalization on a variety of substance use measures according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 shows the mean of the dependent variable for all states under no legalization. Column 3 shows the implied percent change in the outcome variable due to RML relative to baseline mean of no legalization. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Estimates of the Effect Recreational Marijuana Legalization on Public Health Outcomes

Outcome	**ATT** (1)	**Dependent Mean (No Legalization)** **All States** (2)	**Implied % Effect** (3)
A. Homelessness			
Homelessness Rate	-.144 (.2205)	1.658	-9%
Sheltered Homelessness Rate	-.200 (.1594)	1.214	-16%
Unsheltered Homelessness Rate	.0559 (.1981)	0.445	13%
Chronic Homelessness Rate	.0882 (.0572)	0.255	35%
B. Traffic Accidents			
Traffic Accidents Fatality Rate	.0524 (.0442)	1.322	4%
C. Drug Related Deaths			
All Drug Related Deaths Rate	-.982 (2.075)	10	-10%
Opioid Related Deaths Rate	-.482 (2.383)	15	-3%
D. Substance Abuse Treatment Admissions			
All Admissions Rate	-.731 (.6581)	7	-14%
Marijuana Listed as One Drug of Use	.0989 (.1649)	2	4%
Marijuana Listed as Primary Drug of Use	-0.0001 (.0537)	1	0%
E. Hospitalizations			
Hospitalizations per Capita	-2.24 (1.402)	113	-1%
Number of States	51		
Number of Time Periods	21 (14 for homelessness outcomes)		
Minimum Year	2000 (2007 for homelssness outcomes)		
Maximum Year	2020		
Observations	1,071 (714 for homelessness outcomes)		

Notes: ATT estimates of recreational marijuana legalization on a variety of public health measures according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 shows the mean of the dependent variable for all states under no legalization. Column 3 shows the implied percent change in the outcome variable due to RML relative to baseline mean of no legalization. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6: Estimates of the Effect of Recreational Marijuana Legalization on Crime and Arrests

Outcome	**ATT** (1)	**Dependent Mean (No Legalization)** **All States** (2)	**Implied % Effect** (3)
A. Crime			
Overall Crime Rate	86.94 (131.4)	3359	3%
Violent Crime Rate	-11.5 (30.05)	401	-3%
Property Crime Rate	98.54 (104.5)	2958	3%
B. Arrests			
Overall Arrests Rate	465.3*** (122.4)	3615	13%
Violent Crime Offenses	95.34*** (30.28)	511	19%
Property Crime Offenses	71.52*** (18.13)	459	16%
C. Arrests - Selected Offenses			
Drug Offenses	-32.7* (16.97)	404	-8%
Marijuana Possession	-41.9** (16.41)	184	-23%
DUI	38.21* (19.98)	367	10%
Disorderly Conduct	30.36*** (6.886)	172	18%
All Other Offenses	285.3*** (89.66)	2645	11%
Number of States		51	
Number of Time Periods		21	
Minimum Year		2000	
Maximum Year		2020	
Observations		1071	

Notes: ATT estimates of recreational marijuana legalization on a variety of crime and arrests measures according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 shows the mean of the dependent variable for all states under no legalization. Column 3 shows the implied percent change in the outcome variable due to RML relative to baseline mean of no legalization. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Estimates of the Effect of Recreational Marijuana Legalization on Selected Tax Revenues

		Dependent Mean (No Legalization)	
Outcome	**ATT**	**All States**	**Implied % Effect**
(1)	(2)	(3)	
Panel A. General and Selected Taxes			
Total Tax Revenue	87.34	2669	11%
	(204.8)		
Sales Tax Revenue	49.89	850	6%
	(44.56)		
Alcohol Sales Tax Revenue	-2.32***	18	-14%
	(.8226)		
Tobacco Sales Tax Revenue	-3.02	56	-2%
	(3.411)		
Other Sales Tax Revenue	-9.71	95	-4%
	(12.60)		
Panel B. Marijuana Sales and Taxes			
Marijuana Sales	97.98***	0.60	
	(25.23)		
Marijuana Tax Revenue	19.32***	0.05	
	(5.448)		
Number of States		51	
Number of Time Periods		21	
Minimum Year		2000	
Maximum Year		2020	
Observations		1071	

Notes: ATT estimates of recreational marijuana legalization on a variety of tax revenues per capita according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 shows the mean of the dependent variable for all states under no legalization. Column 3 shows the implied percent change in the outcome variable due to RML relative to baseline mean of no legalization. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8: Estimates of the Effect of Recreational Marijuana Legalization on Economic, Labor Market, and Business Outcomes

Outcome	**ATT** (1)	**Dependent Mean (No Legalization)** **All States** (2)	**Implied % Effect** (3)
A. Economic Outcomes			
Log GDP per Capita	.0119	10.93	1.2%
	(.0208)		
Log Income per Capita	.0261**	10.77	3%
	(.0122)		
Log Wages per Capita	.0147	10.10	1.5%
	(.0145)		
Log Proprietors Income per Capita	.1141**	8.340	11%
	(.0488)		
B. Labor Market Outcomes			
Labor Force Participation Rate	.1497	65.63	15%
	(.2815)		
Unemployment Rate	.0014	.0565	1%
	(.0034)		
Log Cannabis Related Job Postings	.3705	1.841	37%
	(.3168)		
C. Business Outcomes			
Establishments Entry Rate	.1150	10.02	1%
	(.1350)		
Establishments Exit Rate	-.078	9.464	-1%
	(.1101)		
Job Creation Rate	.1722	13.68	1%
	(.2401)		
Job Destruction Rate	-.319*	12.91	-2%
	(.1760)		
Net Job Creation Rate	.4911*	.7702	64%
	(.2641)		
Number of States		51	
Number of Time Periods		21	
Minimum Year		2000	
Maximum Year		2020	
Observations		1071	

