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RESEARCH ARTICLE

Perceived versus Measured Impacts of Medical Marijuana on Rural Oklahoma Home Values

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Abstract
Oklahoma has witnessed a remarkable expansion of its medical marijuana industry since legalization in 2018, emerging as the largest in the nation in terms of both dispensaries and growers per capita. However, the ramifications of this burgeoning sector remain largely unexplored in rural areas of the state. A focus group in one rural community provides information on the most important perceived impacts of the industry, which include influences on local housing values. An event study confirms that high-grower (but not high-dispensary) counties saw housing value increases of roughly 20% post-legalization when compared to neighboring states where marijuana remains illegal.

Keywords: Event study; housing values; medical marijuana; Oklahoma

JEL classifications: R11; R21; R52

1. Introduction

Oklahoma passed State Question 788 in June 2018, legalizing the cultivation and use of medical marijuana. This continued a broader national trend, and to date, 38 other states have legalized marijuana either for medical or recreational use (Figure 1). Despite the growing nationwide acceptance of such measures, the legalization of medical marijuana in Oklahoma quickly became a divisive issue. The state's largely hands-off regulatory approach resulted in a dramatic proliferation of patient licenses, dispensaries, and growers. The number of licensed dispensaries in Oklahoma surpassed 2,000 by early 2020 – more than double the number in Colorado, which had legalized recreational marijuana in 2014 (Demko, 2020). Similarly, there were over 6,000 licensed growers by 2020 – compared to only eight for the entirety of neighboring Arkansas. A report from June 2023 commissioned by the Oklahoma Medical Marijuana Authority (OMMA) revealed that growers were producing marijuana in quantities 64 times greater than the demand from licensed consumers in the state (Mudd et al., 2023). The surge in marijuana dispensaries and cultivation facilities prompted immediate concerns within communities regarding their potential impact on local economies, crime rates, utility prices, water systems, and overall quality of life. Notably, marijuana grow operations in Oklahoma now outnumber traditional wheat and cotton farms (Romero, 2021), hinting at potentially disproportionate effects in rural areas. The palpable sense of polarization statewide was evident in the amount of state-level legislative activity (14 marijuana-related bills in the 2022 legislative session; 9 bills in the 2023 session (OMMA, 2023)) and underscores the need for exploration.

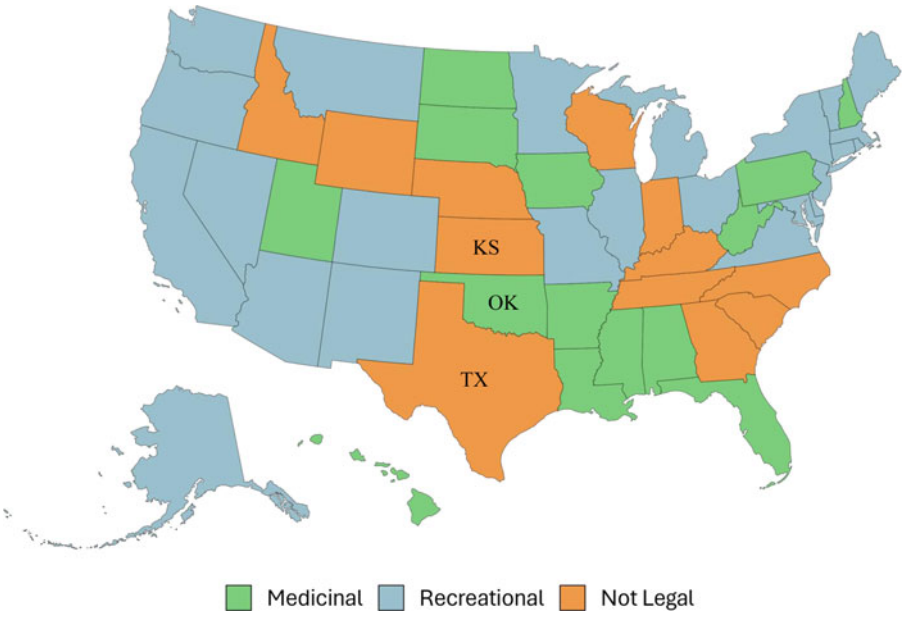

Figure 1. Legal status of marijuana across US states, 2024.
Source: Berke et al., 2024.

Given the state's initial regulatory approach[1], researching the effects of the marijuana industry on local communities represents an important contribution to both Oklahoma and other states that have recently passed similar legislation.[2] This study combines qualitative and quantitative approaches to compare perceived versus measured impacts: it first uses interviews of residents in one rural Oklahoma community about how the industry has impacted local life. One of the most prominent perceived impacts is to housing/property values, with residents complaining that many are now priced out of the housing market. An event study using publicly available data confirms that Oklahoma counties with high numbers of marijuana growers per capita saw housing values increase roughly 20% post-legalization compared to otherwise-similar counties in neighboring states where marijuana is illegal (Kansas and Texas). A similar relationship does not hold for high-dispensary counties, suggesting that an influx of growers – not dispensaries – caused the increase in housing prices as the medical marijuana industry expanded.

