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ABSTRACT

The Effect of Medical Marijuana Laws on Labor Market Outcomes*

A number of recent studies have found that medical marijuana laws (MMLs) are associated with increased marijuana use among adults, in part due to spillover effects into the recreational market. This study is the first to explore the labor market consequences of MMLs. Using repeated cross-sections of the Current Population Survey from January 1990 to December 2014, we find that the enforcement of MMLs is associated with a 2 to 3 percent reduction in hourly earnings for young adult males. The effect is particularly pronounced when examining MMLs that include a collective cultivation provision. For women and older males, there is little evidence of adverse labor market effects of MMLs. We conclude that the health effects of MMLs may adversely affect labor market productivity of young males.

JEL Classification: J31, J38, I18

Keywords: medical marijuana laws, productivity, wages

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I. Introduction

Medical marijuana laws, which have been adopted by 23 states and the District of Columbia, legalize the possession, cultivation, and consumption of marijuana to treat medical conditions such as anxiety, nausea, joint problems, and the side effects of cancer or Human Immune Deficiency Syndrome treatments (Doblin and Kleinman 1991; Galuppo et al. 2014; Hall et al. 2005; Lotan et al. 2014; Naftali et al. 2013; Vinciguerra et al. 1988; Vu et al. 2013). While MMLs reduce the cost of obtaining marijuana for medical purposes via elimination of criminal penalties, there is also evidence that MMLs may impact the recreational market via supply-side reductions in the street price of high-grade marijuana (Anderson et al. 2013).¹ Several studies have found that the enforcement of MMLs is associated with an increase in marijuana use among adults (Anderson and Rees 2011; Choi 2014; Wen et al. 2014), driven by some combination of medicinal and recreational use.

The effect of MMLs on labor supply and earnings is theoretically ambiguous. If MMLs allow individuals with physical or mental health ailments to effectively treat their conditions (Anderson et al. 2014; Sabia et al. Forthcoming), MMLs could increase labor supply and increase productivity among those employed. Moreover, if MMLs create employment opportunities in marijuana production and legitimate sales, this could increase labor supply. However, if MML-induced marijuana use induces lethargy (Delisle et al. 2010; Irons et al. 2014; Pesta et al. 2013), impedes cognition (Hanson et al. 2010), increases depression (Degenhardt et al. 2003; Green and Ritter 2000), or increases the returns to leisure time, this could decrease attachment to the labor force and reduce earnings. Moreover, if marijuana use acts as a gateway to harder drugs (Deza 2012; Mills and Noyes 1984; Miron 2005) or diminishes the acquisition of human capital (Chatterji 2003; Hall 2009) these effects could also adversely affect labor market

¹ See also Malivert and Hall (2014)

productivity (Ashenfelter and Krueger 1994; Banerjee et al. 2013; Buchmueller and Zuvekas 1998; Frijters et al. 2010; Kandel and Davies 1990). In addition, if marijuana users face discrimination in the workplace (Wozniak 2012), this could be yet another mechanism through which MMLs could affect labor market outcomes.

MMLs may also indirectly affect labor market outcomes through their effects on alcohol consumption. If alcohol serves as a “social lubricant” that enhances labor market networking (Chatterji and DeSimone 2006; Peters 2009; Peters and Stringham 2006) and alcohol and marijuana are substitutes (Anderson et al. 2014; Crost and Guerrero 2012; Sabia et al. Forthcoming), MMLs may reduce employment or wages. On the other hand, if alcohol and marijuana are complements (Pacula et al. 2004; Pacula et al. 2013; Wen et al. 2014), or if MMLs reduce more severe problem drinking (Terza 2002), MMLs could increase in employment or wages.

Using repeated cross-sections of the Current Population Survey Outgoing Rotation Groups from January 1990 to December 2014, this study is the first to examine the relationship between MMLs and labor market outcomes. Our results suggest little consistent evidence that MMLs affect net employment or hours worked among employed individuals. However, we do find that enforcement of MMLs is associated with a 2.5 percent reduction in hourly wages for young men. These results are robust to the inclusion of controls for state-specific time-varying substance use policies, state-specific time trends, state-specific anti-marijuana legalization sentiment, and MML policy leads. Findings from synthetic control estimates, while much less precisely estimated, generally point to a similar pattern of results. For women and older males, there is little evidence of adverse labor market effects of MMLs.

