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High times: The effect of medical marijuana laws on student time use

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ABSTRACT

Medical marijuana laws (MMLs) represent a major change of marijuana policy in the U.S. Previous research shows that these laws increase marijuana use among adults. In this paper, we estimate the effects of MMLs on secondary and post-secondary students' time use using data from the American Time Use Survey. We apply a difference-in-differences research design and estimate flexible fixed effects models that condition on state fixed effects and state-specific time trends. We find no effect of MMLs on secondary students' time use. However, we find that college students in MML states spend approximately 20% less time on education-related activities and 20% more time on leisure activities than their counterparts in non-MML states. These behavioral responses largely occur during weekends and summer when students have more spare time. Finally, the impacts of MMLs are heterogeneous and stronger among part-time college students, who are more likely to be first-generation college goers and to come from underrepresented racial and ethnic groups.

"I now have absolute proof that smoking even one marijuana cigarette is equal in brain damage to being on Bikini Island during an H-bomb blast."
■ Ronald Reagan, 40th U.S. President.

1. Introduction

It is a popular belief that marijuana use harms educational performance and predicts school dropout and truancy. Marijuana use is highly correlated with low educational attainment and medical research suggests that marijuana can affect motivation, attention, and cognition. However, empirical evidence on the causal link between marijuana use and educational outcomes is limited. Despite significant policy implications, there are relatively few rigorous studies on the topic. Moreover, much of the extant literature relies on strong identification assumptions. Accordingly, it is unclear to what extent the findings in prior research are driven by unobserved confounders. A key difficulty in identifying the causal effects of marijuana use on educational outcomes is identifying arguably exogenous variation in marijuana consumption.

Over the past two decades, nearly thirty U.S. states have passed medical marijuana laws (MMLs) that allow patients to legally possess and use marijuana. Such laws are naturally controversial; while the number of legal medical marijuana patients was small until very recently, they have the potential to increase illicit marijuana use among non-patients. Large surveys such as the National Survey on Drug Use and Health (NSDUH) document a strong, positive correlation between MMLs and marijuana use (Cerdá, Wall, Keyes, Galea, & Hasin, 2012; Wall et al., 2011). This correlation could be causal as MMLs lower non-patients' marginal cost of marijuana use through several channels. First, MMLs might increase non-patients' access to marijuana and lower the drug's real and shadow price. Some evidence suggests that medical marijuana commonly leaks from legally qualified patients or dispensaries to illegal users (Salomonsen-Sautel, Sakai, Thurstone, Corley, & Hopfer, 2012; Thurstone, Lieberman, & Schmiege, 2011). Second, MMLs could shift social attitudes toward marijuana use and decrease stigma or the perceived harm associated with its use (Carliner, Brown, Sarvet, & Hasin, 2017; Khatapoush & Hallfors, 2004). Finally, MMLs could cause law enforcement and the judicial system to take a more lenient approach to illegal marijuana use (Eddy, 2010; GAO, 2002).[1]

Several recent studies provide evidence of a causal relationship and show that MMLs cause roughly a 20% increase in marijuana use (Chu, 2014, 2015; Wen, Hockenberry, & Cummings, 2015). Nonmedical use likely constitutes most of the increase in marijuana use, as implied by the associated increases in marijuana possession arrests (Chu, 2014). The effects of MMLs appear to be large especially on the intensive margin and on heavy marijuana use. For example, Chu (2014) finds an increase in marijuana treatment admissions that mostly consist of heavy

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[1] For example, cities like Denver, San Francisco, and Seattle, passed initiatives that either legalize marijuana or require authorities to make marijuana offenses 'the lowest law enforcement priority' (Eddy, 2010).

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users and Wen et al. (2015) show that nearly half of the increase in past-month marijuana use is due to increased daily marijuana use. Somewhat surprisingly, the increase in marijuana use is concentrated among adults, as MMLs do not affect marijuana usage among juveniles (Anderson, Hansen, & Rees, 2015; Choo et al., 2014; Lynne-Landsman, Livingston, & Wagenaar, 2013; Wen et al., 2015).[2] The general finding that MMLs affect non-patients' marijuana use suggests that MMLs might affect educational attainment because students may smoke more marijuana and therefore change their motivation and behaviors. Moreover, MMLs might affect educational attainment by causing students to shift to marijuana from other substances: Anderson, Hansen, and Rees (2013) find that MMLs reduce alcohol consumption and traffic fatalities involving alcohol, suggesting that marijuana and alcohol are substitutes, Chu (2015) finds evidence that marijuana and heroin are substitutes, and Bachhuber, Saloner, Cunningham, and Barry (2014), Ozluk (2017), and Powell, Pacula, and Jacobson (2018) show that access to medical marijuana leads to a decrease in opioid-related overdose deaths.

In this paper, we provide novel evidence on the impact of MMLs on student behaviors both in and out of the classroom and contribute to our understanding of the causal relationship between marijuana use and behaviors associated with educational success. Specifically, we estimate the effects of MMLs on students' time spent in education and leisure activities using time diary data from the American Time Use Survey (ATUS) for the years 2003–2016. We use a difference-in-differences research design and estimate fixed effects models that control for state and year fixed effects, state-specific time trends, and a variety of student and time-diary covariates. Both time spent in education and leisure activities can influence educational achievement and attainment (Jacob, 2002; Kalenkoski & Pabilonia, 2014). Educational activities such as attending class and doing homework and research are direct inputs to the education production function, while leisure activities such as watching television may crowd out time in more educationally productive activities such as reading (Schmidt & Anderson, 2007).