2. Background

Oklahoma became the thirtieth state to legalize marijuana for medical purposes, with 56.8% voting "yes" in June 2018 (McClung, 2018). Thousands of Oklahomans quickly took the opportunity to consume medical marijuana with over 235,000 licensed patient cards distributed by January 2020 (OMMA, 2023). The number of licensed patient cards increased to over 386,000 (roughly 10% of Oklahoma's population) by May 2022 before declining slightly to around 350,000 by mid-2024 (OMMA, 2024). Compared to other states with legalized medical marijuana, it is relatively easy to get a patient license in Oklahoma. Oklahoma Medical Marijuana Authority, 2024). Other states typically require documentation of qualifying conditions to be a licensed patient (Monies, 2020). For comparison, Arkansas (which passed medical marijuana in 2016) has roughly 92,000

[1]Oklahoma became known as the "Wild West of Weed" for its lax regulation and low barriers to entry (Tabachnik, 2021).
[2]These include Iowa (2017), West Virginia (2017), Utah (2018), South Dakota (2020), Alabama (2021), Mississippi (2022), Missouri (2018; recreational 2022), and Kentucky (2023) (all for medicinal marijuana unless otherwise noted).

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approved medical marijuana licenses – only about 3% of the state's population (Arkansas Department of Finance and Administration, 2023).

In addition to the relative ease of obtaining a patient license, it was also far less costly to open a dispensary or grow operation in Oklahoma in comparison to neighboring states. A grower license cost $500 in Oklahoma prior to 2023, compared to $15,000 (and $100,00 to renew) in Arkansas (Dover, 2017; Yalch, 2023). Similarly, Oklahoma dispensary licenses only cost $2,500, whereas Arkansas charged dispensary owners $7,500 for a license and required proof of at least $100,000 in liquid assets (Zimmer et al., 2022). The low cost of entry led to nearly 2,500 licensed dispensaries and over 9,000 licensed medical marijuana growers statewide by late 2021 (OMMA, 2023). This compares to only 38 dispensaries and 8 cultivators (i.e., growers) in the entire state of Arkansas (Arkansas State Legislature, 2022). In August 2022, a moratorium on licenses was implemented in Oklahoma, effectively ceasing new medical marijuana facilities from opening. Appendix A shows the number of patient, dispensary, and grower licenses awarded by the OMMA between 2020 and 2024.

In 2023, the OMMA authorized Cannabis Public Policy Consulting to conduct a study examining the supply chain and demand of the medical marijuana market in Oklahoma. The survey-based study found that 55% of patients were accessing at least some of their marijuana from illicit sources (Mudd et al., 2023). These sources include illicitly obtaining from medical dispensaries, family and friends, dealers, delivery, or home growing. Further, the study found that the regulated marijuana supply was roughly 64 times higher than the number of licensed users suggests would be needed. This suggests that Oklahoma is in a heavy state of oversupply – one that the report authors deemed "the largest any state has demonstrated" (Mudd et al., 2023, p. 18) and that a significant amount of the demand for the product is not occurring through legal channels. Relatedly, Han et al. (2024) show that high marijuana "sin taxes" can lead to increases in illicit market activity – which may also be relevant since the excise tax on marijuana in Oklahoma is 7%, compared to only 4% in Arkansas (the only neighboring state with significant border sharing where medicinal marijuana is also legal).

As the industry grew, Oklahomans had the opportunity to cast their vote regarding the future of the industry. In March 2023, a special election was held in which Oklahomans voted on State Question 820, which would have allowed marijuana use for recreational purposes. The "no" votes carried with only 38% of voters voting "yes" and each of the 77 counties voting "no" (Goodman, 2023). The proportion voting "no" was particularly high in many non-metropolitan counties, suggesting some buyer's remorse in these areas that likely saw the largest impacts to everyday activities.

More recently, the US Drug Enforcement Agency (DEA) has prepared a move to reclassify marijuana as a "Schedule 3" drug (i.e., with low potential for physical or psychological dependence) in 2024 (Miller et al., 2024). This has implications for interstate transactions because Schedule 3 drugs are typically allowed to be transported across state lines. However, this interstate commerce is only allowed for drugs approved by the US Food and Drug Administration, which is not the case for nearly all marijuana products (Sacirbey, 2023). Nonetheless, the reclassification of marijuana will likely result in less federal targeting of cross-border sales, and the dispensary/grower proliferation seen in Oklahoma could quickly have an even larger impact on the marijuana market in other states.

3. Literature review

Although medical marijuana has only been legal in Oklahoma since 2018, there is a multitude of research from other states that have enacted medical and recreational marijuana laws. While this existing body of evidence can be applied to Oklahoma in some instances, it is worth reiterating that Oklahoma is unique in that it has the most dispensaries in the country (US Dispensary, 2021) with enough to outnumber gas stations statewide (Morgan, 2022; U.S. Energy Information

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Association, 2022). Analyzing the effects in states with more established laws can assist in developing categories to discuss in the qualitative work to follow; these results also help with understanding longer-term benefits or repercussions.

One major concern with the legalization of medical marijuana is the effect on crime rates. One study, spanning across the eleven states with medical marijuana laws from 1990 to 2006 (Alaska, California, Colorado, Hawaii, Maine, Montana, Nevada, Oregon, Rhode Island, Vermont, and Washington) found that medical marijuana laws may have a crime-*reducing* effect, with homicide and assault decreasing 2.4% for each additional year the legislation was in place (Morris et al., 2014). The authors deduced that medical marijuana legislation did not prove to have any crime-enhancing effects on the seven crime types analyzed: homicide, forcible rape, robbery, aggravated assault, burglary, larceny, and auto theft (Morris et al., 2014). A California-based study conducted with data from January 2012 to December 2013 found that the density of medical marijuana dispensaries had no effect on property or violent crime rates in local areas but did have a "spillover" effect into spatially adjacent areas (Freisthler et al., 2016).