Possible mechanisms to explain an MML-induced decline in earnings among young men include (i) lethargy-inducing, cognitive-diminishing, or depressive effects of marijuana use, (ii) spillover effects of MMLs on alcohol consumption, and (iii) the resultant health effects on occupational mobility or job tenure. Supplemental analyses of the Behavioral Risk Factor Surveillance System surveys uncover some support for these mechanisms, but more research is necessary to uncover the precise channels at work.

II. Background

Between 2002 and 2013, illicit drug consumption amongst individuals ages 12 and older rose from 8.3 to 9.4 percent (SAMHSA 2014). This upturn was driven largely by an increase in marijuana consumption, which rose from 6.2 to 7.5 percent over the same period, with the largest increase occurring after 2008. Frequent marijuana use has also substantially increased in recent years. According to data from the National Survey of Drug Abuse and Health, in 2013, 8.1 million individuals ages 12 and older consumed marijuana on 20 or more days in the past month, representing a 58.8 percent increase from 2007. Among current (past month) marijuana users, over 40 percent were frequent users (SAMHSA 2014).

Employers' concerns about substance use-driven productivity losses and work absences have increased prevalence of on-the-job drug testing. According to Quest Diagnostics (2002, 2014), the number of drug tests the company performed in the combined U.S. workforce increased from 6.3 million in 2001 to 8.5 million in 2013. In 2013, 7.5 million career urine drug tests cost nearly \$150 million.²

² This estimate can be considered a lower-bound cost, as it does not account for spending on other forms of workforce drug tests such as hair tests and oral fluid tests, administrative costs to employers, or the costs to employers of outsourcing drug testing.

While use of harder illicit drugs—such as cocaine, methamphetamine, and heroin—have been linked to adverse health (Chen and Lin 2009; Washton and Gold 1984; Washton and Tatarsky 1983), human capital (Chatterji 2003; Harder and Chilcoat 2007), and labor market outcomes (DeSimone 2002; French et al. 2001; Macdonald et al. 2003; Van Ours 2005), evidence on the consequences of marijuana use is more mixed. Some studies link marijuana use to poorer cognition (Hanson et al. 2010), increased incidence of lethargy (Delisle et al. 2010; Irons et al. 2014; Pesta et al. 2013), and heightened risk of depressive symptomatology (Harder et al. 2006; Van Ours and Williams 2011). There is also evidence that marijuana use may be positively related to later use of harder drugs (Deza 2012; Mills and Noyes 1984; Miron 2005), and diminished academic achievement (Chatterji 2003; Hall 2009). However, marijuana use has also been shown to have important medical benefits that are related to labor market performance. For instance, marijuana use has been found to be effective at reducing joint pain (Blake et al. 2005) and muscle aches (Fiz et al. 2011). Its consumption has also been found to improve appetite (Riggs et al. 2012; Soria-Gomez et al. 2014), and diminish nausea-related symptoms (Doblin and Kleinman 1991; Vinciguerra et al. 1988). Finally, marijuana use has also been linked to diminished anxiety (Marcel et al. 2007) and even reduced completed suicides (Anderson et al. 2014). Therefore—in part because marijuana can be consumed for both recreational and medicinal purposes—it is unclear how increases in its use may affect labor force participation and earnings.

Labor Market Effects of Substance Use. The key empirical challenge to estimating the labor market effects of illicit drug use is in addressing the endogeneity of drug use. To generate plausibly exogenous variation in drug consumption, several studies have relied on an instrumental variables (IV) approach. Gill and Michaels (1992) use prior illegal activity as an

instrument for illicit drug use and found that drug users are less likely to be employed than their non-using counterparts. Zarkin et al. (1998) use (i) self-assessment of risk incurred by using drugs and (ii) perceived difficulty in finding illicit substances as instruments, and find that the relationship between marijuana use and hours of work varies widely (from large and positive to large and negative) across adjacent cross-sectional surveys. French et al. (2001) use religiosity as an instrument and find that chronic drug use is associated with a 9 percentage-point decline in employment, but light drug use has no effect. DeSimone (2002) uses cross-regional variation in illicit drug prices and cross-state marijuana decriminalization laws as instruments, and finds that marijuana use is associated with a 15 percent decline in employment, with cocaine use having a larger adverse effect. MacDonald and Pudney (2000) jointly model drug use and unemployment, and, using church attendance as an exclusion restriction, find that hard drug use is positively related to unemployment of British youths.