Notes: ATT estimates of recreational marijuana legalization on a variety of economic, labor, and business outcomes according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 shows the mean of the dependent variable for all states under no legalization. Column 3 shows the implied percent change in the outcome variable due to RML relative to baseline mean of no legalization. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9: Estimates of the Effect of Recreational Marijuana Legalization on House Prices and Population

Outcome	**ATT**	**Dependent Mean (No Legalization)**	
		All States	**Implied % Effect**
	(1)	(2)	(3)
A. House Prices			
Log Zillow Home Value Index (ZHVI)	.0641*	12.28	6.4%
	(.0330)		
Log Bottom-Tier ZHVI	.0649*	11.72	6.5%
	(.0337)		
Log Top-Tier ZHVI	.0643**	12.84	6.4%
	(.0322)		
Number of States		51	
Number of Time Periods		21	
Minimum Year		2000	
Maximum Year		2021	
Observations		1050	
B. Population			
Log Population Size	.0165**	15.11	2%
	(.0076)		
In-Migration Rate	-.000	0.030	0%
	(.0010)		
Out-Migration Rate	-.006	0.030	-20%
	(.0073)		
Net-Migration Rate	.0062	-.000	
	(.0065)		
Number of States		51	
Number of Time Periods		15	
Minimum Year		2005	
Maximum Year		2019	
Observations		765	

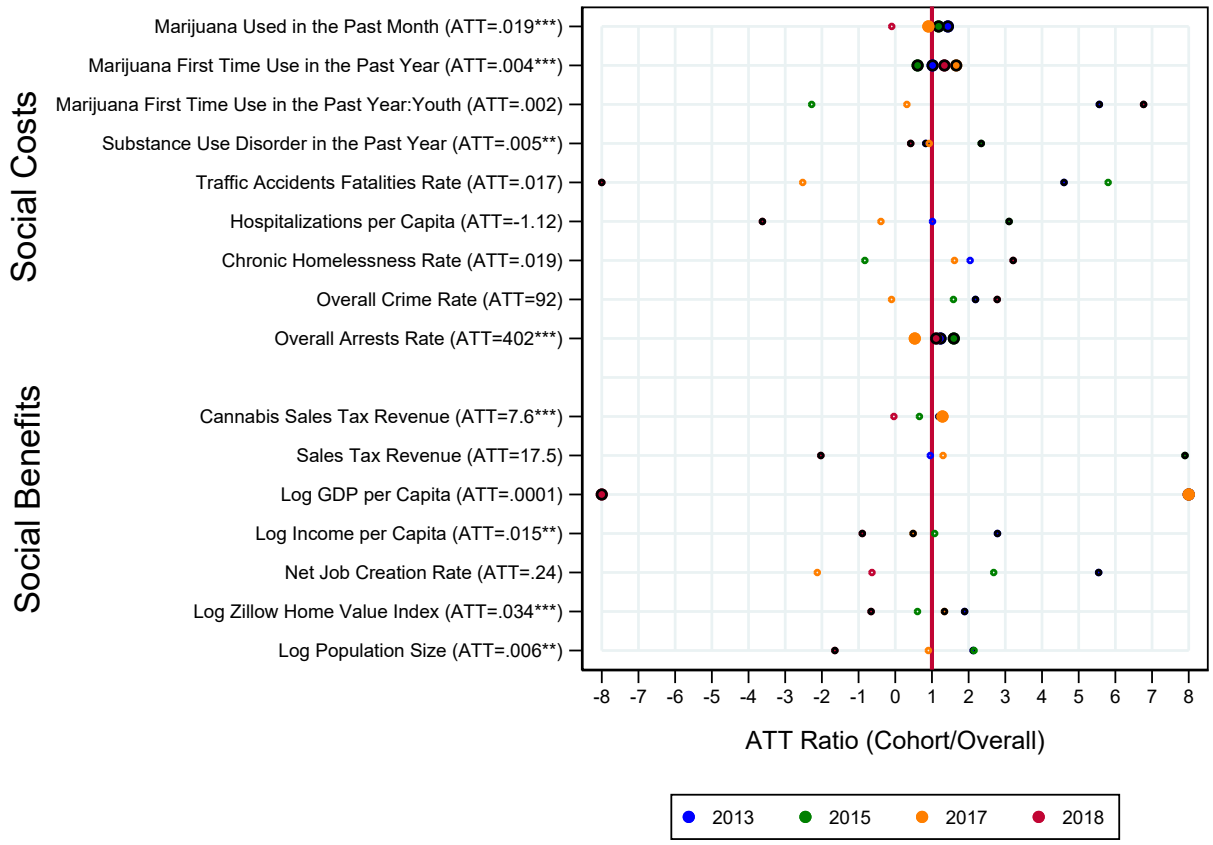
Notes: ATT estimates of recreational marijuana legalization on a variety of business outcomes according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 shows the mean of the dependent variable for all states under no legalization. Column 3 shows the implied percent change in the outcome variable due to RML relative to baseline mean of no legalization. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10: Heterogeneous Effects of Recreational Marijuana Legalization by Legalization Year