In addition to criminal activity concerns, there are concerns about the environmental effects of growing facilities. Three main causes of concern are (1) biodiversity, (2) water use by grow facilities, and (3) increased energy use. A study by Carah et al. (2015) found that these concerns have merit. The California-based study found that marijuana grow facilities, specifically those growing illegal market cannabis, were using pesticides that were creating harmful runoff to native species. Further, the authors reported that 3 billion liters of water were used by greenhouse-grown marijuana alone per growing season. Similarly, in Oklahoma, farmers in Oklahoma are reporting that they are unable to hire commercial pesticide applicators if they are near a marijuana grow facility because the applicators are being threatened with lawsuits by growers (Bodine, 2021). Likewise, the Oklahoma Rural Water Association found that areas dense with growing facilities experienced challenges with water shortages, pressure issues, and increased infrastructure costs (Rosman, 2022; Rubin, 2001). Energy use is also significant in greenhouse growing operations. In 2015, it was reported that growing facilities in Boulder County, Colorado, used 41,808 kilowatt-hours per month compared to the average household consumption of 630 kilowatt-hours per month (Durkay and Freeman, 2016). Similarly, in Oklahoma, a rural water district manager reported that one marijuana farm in his district used 223,000 gallons of water in August 2021 alone (Bodine, 2021). For comparison, a family of four uses an average of 12,000 gallons per month. Several of these concerns (illegal activities, environmental concerns) mirror those from a 2020 study assessing concerns and externalities associated with hemp production facility location in the Southeast United States (Campbell et al., Chaney, 2022).

Notably, medical marijuana has been beneficial to many Oklahomans from a health perspective. A study by Kendzor et al. (2022) found that there were several areas relating to health and overall quality of life that improved for users of medical cannabis. The study, conducted in 2020, found that most licensed survey participants in Oklahoma reported they used medical marijuana for the following reasons (followed by percent of responses): anxiety (42.51%), depression (33.24%), sleep problems (26.98%), chronic pain (24.25%), and arthritis (12.81%). Further, a study across states with and without medical marijuana legalization found that there was a relationship between the legislation and decreased use of opioids (Shah et al., 2018). The research, focusing on a 10% nationwide sample between the years 2006 and 2014, found that legalizing medical marijuana was associated with lower use of opioids (including chronic and high-risk use) in subgroups of both cancer patients and cancer-free groups with chronic pain (Shah et al., 2018). As opioid abuse has been a pressing issue in the United States for the last several decades, this comes as a relief in rural areas. The US Department of Agriculture reported that a study in 2021 covering five states (California, Connecticut, North Carolina, Vermont, and Virginia) found drug-overdose deaths to be higher in rural areas than urban areas, and a 2017 study found 74% of farmers had been directly affected by the opioid crisis (USDA, 2021). As such, the passage of medical marijuana could offer a form of release for individuals who might otherwise turn to opioids.

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One particularly interesting category where the impacts of medical marijuana might be seen is in housing or property values. Here, the potential impact of marijuana legalization effect seems to vary widely. Existing literature suggests that property values tended to increase in states with legal recreational marijuana but decrease in states where marijuana was only legalized for medical purposes. A study by Cheng et al. (2018) found that residential property sale prices in Colorado increased 21% from their initial listing price and that the probability of selling a home increased by 21% between January 2010 and August 2015 (Colorado voted to legalize recreational marijuana in 2012, with legalization beginning in 2014). Out of the 30 recreational marijuana-adopting municipalities included in the study, 70% were urban areas and 53% were metropolitan statistical areas. The authors of this study do note that this could be an "early adopters' effect" as Colorado was one of the first states to legalize marijuana recreationally (with these 30 municipalities being among the first in the state) and these effects were only found two years after legalization (Cheng et al., 2018). Another study by Thomas and Tian (2021) had differing results, likely due to their focus on properties near dispensaries. Their Washington-based study found that housing values decreased by 3.15% within a 0.36-mile radius of dispensaries using housing data from January 2012 to February 2016 (Thomas and Tian, 2021). Notably, Washington is also a state with legal recreational marijuana; however, their system for new dispensaries includes a lottery in which not every applicant is permitted to open a dispensary because the initial number of permitted dispensaries was capped at 334 statewide (Thomas and Tian, 2021). The study was not focused on rural areas specifically, and more urban areas were considered because cities (like Seattle) were allotted more licenses in the lottery than rural areas. No such regulations (i.e., a cap or a lottery) exist in Oklahoma, as the state allowed any applicant to obtain a license with fees ranging from $2,500 to $10,000 until a moratorium was placed on new licenses starting in August 2022 (OMMA, 2023). Because policies differ so much among states, it is important to analyze the effects on property values, specifically in Oklahoma. Both above studies adopted a difference-in-difference model to assess the changes of home values before and after the legalization of marijuana, which is the same approach taken here.

A recent study by the National Association of Realtors (NAR) took a more qualitative research approach to this topic (Christopherson et al., 2023). The association sent out email surveys in March 2023 to realtors in all states where marijuana was legalized for either recreational or medicinal purposes to gauge the effects they were seeing after the legislation had passed as well as their perceptions on the crime rate in areas with dispensaries and grow facilities. The survey was sent to a random sample of 75,000 NAR members who practice residential real estate and 53,000 who practice commercial real estate. The sample was divided by states who only have legalized medical marijuana and those with both recreational and medicinal marijuana. There were 282 respondents from states with only medical cannabis and 1,352 from states with recreational and medical legislation. The study found that 25–29% of members (realtors) had seen an increased demand in warehouse facilities in states where both types of marijuana were legal. Similarly, 18% saw increased demand for storefront properties, and 13–15% saw increases in land values in these locations. Further, the study found that 22–28% of commercial realtors perceived that crime rates had increased in areas near dispensaries. This distinction between grower-focused properties and proximity to commercial businesses (i.e., dispensaries) is an important one. This study expands on these qualitative measures by surveying Oklahoma residents to gauge local perceptions and contrasting their responses with secondary data.