While researchers may argue about the exogeneity of these instruments—for instance, because (i) prior illegal behavior, risk assessment, or religiosity may be related to unobserved personal characteristics related to drug use (such as discount rates or personality) and (ii) cross-regional price variation may capture demand-side characteristics of consumers that affect drug use—taken as a whole, this literature tends to point to adverse employment effects of drug use.

Evidence on the wage effects of illicit drug use is more mixed (Cawley and Ruhm 2012; Van Ours and Williams 2014). A review of the literature by Van Ours and Williams (2014) finds that in the pre-1998 literature, many studies pointed to a positive relationship between drug use and wages (at least for some demographic groups), while the “second wave” of the literature has generally found that “infrequent or non-problematic drug use has no impact on wages, whereas problematic use does have negative wage effects.” (Van Ours and Williams 2014; p. 13).

As in the employment literature, disentangling the effects of drug use from difficult-to-measure correlates—such as ability—has proven challenging (Conti 2010). Van Ours (2006) uses (i) parental marijuana use and (ii) the presence of children in the household as instruments, in a discrete factor framework and finds that marijuana use is associated with a 10 percent reduction in wages among young men in Amsterdam. However, alternate estimation techniques—such as individual fixed effects models to control for fixed individual heterogeneity—suggest much smaller effects.³

Medical Marijuana Laws and Health. No study of which we are aware has estimated the effect of medical marijuana laws on labor market outcomes. However, a number of studies have examined the effect of MMLs on health outcomes that might be expected to affect labor market outcomes. Several studies show—using a difference-in-difference approach that exploits within-state over-time variation in the enforcement of MMLs for identification—that MMLs are associated with a 10 to 19 percent increase in marijuana use among adults (Anderson and Rees 2011; Choi 2014; Wen et al. 2014). In contrast, there is little evidence of spillover effects to those under age 20 (Anderson et al. 2015; Pacula et al. 2014; Wen et al. 2014).

Moreover, MML-induced increases in marijuana use among adults do not appear to come entirely from the medical market. Anderson et al. (2013) show that the enforcement of MMLs—particularly those that allow for collective cultivation of marijuana for multiple patients—is associated with a decline in the average street price of high-grade marijuana, which suggests that the supply-side effects of MMLs may spillover into the recreational market. Moreover, MML-induced increases in marijuana use for younger demographic groups (such as young adult men), with relatively lower rates of medical conditions for which marijuana is designed to treat, further suggests the presence of recreational spillovers (Sabia et al. Forthcoming).

³ See, for example, Kaestner (1994).

Mechanisms to Explain a Link Between MMLs and the Labor Market. The effect of MML-induced increases in marijuana consumption on labor market outcomes is theoretically ambiguous. Sabia et al. (Forthcoming) find evidence that MMLs are associated with a decline in physical activity for younger individuals (those ages 18 to 34), consistent with the hypothesis that marijuana use may induce lethargy (Delisle et al. 2010; Irons et al. 2014; Pesta et al. 2013). However, Sabia et al. (Forthcoming) also find evidence that MMLs are associated with improved physical mobility for older individuals, consistent with pain-alleviating effects of marijuana consumption for medicinal purposes. This suggests that MMLs may increase the probability of employment for older individuals.

There is also evidence that MMLs may affect the demand for substitutes and complements of marijuana. Using data from the Behavioral Risk Factor Surveillance System (BRFSS) from 1990 to the early 2010s, Anderson et al. (2013) and Sabia et al. (Forthcoming) find evidence that MMLs are associated with a decline in alcohol consumption, suggesting that alcohol and marijuana are substitutes. However, Wen et al. (2014) and Choi (2014) use data from the NSDUH from 2004 to 2012 and find that the enforcement of MMLs is associated with *increases* in alcohol consumption. These contradictory findings could suggest some policy heterogeneity, a result also supported by Pacula et al. (2013).