	ATT					
Legalization Year:	2013 (1)	2015 (2)	2017 (3)	2018 (4)	2019 (5)	2020 (6)
A. Costs						
Marijuana Used in the Past Month	.0302***	.0273***	.0181*	.0001	.0169***	.0172***
	(.0048)	(.0030)	(.0102)	(.0016)	(.0020)	(.0023)
Marijuana First Time Use in the Past Year	.0065***	.0034***	.0044***	.0086***	-.000	.0007*
	(.0018)	(.0007)	(.0008)	(.0002)	(.0003)	(.0004)
Substance Use Disorder in the Past Year	.0096*	.0204***	.0022	.0104***	.0027**	-.005***
	(.0051)	(.0027)	(.0061)	(.0010)	(.0013)	(.0015)
Chronic Homelessness Rate	.1663***	.0487	.0769	.0499***	-.005	.0321***
	(.0601)	(.1542)	(.0480)	(.0075)	(.0074)	(.0052)
Overall Crime Rate	280.4	44.11	-38.6	133.2***	-19.1	-155.***
	(175.9)	(345.3)	(44.76)	(21.59)	(24.23)	(33.94)
Overall Arrests Rate	297.0**	834.0***	260.7*	396.1***	54.01	823.2***
	(116.7)	(147.0)	(135.6)	(87.71)	(116.4)	(108.7)
Traffic Accidents Fatrality Rate	.1461***	.0495	-.023	-.078***	.0912***	.1343***
	(.0177)	(.1127)	(.0274)	(.0131)	(.0166)	(.0183)
Substance Use Treatment Admissions (MJ)	.5549**	.1320	-.065	-1.18***	.1636*	.1128
	(.2306)	(.1875)	(.2322)	(.0744)	(.0916)	(.0756)
B. Benefits						
Marijuana Sales Tax Revenue	43.44***	11.74**	12.24**	-.387*	6.104***	16.79***
	(2.566)	(4.955)	(5.083)	(.2143)	(.3183)	(.3021)
Sales Tax Revenue	92.39	111.8***	14.00	-9.24	-73.1***	-3.76
	(106.5)	(16.64)	(33.05)	(12.90)	(10.52)	(13.71)
Log GDP per Capita	.0525***	-.027	.0229**	-.008***	-.007*	-.010**
	(.0126)	(.0525)	(.0090)	(.0027)	(.0043)	(.0050)
Log Income per Capita	.0639***	.0138	.0127***	-.010***	.0080***	.0049**
	(.0061)	(.0254)	(.0036)	(.0017)	(.0020)	(.0021)
Net Job Creation Rate	1.237***	.4213*	-.163	.6101***	-1.29***	
	(.4601)	(.2222)	(.3547)	(.2207)	(.1387)	
Log Zillow Home Value Index (ZHVI)	.1850***	.0066	.0357*	-.023***	.0200***	-.027***
	(.0141)	(.0491)	(.0200)	(.0058)	(.0043)	(.0029)
Log Population Size	.0399***	.0140	.0058	-.010***	-.007***	-.010***
	(.0042)	(.0133)	(.0087)	(.0018)	(.0014)	(.0010)

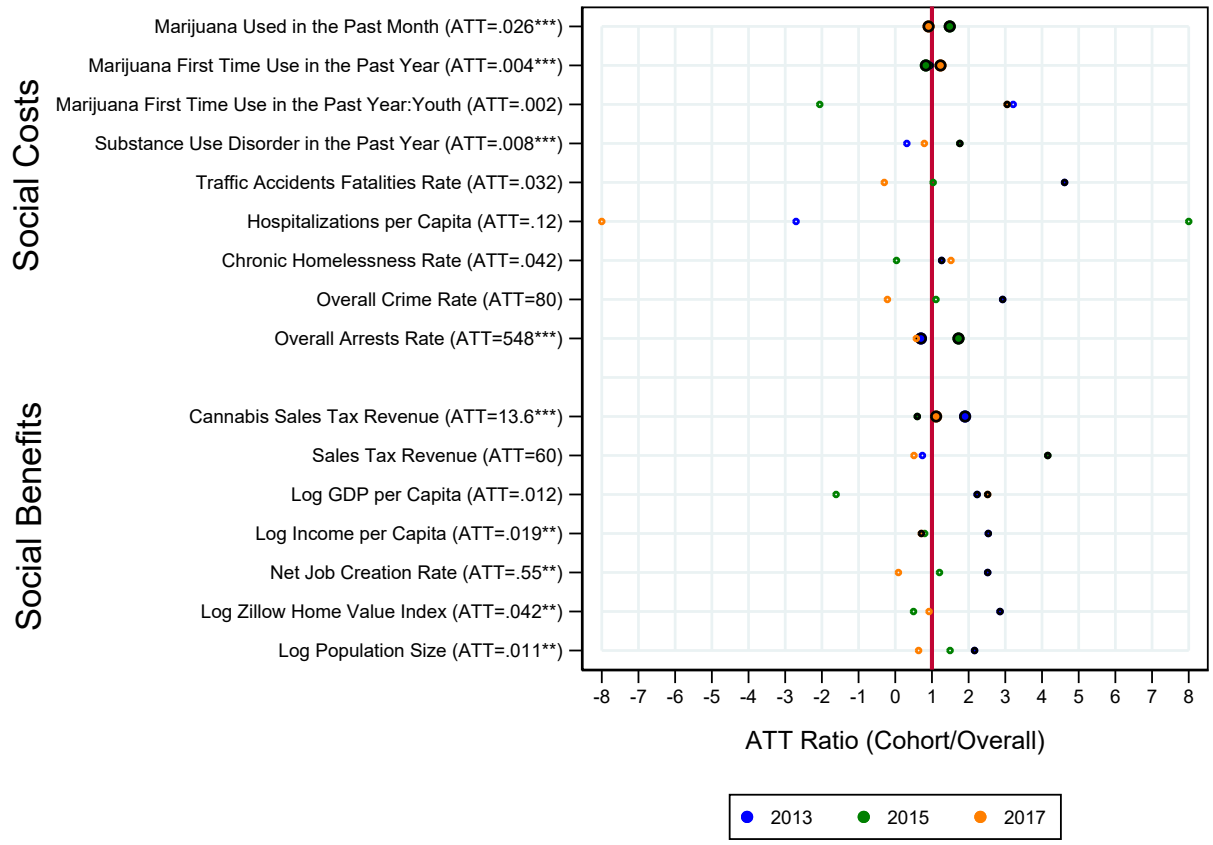
Notes: ATT estimates of recreational marijuana legalization on a variety of costs and benefits by legalization year according to Callaway Sant'Anna (2021) methodology presented in columns 1-6. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