4. Methods and data

4.1. Qualitative research approach

The community research took place in the county seat (Okemah, pop. 3,000) of Okfuskee County, Oklahoma. Okfuskee County was selected as the focal community as part of a larger project

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funded by Oklahoma State University's Rural Renewal Initiative (RRI) because they face three USDA Economic Research Service stressors: low employment, persistent poverty, and persistent child poverty. The area is also strikingly high in terms of growers per capita and around the state average in dispensaries per capita.[3] Notably, 74% of voters in Okfuskee County voted "No" on State Question 820 in 2023, which would have legalized marijuana for recreational use – again, well above the state average of 62%.

A community meeting (with protocol approved by Oklahoma State University's Institutional Review Board) took place in September 2023 to gauge perceptions about how the marijuana industry has affected local life. Participants were made aware of the community meeting via personal and social media marketing, including through local contacts such as the county extension and city manager's office. At the meeting, researchers asked participants to respond to open-ended questions to see how they felt about medical marijuana without being prompted. From there, a series of probe questions/topics were brought up to guide conversation and gain a better understanding of what Okfuskee County residents felt most strongly about. The meeting concluded with an exercise where each participant voted for three issues discussed during the meeting that they felt were the highest priority for their community. Following this meeting, the researchers met independently to decide which of the topics to pursue with quantitative analysis to assess the degree to which these local perceptions were accurate.

4.2. Quantitative data and event-study framework

To analyze the impact of medical marijuana legalization on rural housing values, publicly available data from Zillow's Home Value Index (ZHVI) were used. The ZHVI offers data from January 2000 to 2023 and measures monthly changes in housing estimates, capturing both the level and appreciation of home values across geographical areas and home types (Olsen, 2023). It represents the measure of a typical home value in each county for homes in the 35th to 65th percentile range and is smoothed and seasonally adjusted (Allison, 2022). It is built from individual home estimates derived from machine learning models that incorporate public, user-generated, and real estate data (Hryniw, 2019). The ZHVI has been used in other recent academic research (Gale and Roy, 2023; Gamber et al., 2023; Graham and Makridis, 2023; Holt and Borsuk, 2020; Kahn, 2024) and is particularly useful for rural counties where sales data is limited. Importantly, the ZHVI data is not focused on land or agricultural property values. Rather, it represents the typical home value in a county. These home values may include nearby land but generally do not represent values of land intended for agricultural use. The ZHVI values were adjusted to July 2023 dollars using the federal Consumer Price Index.

To precisely gauge the effects of medical marijuana's legalization on housing values, neighboring states with no legalized marijuana are used as controls. Oklahoma, Texas, and Kansas data were gathered dating back to 2016 (the earliest date that "full" data became available for most counties in these three states and 2.5 years before the legalization of medical cannabis in Oklahoma) to assess how this shift affected rural property values over the course of over seven years. Graphs showing changes in inflation-adjusted county-level home prices for "all homes" from ZHVI from February 2016 to July 2023 for Oklahoma (77 counties), Kansas (104 counties), and Texas (214 counties) are found in Appendix B. The dotted line in these figures represents the formal legalization of medical marijuana (in Oklahoma only) in June 2018. Issues regarding missing data were handled by linearly imputing values from before and after missing periods (used for less than 2% of the data reported, with between 1 and 3 months of missing data). Thirty of the 244 counties in Texas and one county in Kansas were removed entirely as they had no data available or were missing wide swaths (i.e., more than 15 missing months). As a check on the

[3]Okfuskee county has 96 licensed medical marijuana growers per 10,000 population compared to the Oklahoma average of 30 in 2022. They also had 7.1 dispensaries per 10,000 population compared to the state average of 8.7.

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data's quality, we follow Kahn (2024) and compare the ZHVI to the Federal Housing Finance Agency's House Price Index (HPI). The HPI contains some county-level data; however, it is only available annually, and many counties are missing (15 of 77 OK counties; 56 of 230 TX counties; 32 of 104 KS counties).[4] When the monthly ZHVI is converted to annual data and compared to counties with HPI data for years 2016–2022, the correlation is 0.74. The final panel consists of 395 counties over 90 months for 35,550 observations.[5]

We begin our analysis with a basic difference-in-difference framework, with a "post-event" indicator taking value of one for Oklahoma observations when medical marijuana became legal (June 2018 and after). This takes the form:

$$\ln(ZHVI)_{it} = \alpha + \beta PostEvent + \mu_i + \delta_t + \varepsilon_{it} \tag{1}$$

where $ZHVI_{it}$ is the housing value for county i in month t, μ_i and δ_t are county and month fixed effects, respectively, and ε_{it} is an unobserved error term. Here β estimates the aggregate treatment effect of legalization on housing values. The downside of this approach is that it does not provide any information about housing value trends in treated versus control groups both before and after legalization – in particular, for assessing whether the so-called "parallel trends" assumption holds (Lechner, 2011).