The alcohol effects of MML-induced increases in marijuana use could affect labor market outcomes, though a priori it is unclear in which direction. Using state beer taxes and per capita ethanol sales as instruments, Terza (2002) finds evidence of a negative relationship between problem drinking and employment. However, Feng et al. (2001) find that counties that become “wet”—that is, liberalizing alcohol sales regulations—see increases in male employment. Moreover, Auld (2005) finds evidence that moderate drinking is *positively* related to males’

wages, even after controlling for the endogeneity of alcohol consumption. This finding appears to exist for females as well, where the relationship between alcohol consumption and earnings may be even stronger (see, for example, Berger and Leigh 1988; MacDonald and Shields 2001; Mullahy and Sindelar 1991; Peters 2004; Peters and Stringham 2006; and Tekin 2004). These findings could suggest a beneficial “social lubricating” effect of alcohol consumption that aids labor market networking.

In addition, MMLs could also affect labor market outcomes if they induce consumption of harder drugs, perhaps because marijuana acts as a “gateway” drug. However, work by Wen et al. (2014) and Choi (2014) find little evidence that MMLs are associated with changes in cocaine or other hard drug use.

Finally, MMLs could affect individuals’ psychological health, which, in turn could affect labor market outcomes (see, for example, Fletcher 2013). Anderson et al. (2013) find that MMLs are associated with a reduction in suicide rates, which could suggest mental health benefits of increased marijuana use. On the other hand, Sabia et al. (Forthcoming) find little evidence that MMLs affect days of poor mental health.⁴

Contributions. The current study is the first in the literature to examine the effects of medical marijuana laws on labor market outcomes. We also explore heterogeneity in the labor market effects of MMLs by gender and age, which may be important given gender- and age-specific variation in medicinal versus recreational use of marijuana (Doyle and Sheasley 2012; Sabia et al. Forthcoming). In addition, given that there is substantial heterogeneity in state MMLs, we also explore whether the labor market effects of MMLs differ by the type of law.

⁴ Rylander et al. (2014) also find no evidence of a statistically significant association between the number of marijuana registrants and completed suicides.

Finally, we provide some descriptive evidence on mechanisms that could be at work to explain a link between MMLs and labor market outcomes.

III. Data and Measures

The analysis uses repeated cross-sections of the Current Population Survey (CPS) Outgoing Rotation Groups from January 1990 to December 2014, available from the Bureau of Labor Statistics. When weighted using CPS sampling weights, these data are representative of the U.S. population. These data are useful for this study because they contain information on key labor market outcomes of interest, including employment, hours worked, and hourly earnings. The analysis focuses on the working age population ages 18-to-64; we separate our analysis for males and females.

Dependent Variables. We measure labor supply on both the extensive and intensive margins. First, *Employment* is a dichotomous indicator set equal to one if the respondent reports positive hours of paid employment. As shown in Table 1A, 65.2 percent of 18-to-64 year-old men and 58.3 percent of women reported employment.

We measure labor supply on the intensive margin by measuring usual weekly hours of work at the worker's main job, conditional on employment. Among men, the average weekly hours of work was 41.5 hours, while for women it was 36.8 hours. We experimented with use of current hours of work as an alternative measure of labor supply at the intensive margin. This measure produced results similar to those reported below.

Finally, we measure labor market productivity using the respondent's hourly earnings. For workers who report being paid hourly, his or her hourly wage rate is directly reported. For those who are not paid hourly, the wage rate is calculated as the ratio of usual weekly earnings to

usual weekly hours. The average wage rate (in 2014 dollars) earned by males was \$22.94 per hour and by females was \$18.65 per hour.

Medical Marijuana Laws. Our primary analysis uses effective dates agreed upon by Anderson et al. (2013), Wen et al. (2014), and Sabia et al. (Forthcoming) and updated using our own study of legislative statutes and ballot initiatives, confirmed using ProCon.org. These effective dates are shown in Table 2. During the 1990 to 2013 period, 23 states and the District of Columbia enacted MMLs. There are, however, some minor differences in preferred effective dates (see Powell et al. (2015), though they generally only differ by a matter of months.⁵ Thus, we also experiment with an alternate coding of MMLs using Powell et al. (2015).⁶

There is substantial heterogeneity in state MMLs, as discussed extensively by Anderson et al. (2013), Pacula et al. (2013), and Sabia et al. (Forthcoming). For instance, some MMLs legalize collective cultivation of marijuana for multiple patients. Anderson et al. (2013) argue that collective cultivation provisions may be an important driver of supply-side declines in the street price of marijuana in the recreational market. In Appendix Table 3, we provide details regarding the provisions of each state's MML. In our analysis below, we also explore heterogeneity in the effect of MMLs by the provision of MMLs that allow (i) collective cultivation of medical marijuana (9 states), (ii) home cultivation of medical marijuana (14