A Appendix Figures



Notes: The figure plots ratios of cohort specific 1-year cumulative average treatment effect on the treated (ATT) to full sample ATT for a set of selected outcomes. Each horizontal row has four ratios, corresponding to four treatment cohorts in our analysis: 2013 (blue), 2015 (green), 2017 (orange), and 2018 (cranberry). We list outcomes related to social costs of legalization in the top of the figure and outcomes related to economic benefits at the bottom of the figure. Each outcome label also includes the 1-year ATT and its significance level is indicated by significance stars. Large circles indicate that a ratio is statistically different from one, and black outline indicates that the cohort-specific 1-year ATT is statistically different from zero. A ratio above one implies larger 1-year ATT for the cohort relative to the full sample, and vice versa for smaller than one ratios. We compute standard errors using 100 clustered bootstrap replications.

Figure A.1: Relative 1-Year Cumulative Effects by Legalization Year



Notes: The figure plots ratios of cohort specific 2-year cumulative average treatment effect on the treated (ATT) to full sample ATT for a set of selected outcomes. Each horizontal row has three ratios, corresponding to four treatment cohorts in our analysis: 2013 (blue), 2015 (green), and 2017 (orange). We list outcomes related to social costs of legalization in the top of the figure and outcomes related to economic benefits at the bottom of the figure. Each outcome label also includes the 2-year ATT and its significance level is indicated by significance stars. Large circles indicate that a ratio is statistically different from one, and black outline indicates that the cohort-specific 2-year ATT is statistically different from zero. A ratio above one implies larger 2-year ATT for the cohort relative to the full sample, and vice versa for smaller than one ratios. We compute standard errors using 100 clustered bootstrap replications.

Figure A.2: Relative 2-Year Cumulative Effects by Legalization Year

B Baseline Robustness Check Tables

Table B.1: List of Data Source, Outcomes, and Time Periods

Topic	Data Source and Name	Outcomes	Time Period
Marijuana Legalization Status	(1) RAND Opioid Tools and Information Center Resources (RAND-OPTIC)	(-) Dates of medical/recreational/retail marijuana legalization by state	1990-2019
	(2) Google Search (Conducted by Authors)	(-) Dates of medical/recreational/retail marijuana legalization by state	2000-2023
Marijuana and Other Substance Use Rates	(3) Substance Abuse and Mental Health Services Administration (SAMHSA) *National Survey on Drug Use and Health (NSDUH)*	(-) Marijuana Use Rates (Past Month, Past Year, First Time) (-) Other Substances Use Rates (Alcohol, Tobacco, Illicit) (-) Substance use disorder (past year)	2002/3-2018/19, 2021
Homelessness	(4) U.S. Department of Housing and Urban Development (HUD) *Point-in-Time (PIT) Homeless Count*	(-) Total homeless rate (per 1,000 people) (-) Sheltered homeless rate (per 1,000 people) (-) Unsheltered homeless rate (per 1,000 people) (-) Chronic homeless rate (per 1,000 people)	2007-2020
Traffic Accidents Fatalities	(5) National Highway Traffic Safety Administration (NHTSA)	(-) Traffic accidents fatality rate (per 100 million vehicle miles traveled)	2000-2020
Drug-Realted Deaths	(6) Centers for Disease Control and Prevention (CDC) *Multiple Cause of Death (MCD) Data*	(-) All Drug Related Deaths Rate (per 100,000 people) (-) Opioid Related Deaths Rate (per 100,000 people)	2000-2020
Substance Abuse Treatment Admissions	(7) Substance Abuse and Mental Health Services Administration (SAMHSA) *Treatment Episode Data Set: Admissions (TEDS-A)*	(-) All Admissions Rate (per 1,000 people) (-) Marijuana listed as one drug of use Rate (per 1,000 people) (-) Marijuana listed as primary drug of use Rate (per 1,000 people)	2000-2020
Hospitalizations	(8) Centers for Disease Control and Prevention (CDC)	(-) Hospitalizations Rate (per 1,000 people)	2000-2020
Arrests and Crime	(9) Federal Bureau of Investigation (FBI) *Crime Data Explorer*	(-) Overall/violent/property crime rate (per 100,000 people) (-) Overall/violent/property charges of arrests (per 100,000 people) (-) Drug offenses, marijuana possession, DUI, disorderly conduct and all other charges for arrests rate (per 100,000 people)	2000-2020
Taxes	(10) Annual Survey of State and Local Government Expenditures (Census)	(-) Total/sales/alcohol/tobacco/other sales tax revenue (per capita)	2000-2020
	(11) Marijuana Policy Project (MPP)	(-) Cannabis tax revenue (per capita)	
Economic Activity	(12) Bureau of Economic Analysis (BEA)	(-) GDP, Personal income, wages, proprietors' income	2000-2020
Labor Market	(13) Bureau of Labor Statistics (BLS) *Current Population Survey*	(-) Labor force participation rate, unemployment rate	2000-2020
	(2) Lightcast	(-) Cannabis-related job postings (keyword search)	2010-2020
Business Dynamics	(14) Business Dynamics Statistics (BDS)	(-) Business entry, exit, net rate (-) Job creation, destruction, net rate	2000-2020
House Prices	(15) Zillow	(-) Zillow median home value index (ZHVI)	2000-2020
Population	(16) Bureau of Labor Statistics (BLS) *Current Population Survey*	(-) State Annual Population	2000-2020
	(17) American Community Survey (ACS)	(-) In-, out-, net-migration rate (state)	2005-2019