To address this, we follow Clarke and Tapia-Schythe (2020) in using an event-study framework that allows for this before and after visualization:

$$\ln(ZHVI)_{it} = \alpha + \sum_{j=2}^{28} \beta_j \cdot Lead_{it}^{j} + \sum_{k=1}^{61} \gamma_k \cdot Lag_{it}^{k} + \mu_i + \delta_t + \varepsilon_{it}. \tag{2}$$

Here $Lead_{it}^{j}$ and Lag_{it}^{k} are a set of binary variables that indicate that a county is a given number of periods away from the passage of medical marijuana legislation. Note that all control counties (i.e., those in Kansas and Texas) have zero values for all lead and lag variables. Following convention, we omit the month immediately prior to treatment ($j = 1$) to allow for inspection of whether the treatment had an immediate impact (i.e., where $k = 1$). To make a case that a specific treatment *causes* a change in housing values between the treated and control groups, the coefficient estimates prior to treatment (β_j) should be indistinguishable from zero, while those for the post-implementation period (γ_k) should be statistically significant.[6] No control variables are included in this framework because nearly all potential candidates do not vary monthly, and there is a strong argument that such controls are not necessary if treated and control groups are similar prior to treatment (Huntington-Klein, 2023). This is accomplished with the matching approach outlined below.

4.3. Matching high-grower and high-dispensary counties

The event-study specification above can be run on a variety of county subsets, including those defined as non-metropolitan, high-poverty, farming dependent, or with high natural amenities.[7] More central to the research question here is whether counties with high levels of grower or dispensary activity have seen their housing values measurably change after legalization. As such, we construct binary treatment categories for Oklahoma counties in the top quartile and above the median for the number of licensed growers and dispensaries per capita. We then use coarsened

[4]The county-level annual House Price Index is available at https://www.fhfa.gov/data/hpi/datasets.

[5]In theory, individual housing transactions could be used to identify the impacts of interest. Difference-in-difference analysis using repeated cross-sectional data is common practice (Athey and Imbens, 2006; De Chaisemartin and d'Haultfoeuille, 2024). However, this transaction-level data is not publicly available for the three states used in this analysis, and the limited number of transactions in rural counties makes the approach using monthly ZHVI data more appealing.

[6]Note that with only a single treatment period (after June 2018) for a single treatment group (Oklahoma counties only), recent statistical techniques addressing bias that may result from "staggered" difference-in-difference settings are not necessary (Callaway and Sant'Anna, 2021).

[7]These results are available upon request.

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exact matching (CEM) to compile a set of otherwise-similar counties in Kansas and Texas. These counties can then be used as the control group for the event-study model and provide a cleaner case for causality given that they have similar characteristics to Oklahoma counties where the medical marijuana industry has seen high levels of growth.

CEM is a tool for reducing biases found when there are significant imbalances between treated and control groups (Iacus et al., 2012) and has become increasingly popular in agricultural economics and the broader social science literature (Bertoni et al., 2020; Fraser et al., 2021; Meadowcroft et al., 2020). The modeler chooses specific demographics expected to influence treatment, and the matching process then assigns a "bin signature" to each observation representing its covariate distribution. The sample is then pruned when a "bin" contains either only treated or control observations (i.e., a match cannot be made), and those observations are removed from the regression analysis that follows. In practice, the covariates are selected based on regressions of the number of growers and dispensaries per capita in Oklahoma counties (compiled from OMMA data as of 2022). For dispensaries per capita, the selected county-level covariates are the percentage with a disability, the natural log of the population, and the Gini index. For growers per capita, the covariates are the percentage with health insurance, population density, and the natural log of commodity sales per farming operation.[8] Appendix C shows how the use of these covariates reduces the imbalances across treated and control groups, with an accompanying reduction in sample size.[9] For example, initially, there are 20 treated Oklahoma counties in the top quartile for dispensaries per capita, and 329 possible KS/TX control counties to compare them to. After CEM, this sample shrinks to 13 treated and 66 control counties. Other matching specifications were tried, with similar results (available upon request).

5. Results

The community meeting in Okemah took place in September 2023 and lasted around two hours. Twenty-five local residents participated, with 20 voting in the exercise at the end of the event. The full group was split into two smaller groups for open-ended discussion and then brought together to compile a "Top 6" categories representing areas where they believed their community was most impacted by the legalization of medical marijuana. The six groups (summarized in Table 1) are as follows: (1) wellness/health, (2) property values, (3) misinformation, (4) distribution safety/product safety, (5) utilities, and (6) industry regulations. Participants then expanded on each of these areas, summarizing the takeaway issue/concern with each. Finally, each participant was provided with three tokens to vote for their own "Top 3" categories among the six generated by the group discussion. Table 1 also includes the aggregate number of votes received during this exercise (note that there were 60 total votes across the 20 voters).

One of the categories listed in Table 1 is property values and land use. The discussion on this topic largely centered around land and houses being purchased by "outside speculators" (largely grow operations) and driving up local prices and property taxes. Three of the 25 session participants brought up the price of local *housing* (distinct from agricultural land) prices as an issue during the initial discussion, which is on par with the 13% (8 out of 60) votes cast during the voting exercise. Further assessment by the researchers on this project determined that this category could be empirically evaluated using publicly available data in a relatively short time period. The other categories in Table 1 will be explored in future research through the RRI as funding allows.

[8]Each of the variables used for CEM are taken from the 5-year county-level Census ACS estimates (2014-2018), except for commodity sales per farming operation, which came from the 2017 NASS. As such, all variables used in the matching are from before legalization.