⁵One exception is Maryland, which Powell et al. (2015) code as having enforced an MML beginning in 2003. In contrast, neither Wen et al. (2014) nor Anderson et al. (2013) code Maryland in this matter. The difference appears to be driven by authors' differences in interpretation of an MML. In 2003, Maryland adopted a law that allowed defendants prosecuted for marijuana possession to claim, as a mitigating circumstance, their possession of marijuana was for medical purposes. This law, however, did not prevent patients from getting arrested, prosecuted or fined. In 2013, the state passed another law to allow the distribution of medical marijuana through academic centers, none of which accepted the appointment. The current MML which took effect on June 1, 2014 was the first to set regulations on dispensaries, patient registries, fees, possession limits, qualifying conditions and more. We experiment with an alternate coding of Maryland's law, but find a qualitatively similar pattern of results.

⁶ We also experiment with alternative coding of the MML law to render small month-specific differences in agreed-upon effective dates generally moot: (i) MML set equal to 1 if a state had an effective MML law in the entire year and 0 otherwise, and (ii) MML set equal to 1 if a state had an effective MML law at any time in a year and 0 otherwise. The findings from these specifications are qualitatively and quantitatively similar (see Appendix Tables 1 and 2).

states), and (iii) medical marijuana to be prescribed for pain (16 states). By the end of 2014, eight states, including Arizona, California, Colorado, Montana, Nevada, Oregon and Rhode Island, had implemented all three of the above provisions.

IV. Empirical Strategy

We begin by pooling repeated cross-sections of states and months between January 1990 and December 2014 and estimating a difference-in-difference model of the following form:

$$E_{ist} = \beta_0 + \beta_1 \text{MML}_{smt} + \mathbf{X}'_{st} \beta_2 + \mathbf{Z}'_{imt} \beta_3 + v_s + \kappa_m + \omega_t + \varepsilon_{imst} \quad (1)$$

where E_{ist} measures the labor market outcome (employment, usual hours worked, or hourly wages) of individual i residing in state s at time t , MML is an indicator for whether state s had an MML law in effect in month m in year t , \mathbf{X}_{st} is a vector of time-varying state controls, \mathbf{Z}_{imt} is a vector of individual-level time-varying controls, v_s is a time-invariant state effect, κ_m is a month effect, and ω_t is a state-invariant time effect. Included in vector \mathbf{X}_{st} are the real value of the higher of the state or federal minimum wage, real per-pack cigarette and beer taxes, an indicator for whether a state has decriminalized marijuana, and real state GDP per working-age (18-64) person.⁷ Included in the vector of individual-level controls \mathbf{Z}_{ist} for the employment regressions are age (linear and squared), years of school completed, marital status, and race/ethnicity and whether the respondent is enrolled in school. In the conditional hours and wage regressions, we also include potential experience (age minus years of schooling completed minus 6) and

⁷ We include state per capita GDP to control for state business cycle effects, but it is also a measure of income that could be affected by MMLs . Results are qualitatively and quantitatively similar to when omitting state per capita GDP as a control.

dummies for the worker's main industry. The means of each of our control variables appear in Table 1B.

The key parameter of interest, β_1 , captures the relationship between MMLs and labor market outcomes. Identification of this parameter comes from the states that began enforcing MMLs between January 1990 and December 2014. The credibility of the identification of β_1 depends on the common trends assumption of our difference-in-difference model. This assumption could be violated if (i) there are state-level time-varying unobservables—such as anti-marijuana legalization sentiment—that are correlated with both the adoption of MMLs and with drug use, which could affect labor market outcomes, (ii) trends in labor market outcomes differ in MML states relative to comparison states prior to the adoption of an MML, or (iii) MMLs are adopted in response to labor market trends.

We use a number of econometric strategies to address the possibility that the common trends assumption might be violated. First, as noted above, we include controls for state-specific policies related to risky health behaviors (beer taxes, cigarette taxes, marijuana decriminalization laws), the state business cycle (state per capita GDP), and demographic trends (age, potential experience, race, marital status, and school enrollment). Second, we add state-specific linear time trends to the right hand-side of equation (1) to control for any unmeasured time trends that are unfolding linearly. Third, we draw data from the General Social Survey (GSS) to explicitly control for state-level anti-marijuana legalization sentiment. Respondents to the GSS were asked:

“Do you think the use of marijuana should be made legal or not?”