Notes: This table lists data sources, files, and the time period covered by the associated files.

Table B.2: Sensitvity of Estimates of Recreational Marijuana Legalization on Marijuana Use Rates to Under-Reporting

Outcome	**Baseline (0%)**	**Under-Reporting Rate (No RML)**			
		5%	10%	15%	20%
	(1)	(2)	(3)	(4)	(5)
Used in the Past Month	.0216***	.0146***	.0076*	.0006	-.006
	(.0040)	(.0042)	(.0044)	(.0046)	(.0048)
Used in the Past Year	.0272***	.0169***	.0065	-.003	-.014**
	(.0046)	(.0048)	(.0051)	(.0053)	(.0055)
First Time Use in the Past Year	.0041***	.0028***	.0014*	.0000	-.001
	(.0007)	(.0008)	(.0008)	(.0008)	(.0008)

Notes: ATT estimates of recreational marijuana legalization on a variety of substance use measures according to Callaway Sant'Anna (2021) methodology presented in columns 1-5. Control states include never treated and not yet treated states. Each column assumes an under-reporting rate of NSDUH survey respondents such that in states that did not legalize marijuana for recreational use the actual rate is higher by 5-20% compared to the survey results, and that there is no under-reporting once marijuana is legalized for recreational use. Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.3: Robustness of Estimates of Recreational Marijuana Legalization on Substance Use Rates

Outcome	Baseline	Robustness					
		Controls	Spillovers		Control Group Selection		
		Time-Varying Controls	Any Neighbor RML Control	Share of Neighbors with RML Control	Never-Treated (No RML) States Only	Medical Legaliza-tion States As Controls	No RML or MML States Only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Marijuana							
Used in the Past Month	.0216***	.0253***	.0213***	.0214***	.0233***	.0240***	.0256***
	(.0040)	(.0053)	(.0040)	(.0040)	(.0039)	(.0044)	(.0042)
Used in the Past Year	.0272***	.0349***	.0265***	.0264***	.0280***	.0307***	.0298***
	(.0046)	(.0072)	(.0047)	(.0048)	(.0046)	(.0051)	(.0049)
First Time Use in the Past Year	.0041***	.0041***	.0040***	.0040***	.0043***	.0050***	.0046***
	(.0007)	(.0011)	(.0008)	(.0008)	(.0007)	(.0008)	(.0008)
B. Other Substances							
Alcohol Use in the Past Month	-.000	.0110	.0007	.0009	-.002	-.001	-.004
	(.0036)	(.0079)	(.0040)	(.0041)	(.0036)	(.0039)	(.0048)
Tobacco Use in the Past Month	-.005	-.002	-.006	-.007*	-.007	-.006	-.009*
	(.0044)	(.0082)	(.0043)	(.0043)	(.0045)	(.0051)	(.0049)
Illicit Substance Use in the Past Month	.0009	.0009	.0011	.0011	.0010	.0014	.0007
	(.0011)	(.0020)	(.0011)	(.0011)	(.0011)	(.0012)	(.0012)
Substance Use Disorder in the Past Year	.0094***	.0115**	.0094***	.0094***	.0100***	.0115***	.0098***
	(.0031)	(.0051)	(.0031)	(.0031)	(.0033)	(.0037)	(.0036)
C. Marijuana - Youth (12-17)							
Used in the Past Month	.0025	.0095**	.0023	.0024	.0021	.0023	.0024
	(.0018)	(.0041)	(.0019)	(.0019)	(.0019)	(.0025)	(.0020)
Used in the Past Year	.0045	.0138**	.0045	.0045	.0035	.0045	.0024
	(.0049)	(.0061)	(.0049)	(.0050)	(.0048)	(.0051)	(.0048)
Used in the Past Year	.0017	.0024	.0017	.0016	.0016	.0025	.0007
	(.0026)	(.0052)	(.0026)	(.0026)	(.0024)	(.0025)	(.0025)

Notes: ATT estimates of recreational marijuana legalization on a variety of substance use measures according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 adds state-level time-varying controls: state population shares for non-Hispanic whites, males, and three age groups (18-24, 25-64, and 65 and older year olds), state unemployment rate, and median household income, and beer and cigarette tax rates. Columns 3-4 test for potential spillovers by including an indicator for whether the state has a neighbor that RML (column 3) or the share of neighboring states that RML (column 4). Columns 5-7 use different states to serve as controls. In column 5 we use only never-treated states as controls, in column 6 we use only states that legalized medical marijuana use as controls, and in column 7 we include only states that did not legalize marijuana for any use as controls . Standard errors are clustered at the state level. . *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.4: Robustness of Estimates of Recreational Marijuana Legalization on Public Health Outcomes