[9]The univariate imbalances reported here are the L1 metrics reported by Iacus et al. (2012), which range from 0 to 1 (1 representing the largest possible imbalance). General guidance from the statistics literature is that L1 measures lower than 0.10 or 0.25 represent data that is adequately balanced (Austin, 2009; Rubin, 2001).

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Table 1. Perceived impacts of medical marijuana industry on Okemah, OK residents

Number	Category	Discussion points	Number of votes*
1	Wellness/health	Strong support for accessibility of medical marijuana for veterans/ disabled. Many viewed marijuana as a natural/safer alternative for pain management compared to opioids/alcohol.	13
2	Property values	Loss of farmland and increase in outside speculators (foreign and domestic) on local property. Neighboring land values increasing; property taxes increasing. More difficult for local residents to purchase a home.	8
3	Misinformation	Lack of knowledge in the community about marijuana and its medicinal benefits. Pre-existing negative perceptions of marijuana. Influence of both pro- and anti-marijuana propaganda was a concern.	7
4	Distribution/ product safety	Legalization of medical marijuana has made it physically safer (safer product and for individuals who may have purchased it illegally prior to legalization). Unintended use by children was a concern, particularly for products where the packaging looks like candy.	11
5	Utilities	Concerns about potential water shortages, power grid overloads, and inadequate infrastructure. Potential impact on taxpayers/utility prices. Local utility employees offered that the influx of growers resulted in higher revenues for both electricity and water providers.	11
6	Industry regulations	OMMA overwhelmed – lack of enforcement/oversight. Many felt OMMA gave out too many dispensary/grower licenses. Some concerns about whether local workforce shortages were related to drug testing.	10

*Each of the 20 participants voted for 3 categories they felt were most important for their community (60 total votes).

Table 2 provides the results of the basic difference-in-difference specification in equation (1). It includes aggregate treatment effects for all Oklahoma counties and those pruned to the top half and top quarter of both dispensaries per capita and growers per capita. The results suggest a slightly negative impact (−1.4%) on property values for all counties, but a 5 to 7% increase for counties with high levels of growers. No aggregate impact was seen for counties with high levels of dispensaries.

The event-study results from equation (2) are plotted in Figures 2, 3, and 4. They provide more nuance and demonstrate that the legalization of medical marijuana in Oklahoma had strong positive impacts on housing values, but only in counties where grower activity was particularly pronounced. The negative aggregate impact suggested for all OK counties in Table 2 appears to be driven by just a few months and is not robust over time (Figure 2). However, the positive effect for high-grower counties (Figure 3) increases over time and becomes larger for more stringent definitions of treatment, with counties in the top quartile of growers per capita seeing their housing values increase by 25% five years after legalization. This compares to roughly 20% for counties in the top half for the same time period. No impact is seen for high-dispensary counties (Figure 4). Results from the non-trimmed samples (Appendix D) show reduced impacts (10–13% increases after five years) for the high-grower counties, and again no impact for high-dispensary counties.

Several points are worth emphasizing about these event-study plots. First, none of the $Lead_{it}^{j}$ coefficients (β_j) are statistically different from zero, validating the parallel trends assumption (i.e., that housing values in the treated and control groups behaved similarly prior to treatment) and suggesting that the matching protocol worked. Second, the positive impact on housing values in Figure 3 is not seen until roughly 20 months post-legalization (around February 2020). After that, it ramps up nearly linearly except for a short-lived decline about three years afterward (June 2021) – around the same time the number of licensed medical marijuana growers reached its peak. The impact continues after August 2022, when the moratorium on grower/dispensary licenses was put into place, suggesting that this policy change did not immediately relieve upward pressure on housing values in high-grower counties.

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Table 2. Difference-in-difference (DiD) results for impact of medical marijuana legalization on housing values

			Matched grower				Matched dispensaries			
	All counties		Top 50%		Top quartile		Top 50%		Top quartile	
	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.
DiD coefficient (β)	−0.0142***	0.0031	0.0505***	0.0038	0.0708***	0.0048	−0.0046	0.0050	0.0017	0.0061
Number obs.	35,550		19,080		13,050		11,340		7,821	
R^2	0.9676		0.9695		0.9652		0.9644		0.9683	

***denotes statistical significance at the $p < 0.01$ level.

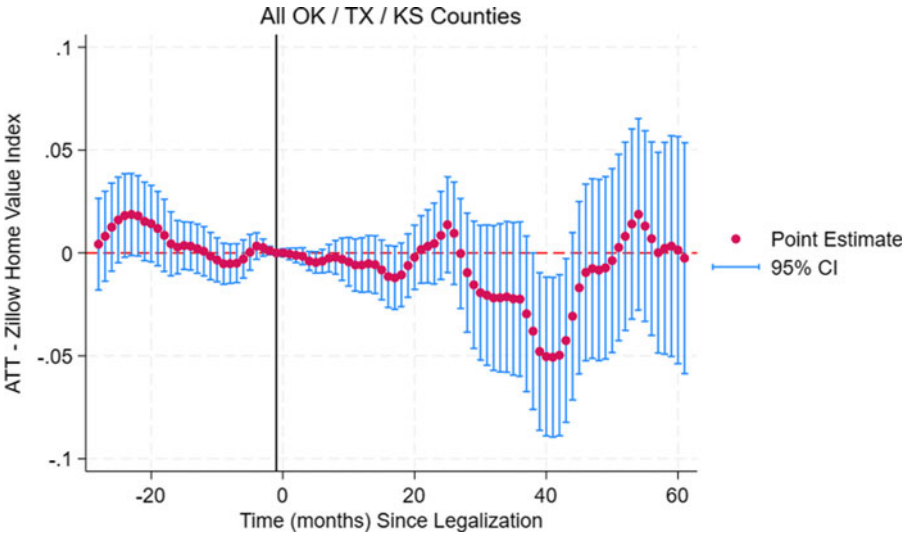

Figure 2. Housing value event-study plot, all counties.