Consistent with extant evidence that MMLs do not affect juvenile drug use, we find no effect of MMLs on high-school students' time use. In contrast, our results suggest that college students spend less time on education-related activities such as attending class and doing homework but more time on leisure activities such as watching television after the passage of MMLs. On average, college students' education time decreased by approximately 20–23% while their leisure time increased by 21–22%, both of which are roughly equivalent to 30 min on an average day. MMLs that provide broader access to marijuana appear to have stronger effects on education time than more restrictive MMLs. The decrease in education time occurs largely on the extensive margin, as college students are 16–19% less likely to spend any time on education activities. However, changes on the intensive margin contribute to the reduction in leisure time. Conditional on positive leisure time, time spent in leisure activities increased by 16–17% among college students.

These behavioral changes are not evenly distributed and largely occur during weekends and summer when students have more flexibility in allocating time. Interestingly, the effects of MMLs are heterogeneous: the changes in time use are driven mostly by part-time college students rather than full-time college students. Our findings indicate that marijuana use may harm educational outcomes, particularly among students who are only tenuously connected to schooling, and provide evidence on potential behavioral channels through which these effects may operate.

This research makes several contributions. First, this paper leverages a new identification strategy—the exogenous shock of MMLs—for detecting the effects of marijuana use on intermediate educational outcomes. Previous studies either use instrumental variables that are largely based on cross-sectional variation, or try to model individual heterogeneity econometrically, with Marie and Zölitz (2017) being a notable exception. In contrast, the current study exploits a more plausible source of exogenous variation in marijuana consumption. Indeed, our findings are consistent with the results in Marie and Zölitz (2017), who find that university students' academic performance increased at Maastricht University after legal access to marijuana was removed, particularly for low-performing students. Second, students' behavioral responses to MMLs are of policy interest in their own right. The finding of stronger negative effects on the educationally productive activities of potentially disadvantaged groups is particularly relevant to discussions of inequality and the design of future education and health policies. Finally, while MMLs provide numerous benefits to patients, unintended negative externalities associated with increased access to marijuana exist. Identifying and quantifying unintended consequences of public policy is paramount to conducting careful cost-benefit analyses and to improving future iterations of policies.

The paper proceeds as follows: Section 2 briefly describes the history of MMLs and what is known about the relationship between marijuana use and educational outcomes. Sections 3 and 4 describe the data and empirical strategy, respectively. Section 5 presents the results and section 6 concludes.

2. Background and literature review

2.1. History of medical marijuana laws

In the late 1970 s, many states began passing legislation that allowed the use of medical marijuana through research programs, but only a handful of states' research programs became operable due to federal restrictions (Pacula, Chriqui, Reichmann, & Terry-McElrath, 2002). In 1986, the Food and Drug Administration (FDA) approved Marinol, a prescription drug containing the same active ingredient, Delta-9-THC, as marijuana. However, taking oral medications could be difficult for patients suffering from severe nausea, a common symptom among AIDS and cancer patients. In the late 1980 s and early 1990 s, smokable marijuana was discovered to benefit growing populations of AIDS and cancer patients. In 1996, California became the first state to pass a medical marijuana law allowing patients to legally use and possess marijuana. With growing positive medical evidence and lobbying by marijuana legalization advocacy groups, such as the National Organization for the Reform of Marijuana Laws (NORML), many states have since joined California in passing a new wave of medical marijuana legislation. As of 2017, 24 states and the District of Columbia have passed similar medical marijuana laws. Five other states, Minnesota, New York, Ohio, Pennsylvania, and West Virginia, passed medical marijuana laws that only allow non-smokable marijuana that is not dry leaf or in plant form (edibles are banned too). States with effective medical marijuana laws, including the five states with non-smokable laws, and the years they become legally effective, are summarized in Table 1 (Leafly 2018; MPP 2018; Powell et al., 2018; ProCon.org 2017).

These laws permit patients with legally designated diseases and syndromes to use marijuana as a means of treatment. The designated symptoms and conditions typically include AIDS, anorexia, arthritis, cachexia, cancer, chronic pain, glaucoma, migraines, persistent muscle spasms, severe nausea, seizures, and sclerosis. Patients can legally possess marijuana up to a fixed amount that varies by state. Since MMLs do not change the criminal status of marijuana, only legal patients can be exempted from state penalties. To become a legal patient,

[2] See Sarvet et al. (2018) for a thorough literature review and Chu (2018) for its commentary. However, some evidence suggests adolescent marijuana use among subgroups or on some margins might have increased. For example, Wen, Hockenberry, and Cummings (2015) find that MMLs increase first-time marijuana use but not regular use among ages 12–20; Smart (2015) finds that growth in the population shares of registered medical marijuana patients leads to an increase in adolescent marijuana use; Chu (2014) shows that MMLs increase marijuana use among treatment patients aged 15–17 in the online appendix.