In 1990, 83.2 percent of all GSS respondents reported opposition to the legalization of marijuana; this figure fell to 51.6 percent by 2010.⁸ An examination of our estimate of β_1 from equation (1) including this control will allow us to separate the effects of medical marijuana legalization from endogenous state sentiment changes. Fourth, we examine four years of MML policy leads to test for differential state trends occurring prior to the implementation of an MML in treatment and control states.

Finally, we pursue a synthetic control design approach following Abadie et al. (2010), which involves the construction of data-driven counterfactuals for each MML state. The donor states are comprised of those 27 states that did not implement an MML between January 1, 1990 and December 31, 2014. The synthetic state for each MML state is generated using pre-treatment levels and trends in each of our controls (years of school completed, marital status, and race/ethnicity, school enrollment status, industry of main job, effective state minimum wage, state real per-pack cigarette and beer taxes, the presence of a state decriminalized marijuana law, real state GDP per person ages 18-to-64), and the natural logs of real hourly wages in years prior to the adoption of an MML. Each synthetic state is comprised of a weighted linear combination of the donor states. We then estimate a difference-in-difference estimates using the treatment state and its positively weighted donor states, and weight regressions using synthetic weights.

Statistical inference from synthetic estimates is made in two ways: (i) using wild bootstrapped standard errors clustered on the state, a procedure commonly used with small numbers of clusters (Cameron et al. 2008), and (ii) generating p-values for our synthetic estimates using a permutation-type test whereby we assign a placebo MML effective dates (equivalent to the treatment state's actual effective date) to each donor state to simulate the

⁸ One limitation of this measure is that it is only available for the calendar years 1990-1991, 1993, and even-numbered years between 1994 and 2000. In those years, the data are non-missing in 79 percent of state-year cells. Anti-marijuana legalization sentiment is not measured in Nevada or Nebraska in the GSS.

distribution of estimates under the null hypothesis (that there is no effect) and then calculate a p-value for the “true” estimate (Adabie et al. 2010).

V. Main Results

The findings appear in Tables 3 through 10. For ease of presentation, we present estimates of β_1 in our tables, but estimated coefficients on the controls are available upon request. We present estimates separately by gender and age to allow for heterogeneity in policy impacts. All difference-in-difference regressions are weighted by the CPS sample weights, and standard errors corrected for clustering on the state. As noted above, synthetic regressions are weighted by the synthetic control weights. Wild bootstrapped standard errors and placebo p-values calculated as described above are reported.

In Table 3, we present the estimates of the effect of MMLs on employment. Baseline difference-in-difference estimates (Panel I) show little evidence that MMLs are associated with economically or statistically significant changes in labor supply at the extensive margin for the pooled, male, or female samples. These estimates become smaller and remain indistinguishable from zero after controlling for state-specific linear time trends (Panel II). When controlling for state-specific linear time trends (Panel II), the precision of our estimates is such that we can rule out, with 95 percent confidence, employment reductions greater than 2.7 percent for males and 3.9 percent for females. We can also rule out employment gains greater than 6.5 percent for males and 4.4 percent for females.⁹

Table 4 presents the estimates of the relationship between MMLs and the natural log of hours worked among employed individuals. We find little evidence in Panels I and II that the

⁹ In Appendix Table 4, we experiment with our employment definition to include self-employment, which could be important for the secondary marijuana market. The pattern of results suggests little consistent evidence that MMLs affect employment using this broader employment definition, with the possible exception of older males.

enforcement of MMLs is associated with economically or statistically significant impacts on labor supply at the intensive margin. In models that include state-specific time trends (Panel II), the precision of our estimates is such that we can rule out, with 95 percent confidence, MML-induced hours reductions greater than 1.8 percent for males and 2.5 percent for females. We can also rule out MML-induced hours gains greater than 4.9 percent for males and 6.3 percent for females. Together, our estimates in Tables 3 and 4 provide little evidence that state MMLs is associated with economically or statistically significant changes in labor supply on either the extensive or intensive margins for males or females.