6. Discussion

This research sought to address critical gaps in existing medical marijuana literature by meshing subjective perceptions of residents of one rural Oklahoma town with an empirical analysis of the measurable impact on one of the categories identified by the community (property/housing values). The Oklahoma medical marijuana landscape is particularly unique, characterized by a high number of dispensaries and grow facilities both in terms of pure quantity and per capita. A combination of qualitative methods (focus groups and voting exercise) and quantitative techniques (panel event study) was employed to compare perceived versus measured effects on housing values, and similar approaches could be used for issues raised in other locations.

For the qualitative analysis, a focus group in Okemah identified six primary areas of interest and concern for rural Oklahomans, namely: (1) wellness/health, (2) property values, (3) misinformation, (4) distribution safety/product safety, (5) utilities, and (6) industry regulations. Two important takeaways from these final categories are that (1) not all perceived impacts are negative and (2) local crime rates were not included. In fact, the category receiving the most votes from participants centered on the largely positive impact of the industry on local veterans and disabled citizens who were viewed as having legitimate reasons to consume. This is consistent with existing studies focusing on the benefits of medical marijuana (Kendzor et al., 2022). Further, while Oklahoma's marijuana industry has made headlines for its linkage to organized crime

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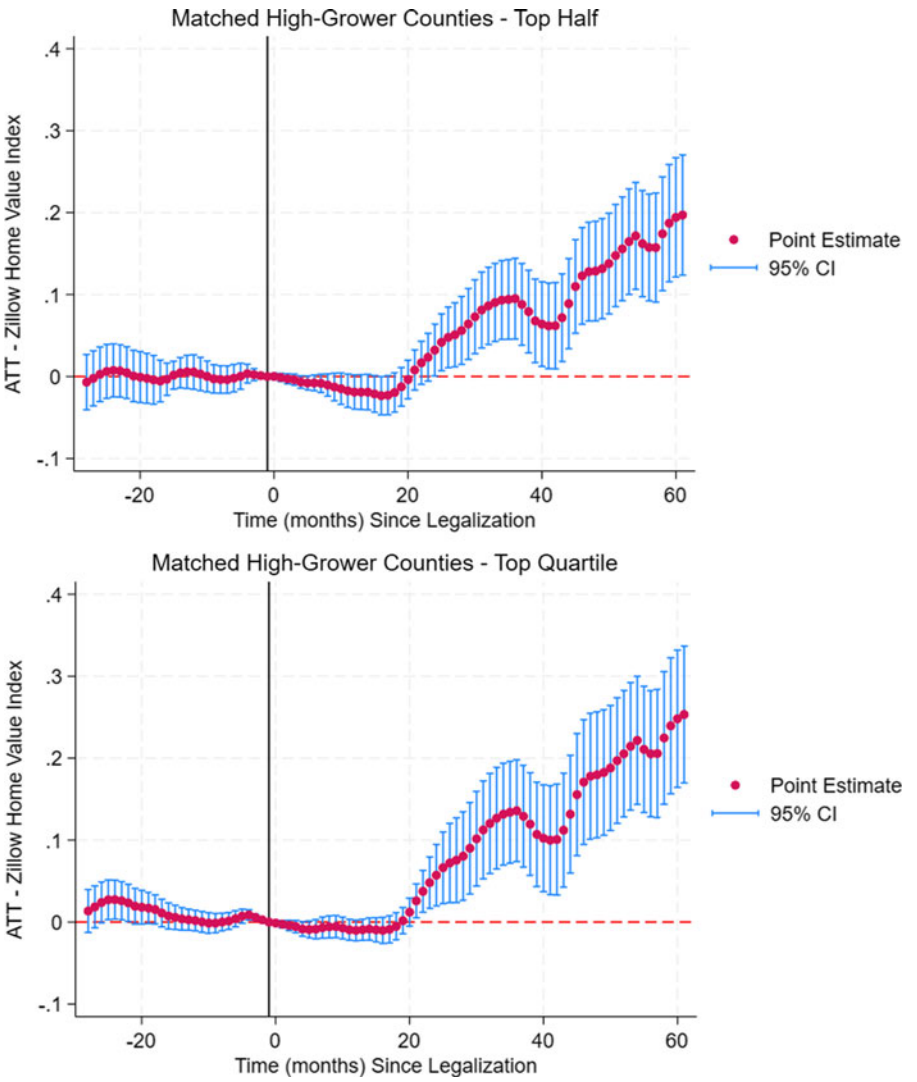

Figure 3. Housing value event-study plot, high-grower counties in OK.

(Ayer, 2024; Yalch, 2023), local perceptions of crime-related impacts likely vary according to "on the ground" experiences. This qualitative finding adds to the body of evidence suggesting minimal impacts on crime rates following the passage of medical marijuana laws (Freisthler et al., 2016; Morris et al., Oklahoma Medical Marijuana Authority, 2024). Ongoing survey work is attempting to verify if these issues are consistently viewed as important in other rural locations across Oklahoma.

