The effects of medical marijuana laws on illegal marijuana use☆

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ARTICLE INFO

ABSTRACT

More and more states have passed laws that allow individuals to use marijuana for medical purposes. There is an ongoing, heated policy debate over whether these laws have increased marijuana use among non-patients. In this paper, I address that question empirically by studying marijuana possession arrests in cities from 1988 to 2008. I estimate fixed effects models with city-specific time trends that can condition on unobserved heterogeneities across cities in both their levels and trends. I find that these laws increase marijuana arrests among adult males by about 15–20%. These results are further validated by findings from data on treatment admissions to rehabilitation facilities: marijuana treatments among adult males increased by 10–20% after the passage of medical marijuana laws.

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"*By characterizing the use of illegal drugs as quasi-legal, state-sanctioned, Saturday afternoon fun, legalizers destabilize the societal norm that drug use is dangerous. . .Children entering drug abuse treatment routinely report that they heard that 'pot is medicine' and, therefore, believed it to be good for them.*" Andrea Barthwell, M.D., Former Deputy Director of the White House Office of National Drug Control Policy, in an editorial in *The Chicago Tribune*, February 17, 2004.

1. Introduction

Medical marijuana legislation represents a major change in U.S. policy toward marijuana in recent years. As of May 2014, 22 states and the District of Columbia had passed laws that allow individuals with designated symptoms to use marijuana for medical purposes. Two medical marijuana states, Colorado and Washington, went further to legalize the recreational use of marijuana in November 2012.

Although the number of legal patients was relatively small until recently, it has been a popular belief among public media that legalization has increased illegal marijuana use among non-patients (Leger, 2012; O'Connor, 2011). Federal agencies such as the Drug Enforcement Administration (DEA) also oppose these laws based on this notion, and continue to list marijuana as a Schedule I drug with no accepted medical value (Drug Enforcement Administration, 2011). Some evidence suggests that the leaking of medical marijuana from legal patients or dispensaries may be common (Salomonsen-Sautel et al., 2012; Thurstone et al., 2011). Moreover, these laws could send a "wrong message" to the public and increase social acceptance for marijuana use. For example,

Khatapoush and Hallfors (2004) find that people in California perceived less harm from smoking marijuana after legalization. Empirically, there is indeed a strong correlation among medical marijuana legislation, the perceived risk of marijuana, and marijuana use. Drawing on public-use state-level data from the National Survey on Drug Use and Health (NSDUH) for the years 2002 through 2008, Wall et al. (2011) find that legalization was associated with a higher prevalence rate and a lower perceived risk of marijuana use among juveniles. Cerdá et al. (2012) also find a similar correlation among adults from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC).

Despite the strong correlation, the causal link appears to be weak after accounting for existing state differences. Most of the existing studies focus on juveniles. Harper et al. (2012) show that the findings from Wall et al. (2011) are quite sensitive to the inclusion of state fixed effects. A couple of studies look at the Youth Risk Behavior Surveillance System (YRBSS) and do not find any change in juvenile marijuana usage (Choo et al., 2014; Lynne-Landsman et al., 2013; O'Keefe and Earleywine, 2011). Using a number of datasets that cover a longer period, including the YRBSS, Treatment Episode Data Sets (TEDS), and National Longitudinal Survey of Youth 1997 (NLSY97), Anderson et al. (2012) also finds no evidence of an increase in marijuana use among teenagers. On the other hand, based on the same datasets, Pacula et al. (2013) find some evidence that specific dimensions of medical marijuana laws, such as home cultivation and legal dispensaries, appear to be positively associated with marijuana use.

Only a few studies focus on adults, even though the marijuana prevalence rate is actually higher among young adults than among juveniles from survey data. (For example, see Table E1 in Appendix E.) Gorman and Huber (2007) use a time series framework and do not find any significant change in marijuana use among arrestees from the Arrestee Drug Abuse Monitoring data (ADAM). But their data were limited to a small portion of arrestees with available urine test samples from only four cities in a short time span. Based on the public-use state-level NSDUH data, the estimates from Harper et al. (2012) are positive but insignificant for young adults aged 18–25. However, the fixed-effect estimates in Harper et al. (2012) may not be very precise because the public-use NSDUH only provides state-level data on marijuana use as two-year moving averages with the intention of reducing within-state variation.