Wages. In Table 5, we turn to the effect of MMLs on wages. While we find that the enforcement of an MML is associated with little change in wages for teenage males—a population for whom there is relatively little evidence of MML-induced marijuana spillovers—there is some evidence that MMLs are negatively related with hourly earnings of young adult males, particularly those ages 20 to 39, a population whose marijuana use has been shown to rise in response to MMLs. Specifically, for young males ages 20-to-29 (Panel I, column 3), enforcement of an MML is associated with a 2.5 percent decrease in hourly wages, and for those ages 30-to-39 (Panel I, column 4), a (statistically insignificant) 1.3 percent decline in wages. The inclusion of state-specific linear time trends as controls (Panel II) produces a similar pattern of results. Our estimates suggest little evidence that the enforcement of MMLs is associated with changes in wages for women, though the estimates are generally negative for those over age 20. When we estimate a wage equation that corrects for selection into employment via a Heckman selection correction technique, the results follow a similar pattern (Appendix Table 5). In addition, when we use effective date coding preferred by Powell et al. (2015), the pattern of results is also similar (see Appendix 6).

The credibility of our estimates of β_1 relies on the parallel trends assumption of our difference-in-difference approach. One threat to the validity of our research design would be if a state MML is simply serving as a proxy for state-specific time-varying changes in marijuana legalization sentiment. Using our measure of anti-marijuana sentiment obtained from the GSS as an additional explanatory variable, we re-estimate equation (1), including state linear time trends, for each of our outcomes. The estimates, presented in Table 6, show a pattern of results similar to our findings in Tables 3 through 5.¹⁰

VI. Sensitivity of Wage Results to Alternate Specifications

Could the negative wage effects of MMLs we obtain, particularly for young males, be contaminated by the differential pre-treatment trends in labor market outcomes in MML and non-MML states? And could the effects of MMLs take time to unfold? To address these possibilities, in Table 7, we add controls for four years of MML policy leads and three years of policy lags. The results, in general, provide little support for significant effects of policy leads, either when individually or jointly considered. After controlling for policy leads, however, we continue to find that the enforcement of an MML is associated with a significant decline in hourly wages for younger males, particularly those under 40 and especially for those ages 20-to-29. Moreover, the effects appear to get larger over time, reaching 3 to 5 percent, suggesting possible cumulative negative effects of MMLs on productivity.¹¹

¹⁰ As noted earlier, the sample sizes in the regressions controlling for anti-marijuana sentiment are smaller than those in our baseline regressions, for anti-marijuana legalization sentiment is not measured in Nevada or Nebraska in the GSS.

¹¹ See Appendix Tables 7 and 8 for the long-run effect of state MML on employment and log hours.

While the lack of evidence for differential pre-treatment trends in wages for MML and non-MML states gives us some confidence that our estimates are capturing policy impacts, we next examine whether the effects we observe for younger adults persist when we use a synthetic control design. We focus on younger males ages 20-to-29, the population for whom the largest negative wage effects are observed. As noted above, each treatment state's synthetic control is a weighted linear combination of the control states. For instance, the synthetic counterfactual for Montana is comprised of 29.1 percent North Dakota, 29.4 percent South Dakota, 21.4 percent Arkansas, 9.3 percent Kentucky, and 10.8 percent Wyoming while the synthetic counterfactual for New York is comprised of 79.1 percent Virginia, and 20.9 percent Pennsylvania. The synthetic control weights for each treatment state are shown in Appendix Table 9.

Figures 1 through 4 show trends in wages for males 20-to-29 for each of the MML states and their synthetic control state. The vertical line denotes the year a given state's MML is enforced. Prior to the implementation of MMLs, the trends in hourly wages are similar in many treatment and their counterfactual synthetic states, such as Arizona, California, Montana, Nevada, New Mexico, Oregon and Vermont, as measured using the root mean square prediction error (RMSPE) between the MML state and the synthetic control state in the pre-treatment period (< 0.035). For some states, however—particularly smaller states with more volatile pre-treatment wage trends due to smaller samples—the pre-treatment wage trends match less well (see, for example, Connecticut and the District of Columbia).

In Table 8, we present our synthetic difference-in-difference estimates. Though the point estimates continue to suggest negative wage effects of MMLs for young men, generating our standard errors via clustered wild bootstrapping or our p-values via permutation-type placebo-tests renders many of these estimates statistically indistinguishable from zero. Thus, we view

our synthetic estimates as suggestive rather than dispositive of negative wage effects for young men.