Outcome	Baseline	Robustness: Controls: Time-Varying Controls	Robustness: Spillovers: Any Neighbor RML Control	Robustness: Spillovers: Share of Neighbors with RML Control	Robustness: Control Group Selection: Never-Treated (No RML) States Only	Robustness: Control Group Selection: Medical Legalization States As Controls	Robustness: Control Group Selection: No RML or MML States Only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Homelessness							
Homelessness Rate	-.144	-.069	-.151	-.156	-.103	-.124	-.080
	(.2205)	(.2340)	(.2175)	(.2159)	(.2194)	(.2254)	(.2184)
Sheltered Homelessness Rate	-.200	-.200	-.198	-.196	-.182	-.173	-.191
	(.1594)	(.2361)	(.1604)	(.1608)	(.1590)	(.1605)	(.1585)
Unsheltered Homelessness Rate	.0559	.1314	.0466	.0393	.0791	.0495	.1109
	(.1981)	(.2020)	(.1960)	(.1945)	(.1969)	(.2047)	(.1945)
Chronic Homelessness Rate	.0882	.1063	.0829	.0798	.0950	.0872	.1033*
	(.0572)	(.0696)	(.0542)	(.0532)	(.0579)	(.0591)	(.0595)
B. Traffic Accidents							
Traffic Accidents Fatality Rate	.0524	.0706	.0517	.0541	.0656	.0834	.0464
	(.0442)	(.0604)	(.0487)	(.0492)	(.0449)	(.0503)	(.0431)
C. Drug Related Deaths							
All Drug Related Deaths Rate	-.982	-3.80	-.344	-.054	-.092	-.399	.2571
	(2.075)	(3.450)	(1.939)	(1.986)	(2.113)	(2.642)	(2.375)
Opioid Related Deaths Rate	-.482	-3.17	.1679	.4879	.2569	-.533	1.196
	(2.383)	(4.066)	(2.235)	(2.289)	(2.446)	(2.974)	(2.755)
D. Substance Abuse Treatment Admissions							
All Admissions Rate	-.731	-.728	-.898	-1.01	-.241	-.221	-.264
	(.6581)	(1.917)	(.7218)	(.8036)	(.5701)	(.5944)	(.5710)
Marijuana Listed as One Drug of Use	.0989	.3999	.0900	.0894	.0748	.1123	.0326
	(.1649)	(.3778)	(.1602)	(.1637)	(.1592)	(.1718)	(.1692)
Marijuana Listed as Primary Drug of Use	-0.0001	.1483	.0006	-.000	-.025	-.017	-.033
	(.0537)	(.1323)	(.0490)	(.0503)	(.0593)	(.0742)	(.0638)
E. Hospitalizations							
Hospitalizations per Capita	-2.24	-2.15	-2.55*	-2.74**	-2.52*	-2.65*	-3.38**
	(1.402)	(2.093)	(1.305)	(1.304)	(1.445)	(1.618)	(1.695)

Notes: ATT estimates of recreational marijuana legalization on a variety of public health outcomes according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 adds state-level time-varying controls: state population shares for non-Hispanic whites, males, and three age groups (18-24, 25-64, and 65 and older year olds), state unemployment rate, and median household income, and beer and cigarette tax rates. Columns 3-4 test for potential spillovers by including an indicator for whether the state has a neighbor that RML (column 3) or the share of neighboring states that RML (column 4). Columns 5-7 use different states to serve as controls. In column 5 we use only never-treated states as controls, in column 6 we use only states that legalized medical marijuana use as controls, and in column 7 we include only states that did not legalize marijuana for any use as controls . Standard errors are clustered at the state level. . *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.5: Robustness of Estimates of Recreational Marijuana Legalization on Crime and Arrests

Outcome	Baseline	Robustness: Controls: Time-Varying Controls	Robustness: Spillovers: Any Neighbor RML Control	Robustness: Spillovers: Share of Neighbors with RML Control	Robustness: Control Group Selection: Never-Treated (No RML) States Only	Robustness: Control Group Selection: Medical Legalization States As Controls	Robustness: Control Group Selection: No RML or MML States Only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Crime							
Overall Crime Rate	86.94	130.7	85.93	84.76	93.26	69.09	119.2
	(131.4)	(129.7)	(131.2)	(131.6)	(131.5)	(136.3)	(131.8)
Violent Crime Rate	-11.5	16.48	-14.8	-16.8	-12.5	-14.9	-9.87
	(30.05)	(28.96)	(30.64)	(30.92)	(29.87)	(30.57)	(29.77)
Property Crime Rate	98.54	114.2	100.7	101.6	105.7	84.05	129.1
	(104.5)	(117.6)	(104.4)	(104.5)	(104.7)	(109.5)	(105.4)
B. Arrests							
Overall Arrests Rate	737.3	480.3***	504.6***	380.5***	98.37***	684.3***	684.3
	(448.5)	(136.6)	(143.2)	(140.8)	(194.0)	(151.1)	(151.1)
Violent Crime Offenses	142.6**	96.87***	100.0***	85.03***	39.94***	133.5***	133.5
	(57.80)	(29.47)	(29.03)	(32.29)	(36.97)	(33.85)	(33.85)
Property Crime Offenses	97.82*	75.42***	79.12***	60.80***	24.52***	99.86***	99.86
	(55.94)	(19.23)	(19.57)	(21.24)	(28.67)	(22.57)	(22.57)
C. Arrests - Selected Offenses							
Drug Offenses	-32.7*	15.71	-31.0*	-29.2	-59.4***	-83.8***	-33.2*
	(16.97)	(68.99)	(18.42)	(19.33)	(20.33)	(29.66)	(19.51)
Marijuana Possession	-41.9**	-23.6	-41.3**	-40.9**	-49.5***	-59.9***	-38.3*
	(16.41)	(49.38)	(16.55)	(17.25)	(17.62)	(18.60)	(19.62)
DUI	38.21*	51.33	38.51*	40.53*	40.28*	30.57*	50.74**
	(19.98)	(42.70)	(22.27)	(23.57)	(20.64)	(25.14)	(22.83)
Disorderly Conduct	30.36***	8.679	27.81***	27.23***	29.44***	16.20***	43.71***
	(6.886)	(25.40)	(6.554)	(6.470)	(8.688)	(11.38)	(12.20)
All Other Offenses	285.3***	385.3	294.9***	309.2***	238.8**	84.61**	404.9***
	(89.66)	(265.5)	(100.0)	(105.0)	(96.55)	(119.8)	(103.6)