One limitation in existing studies is that they largely ignore the intensive margin. For example, Anderson et al. (2013) show that the prices of high-quality marijuana are decreasing over time after legalization. As consumption may respond to price at both the extensive and intensive margins, the small-to-none estimated effects in the above studies could be a result of ignoring the intensive margin. Based on the restricted version of the NSDUH, with access to individual-level data, a new working paper from Wen et al. (2014) suggests strong legalization effects on both the extensive and intensive margins. For adults aged 21 or above, they find an increase in the probability of marijuana use of 16% and an increase in marijuana use frequency of 12–17%. They find an even larger increase for heavy marijuana use, with a 15–27% increase in the probability of marijuana dependence.

Adding to the still-limited literature, this paper focuses on adults and estimates the effects of medical marijuana laws on illegal use among non-patients. Specifically, I use marijuana possession arrests at the city level from the Uniform Crime Reports (UCR) for the years 1988–2008. To address the concern that arrests could be biased if law enforcement endogenously responds to these medical marijuana laws, I supplement the analysis by using the state-level marijuana treatment admissions that are not referred by the criminal justice system from the Treatment Episode Data Sets (TEDS) for the years 1992–2008. Although arrests and
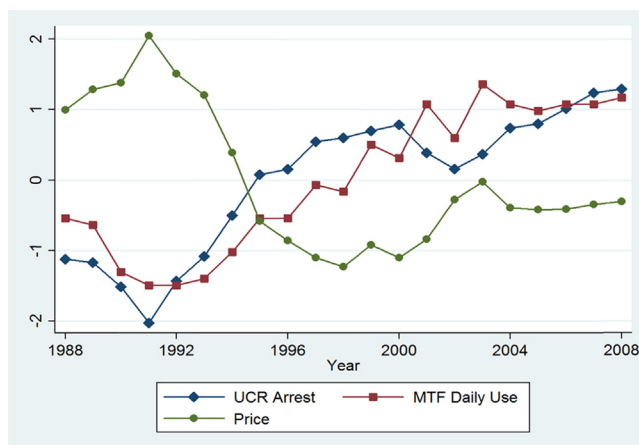
Fig. 1. Marijuana arrest rates, prices and daily use rates 1988–2008 (normalized). *Note*: The marijuana arrests are the yearly averages of arrest rates from my sample, the daily marijuana use rates are among ages 19–28 from the Monitoring The Future (MTF), and marijuana prices (without control for purity) are from the 2012 National Drug Control Strategy Data Supplement. All series in this figure are normalized to mean zero and standard deviation one.

treatments do not measure marijuana use directly, as they represent frequencies rather than individuals, conceptually they are able to capture changes not only at the extensive margin but also at the intensive margin. Also, arrest and treatment data represent objective measures, and they do not suffer from the self-reporting bias that is common in survey data (Golub et al., 2005; Harrison et al., 2007). It is particularly important in the current context, since people may report more honestly after legalization (Miller and Kuhns, 2011). Another advantage of these datasets is that they cover a period during which 12 states legalized medical marijuana and provide more observations at the city/state levels than many survey datasets. This can reduce potential imprecision in some existing estimates that are based on only a few law changes or a small number of observations at the state level.

In this paper, I adopt a more robust difference-in-difference (DD) research design. As in the standard DD type approach, I estimate reduced-form models for the effects of medical marijuana laws on marijuana arrests/treatments, conditioning on city/state and year fixed effects. To relax the assumption of parallel trends in the standard DD approach, I control for city/state-specific time trends (linear or quadratic) to allow for different trends of arrests/treatments in each city/state. Therefore, my models can account for empirically important unobserved cross-city/state heterogeneity in both levels and trends. Drawing inference from marijuana arrests and treatments, I find that the main effect of these laws on adult males was to increase illegal marijuana usage. From the UCR, medical marijuana laws, on average, are associated with a 15–20% increase in marijuana possession arrests among adult males. The results from the TEDS are consistent with the findings from the arrest data, indicating a 10–15% increase in marijuana treatments among adult males. Further examination reveals that the increase in marijuana treatments mainly comes from referrals without prior treatment episodes. The estimates indicate a 20% increase in first-time marijuana treatments that excludes any recidivism.

As there are more and more states passing medical marijuana laws, this paper addresses the heated policy debate on these laws by presenting evidence for an increase in illegal use among non-patients. Fig. 1 shows that the marijuana possession arrest rates