The qualitative results indicated a largely negative perception of the impact of the industry on local property values. To assess this empirically, we used monthly county-level data from 2016 through 2023 on housing values for Oklahoma and two neighboring states where all marijuana is illegal (Kansas and Texas). After pruning the sample to only consider control counties similar to Oklahoma high-grower and high-dispensary counties, event-study models demonstrate that high-grower counties (but not their high-dispensary counterparts) were impacted. Five years after legalization, "typical" housing values were 20 to 25% higher in these locations than what would have been expected in comparable Kansas or Texas counties. However, the impacts only began roughly 20 months after the legislation was passed. We argue that this increase was driven by the

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Figure 4. Housing value event-study plot, high-dispensary counties in OK.

surge in growers between late 2020 and early 2022 (Appendix A) and continued over time, perhaps as remaining growers increased their local presence and added workers.[10] This result largely validates the perception of Okemah residents, who expressed concern about property values rising and locals being priced out of the housing market. Indeed, in Okfuskee County (where Okemah is located), the inflation-adjusted Zillow Home Value index rose from $72,500 at the time of legalization to $78,325 twenty months later and then to $120,158 by June 2023. Given that Okfuskee is in the top quartile of growers per capita, the expected June 2023 ZHVI in a hypothetical counterfactual where medical marijuana never became legal would have been

[10]A reviewer questions whether the modeling approach is picking up an increase in housing demand due to COVID. However, COVID restrictions across the three states were relatively similar and likely not responsible for the housing price increases documented here. All three states reopened businesses within roughly one week of each other (OK – 4/24/20; TX – 5/1/20; KS – 5/4/20), and only KS had a stay-at-home order in place for the general public, which lasted for only April 2020 (Raifman et al., 2020).

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$96,125. This is roughly $24,000 lower than the actual ZHVI at that time – a striking amount for most counties but even more pronounced for one with persistent poverty and low employment like Okfuskee.

The fact that impacts were limited to high-grower, but not high-dispensary, counties suggests that cannabis grower activity is primarily responsible for driving up local housing values. This coincides with anecdotal evidence about cash offers for land and houses (often with perceptions of out-of-state or international backing) in rural areas of the state (Patterson, 2021; Chaney, 2022). An important caveat, however, is that the home values reported here through the ZHVI are *not* focused on agricultural land and, as such, do not capture any changes driven solely by investment in land. The National Agricultural Statistics Service (NASS) does have data on agricultural land values and rent, but not at the county level and only on an annual basis. Oklahoma Cooperative Extension provides county-level data on agricultural land values, but again only annually. Future research could attempt to quantify the impacts of the marijuana industry on agricultural land values if data becomes available at a more frequent interval.

Several limitations to our approach are worth mentioning. The first is that itemized data on the number and locations of growers or dispensaries over time is not available from the OMMA website. We use grower/dispensary data from February 2022, which is close to the peak of grower licenses. The second is that the analysis here cannot say anything conclusive about the mechanism by which this legislation affected home values. There are several possible mechanisms for this impact, including increased demand from new workers in the industry, spillover effects from rising commercial and agricultural land values, and general economic growth and job creation in the area. While we hypothesize that the mechanism most likely runs from potential growers to land to housing, we are unable to test this due to the lack of monthly agricultural land values discussed above. Further, new workers in grow operations across the state were often undocumented (Feng, 2024; Rotella, 2024) and were likely hidden from formal population change measures. Land purchases by foreign countries also increased dramatically in Oklahoma during this time, with USDA reports documenting over 1 million additional foreign-held acres in the state in 2023 (1.7 million) compared to 2018 (0.7 million) (USDA FSA, 2018-2023). The delayed impact documented here likely reflects the industry adjusting to these changing local conditions, including foreign investment.

From a policy perspective, several efforts have already been made to address the issue of outside speculators entering the Oklahoma marijuana market. In particular, HB 2612 (passed in 2019) required that at least 75% of all marijuana-related businesses be owned by Oklahoma residents who have lived in the state for no less than two years. However, organizations appear to be evading this law by using "straw" or "ghost" owners. In such cases, individuals are listed as majority (at least 75%) shareholders but are not involved with the day-to-day running of the business. These entities have increasingly become targets of the Oklahoma Bureau of Narcotics and the Attorney General (Mangold, 2022; Schlotthauer, 2023). Another law dealing with excessive amounts of growers, HB 2179, was passed in 2022. It created "tiers" of fees for growing facilities that ramped up from $2,500 for up to 2.5 acres to $50,000 for between 40 and 50 acres. Finally, Senate Bill 212 was passed in late 2023, prohibiting foreign individuals from purchasing land in the state for marijuana cultivation.

7. Conclusion

The "Wild West of Weed" title bestowed upon Oklahoma offers lessons for states that may follow in its footsteps. Too little initial regulation resulted in an oversupply of dispensaries and growers, with impacts on local communities that are only now being quantified (Demko, 2023). Follow-up legislation attempted to correct many of the original oversights, but the impacts can be long-lasting. This is demonstrated by the fact that housing values continued to rise in high-grower counties even after a moratorium/higher fees were placed on additional grower licenses.

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As marijuana continues its journey atowards a lower-tier Schedule 3 drug, it is important to gauge the industry's current (and potential future) impacts on local communities. The approach here offers a path for comparing perceived and measured effects by engaging local residents and following up with empirical analysis. Future work should explore other ways in which the marijuana industry affects residents' quality of life, including in states where the regulatory approach was more restrictive.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/aae.2025.13.

Data availability statement. All quantitative data used is derived from publicly available sources and can be shared. The qualitative data was derived from an IRB-approved project and can be shared in summary form.

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