Notes: ATT estimates of recreational marijuana legalization on crime and arrests measures according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 adds state-level time-varying controls: state population shares for non-Hispanic whites, males, and three age groups (18-24, 25-64, and 65 and older year olds), state unemployment rate, and median household income, and beer and cigarette tax rates. Columns 3-4 test for potential spillovers by including an indicator for whether the state has a neighbor that RML (column 3) or the share of neighboring states that RML (column 4). Columns 5-7 use different states to serve as controls. In column 5 we use only never-treated states as controls, in column 6 we use only states that legalized medical marijuana use as controls, and in column 7 we include only states that did not legalize marijuana for any use as controls Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.6: Robustness of Estimates of Recreational Marijuana Legalization on Selected Tax Revenues and Marijuana Sales Revenue

		Robustness					
		Controls	**Spillovers**		**Control Group Selection**		
Outcome	**Baseline**	Time-Varying Controls	Any Neighbor RML Control	Share of Neighbors with RML Control	Never-Treated (No RML) States Only	Medical Legaliza-tion States As Controls	No RML or MML States Only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Tax Revenue	87.34	399.9	79.82	76.93	142.1	166.5	115.9
	(204.8)	(348.6)	(205.3)	(205.1)	(212.4)	(220.9)	(214.9)
Sales Tax Revenue	27.03	62.74	41.49	38.98	57.21	61.27	53.15
	(41.81)	(72.39)	(46.13)	(47.42)	(45.76)	(50.07)	(45.38)
Alcohol Sales Tax Revenue	-2.32***	-5.88***	-2.41***	-2.46***	-2.29**	-2.11**	-2.48***
	(.8226)	(2.268)	(.7842)	(.7988)	(.9039)	(1.117)	(.9525)
Tobacco Sales Tax Revenue	-3.02	.0843	-3.10	-3.05	-4.55	-7.90	-.937
	(3.411)	(5.892)	(3.380)	(3.385)	(3.588)	(4.024)	(3.394)
Other Sales Tax Revenue	-9.49	-34.7*	-8.17	-7.06	-4.19	-9.25	1.577
	(12.59)	(19.48)	(11.22)	(10.85)	(12.82)	(13.87)	(13.03)
Marijuana Sales	97.98***	99.17***	97.45***	97.36***	103.2***	99.62***	113.8***
	(25.23)	(26.87)	(25.20)	(25.25)	(25.96)	(26.41)	(26.01)
Marijuana Tax Revenue	19.32***	19.37***	19.27***	19.26***	20.42***	20.15***	22.02***
	(5.448)	(5.560)	(5.447)	(5.450)	(5.543)	(5.570)	(5.617)

Notes: ATT estimates of recreational marijuana legalization on selected tax revenues and marijuana sales revenues according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 adds state-level time-varying controls: state population shares for non-Hispanic whites, males, and three age groups (18-24, 25-64, and 65 and older year olds), state unemployment rate, and median household income, and beer and cigarette tax rates. Columns 3-4 test for potential spillovers by including an indicator for whether the state has a neighbor that RML (column 3) or the share of neighboring states that RML (column 4). Columns 5-7 use different states to serve as controls. In column 5 we use only never-treated states as controls, in column 6 we use only states that legalized medical marijuana use as controls, and in column 7 we include only states that did not legalize marijuana for any use as controls Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.7: Robustness of Estimates of Recreational Marijuana Legalization on Economic, Labor Market, and Business Outcomes

Outcome	Baseline	Robustness					
		Controls	Spillovers		Control Group Selection		
		Time-Varying Controls	Any Neighbor RML Control	Share of Neighbors with RML Control	Never-Treated (No RML) States Only	Medical Legalization States As Controls	No RML or MML States Only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Economic Outcomes							
Log GDP per Capita	.0119	.0106	.0119	.0119	.0138	.0174	.0098
	(.0208)	(.0263)	(.0220)	(.0222)	(.0210)	(.0222)	(.0218)
Log Income per Capita	.0261**	.0023	.0271**	.0276**	.0285**	.0291**	.0279**
	(.0122)	(.0153)	(.0133)	(.0137)	(.0128)	(.0146)	(.0128)
Log Wages per Capita	.0147	.0151	.0143	.0140	.0168	.0200	.0134
	(.0145)	(.0169)	(.0151)	(.0152)	(.0147)	(.0159)	(.0153)
Log Proprietors Income per Capita	.1141**	-.069	.1196**	.1224**	.1136**	.1109**	.1165**
	(.0488)	(.0863)	(.0518)	(.0523)	(.0498)	(.0532)	(.0520)
B. Labor Market Outcomes							
Labor Force Participation Rate	.1497	-.009	.1348	.1286	.2019	.1270	.2827
	(.2815)	(.4403)	(.2824)	(.2861)	(.2879)	(.3048)	(.3067)
Unemployment Rate	.0014	.0005	.0015	.0014	.0008	-.002	.0039
	(.0034)	(.0040)	(.0036)	(.0037)	(.0036)	(.0041)	(.0035)
Log Cannabis Related Job Postings	.3705	.1407	.3801	.4102	.4658	.4329	.5013
	(.3168)	(.5993)	(.3384)	(.3433)	(.3385)	(.3672)	(.3575)
C. Business Outcomes							
Establishments Entry Rate	.1150	.3901	.0804	.0634	.0752	.1989	-.058
	(.1350)	(.3701)	(.1410)	(.1464)	(.1523)	(.1808)	(.1384)
Establishments Exit Rate	-.078	.2558*	-.086	-.089	-.098	-.145	-.046
	(.1101)	(.1523)	(.1181)	(.1219)	(.1168)	(.1400)	(.1119)
Job Creation Rate	.1722	.4882	.1909	.2241	.1718	.3134	.0193
	(.2401)	(.4110)	(.2621)	(.2722)	(.2730)	(.2989)	(.2772)
Job Destruction Rate	-.319*	.1341	-.272	-.261	-.324*	-.172*	-.488**
	(.1760)	(.7368)	(.1798)	(.1920)	(.1837)	(.1934)	(.1903)
Net Job Creation Rate	.4911*	.3543	.4630	.4857	.4965	.4862	.5076*
	(.2641)	(.8448)	(.2968)	(.3191)	(.3053)	(.3593)	(.2799)

Notes: ATT estimates of recreational marijuana legalization on a variety of economic, labor market, and business outcomes according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 adds state-level time-varying controls: state population shares for non-Hispanic whites, males, and three age groups (18-24, 25-64, and 65 and older year olds), state unemployment rate, and median household income, and beer and cigarette tax rates. Columns 3-4 test for potential spillovers by including an indicator for whether the state has a neighbor that RML (column 3) or the share of neighboring states that RML (column 4). Columns 5-7 use different states to serve as controls. In column 5 we use only never-treated states as controls, in column 6 we use only states that legalized medical marijuana use as controls, and in column 7 we include only states that did not legalize marijuana for any use as controls Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.8: Robustness of Estimates of Recreational Marijuana Legalization on House Prices and Population

Outcome	**Baseline**	**Robustness**					
		Controls	**Spillovers**		**Control Group Selection**		
		Time-Varying Controls	Any Neighbor RML Control	Share of Neighbors with RML Control	Never-Treated (No RML) States Only	Medical Legaliza-tion States As Controls	No RML or MML States Only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. House Prices							
Log Zillow Home Value Index (ZHVI)	.0641*	.0265	.0613*	.0581*	.0592*	.0708*	.0466
	(.0330)	(.0371)	(.0326)	(.0334)	(.0347)	(.0352)	(.0370)
Log Bottom-Tier ZHVI	.0649*	.0196	.0627*	.0598*	.0619*	.0692*	.0545
	(.0337)	(.0419)	(.0333)	(.0341)	(.0357)	(.0364)	(.0381)
Log Top-Tier ZHVI	.0643**	.0340	.0612*	.0579*	.0583*	.0700*	.0457
	(.0322)	(.0339)	(.0318)	(.0325)	(.0336)	(.0340)	(.0352)
B. Population							
Log Population Size	.0165**	.0073	.0155**	.0145*	.0144*	.0180*	.0106
	(.0076)	(.0126)	(.0076)	(.0080)	(.0078)	(.0085)	(.0087)
In-Migration Rate	-0.0001	-.001	-.000	-.000	-.000	.0000	-.001
	(.0010)	(.0017)	(.0010)	(.0010)	(.0010)	(.0011)	(.0010)
Out-Migration Rate	-.006	-.005	-.006	-.006	-.006	-.007	-.006
	(.0073)	(.0067)	(.0073)	(.0073)	(.0073)	(.0073)	(.0073)
Net-Migration Rate	.0062	.0038	.0061	.0061	.0062	.0072	.0051
	(.0065)	(.0063)	(.0065)	(.0065)	(.0065)	(.0065)	(.0065)

Notes: ATT estimates of recreational marijuana legalization on house prices and population outcomes according to Callaway Sant'Anna (2021) methodology presented in column 1. Control states include never treated and not yet treated states. Column 2 adds state-level time-varying controls: state population shares for non-Hispanic whites, males, and three age groups (18-24, 25-64, and 65 and older year olds), state unemployment rate, and median household income, and beer and cigarette tax rates. Columns 3-4 test for potential spillovers by including an indicator for whether the state has a neighbor that RML (column 3) or the share of neighboring states that RML (column 4). Columns 5-7 use different states to serve as controls. In column 5 we use only never-treated states as controls, in column 6 we use only states that legalized medical marijuana use as controls, and in column 7 we include only states that did not legalize marijuana for any use as controls Standard errors are clustered at the state level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$