Mechanisms. If MMLs are associated with a reduction in earnings for young men, what could explain such an effect? While we do not have data on individuals' cognitive processes across states and over time, we attempt to measure two other potential channels identified in the literature: alcohol consumption and lethargy. For this purpose, we draw data from the Behavioral Risk Factor Surveillance System (BRFSS) from 1990 to 2013. We measure alcohol consumption as the number of alcoholic beverages the respondent has consumed per month, a standard measure used in the medical marijuana literature (Anderson et al. 2013; Sabia et al. Forthcoming).¹² Our measure of lethargy is imperfect, as it is actually a measure of exercise. Respondents to the BRFSS are asked about the number of days they engage in vigorous activities in a usual week.¹³ While this measure may be correlated with lethargy, it may also capture one's physical mobility, which could itself be affected by MMLs. For example, if marijuana is used for medicinal purposes to ameliorate pain associated with joint ailments, arthritic problems, or fibromyalgia, then MMLs could increase physical mobility (see Sabia et al. Forthcoming).

The results—estimated via negative binomial for exercise days and least squares for alcoholic beverages—provide some evidence that these mechanisms may be important in understanding the labor market consequences of MMLs. We find that the enforcement of MMLs is associated with a reduction in exercise days (Panel I) and alcohol consumption (Panel II)

¹² The average number of drinks in the previous month is calculated using the respondent's responses to the following questions, "Have you had any beer, wine, wine coolers, cocktails, or liquor during the past month?", "During the past month, how many days per week or per month did you drink any alcoholic beverages, on the average?" and "On days when you drink, about how many drinks do you drink on average?"

¹³ Vigorous exercise is measured as the number of days the respondent engaged in vigorous activities in a usual week. The measure is generated using the questionnaire item: "How many days per week do you do vigorous activities such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate for at least 10 minutes at a time?"

among younger adults. These results are consistent with spillover effects of medical marijuana into the youth recreational market that could suggest (i) lethargy-inducing effects of marijuana use, and (ii) a substitution away from alcohol, a “social lubricant” that may be important for labor market networking. However, these effects are also observed across age groups other than simply young males. For example, we find that the implementation of MMLs is associated with a 12.75 percent decrease in alcohol consumption for females ages 20-to-29 and a 5.4 percent decrease in alcohol consumption for females ages 50-to-64. These estimates are inconsistent with previous studies finding the positive relationship between alcohol consumption and earnings may be stronger for women than men (Berger and Leigh 1988; MacDonald and Shields 2001; Mullahy and Sindelar 1991; Peters 2004; Peters and Stringham 2006; and Tekin 2004). Thus, it is probably not the case that alcohol consumption or lethargy-inducing effects of marijuana can fully explain the effect we observe. Rather, effects on cognitive functioning, job tenure or occupational mobility may also be important. Unfortunately, such measures are not included along with earnings information in the CPS outgoing rotation groups.

Heterogeneity in MMLs. Finally, we explore heterogeneity in the wage effects of MMLs by type of MML. As a number of scholars have documented, MMLs across different states have different components which affect marijuana users’ incentives and behaviors differently (Anderson et al. 2013; Pacula 2013). In Table 10, we explore the wage effects of different components of MMLs, including provisions that allow for (i) collective cultivation of medical marijuana for multiple patients, (ii) home cultivation of medical marijuana, and (iii) prescriptions for chronic pain. The results suggest that the largest adverse wage effects may be driven by state MMLs that allow collective cultivation for multiple patients. This finding is consistent with the

hypothesis that these provisions are an important driver of supply-side price reductions in recreational marijuana (Anderson et al. 2013; Sabia et al. Forthcoming).

VII. Conclusions

Recent research by Wen et al. (2014) and Anderson and Rees (2011) suggest that MMLs are associated with increases in marijuana use among adults. However, to our knowledge, no research has been conducted on the labor market consequences of these laws. This study presents the first estimates of the relationship between state medical marijuana laws and labor market outcomes. Difference-in-difference estimates suggest that the enforcement of a state MML is associated with a 2 to 3 percent reduction in hourly earnings of young men ages 20-to-29. These results are generally robust to the inclusion of controls for state-level time-varying substance use policies, state-specific linear time trends, and state-specific anti-marijuana legalization sentiment. However, they are somewhat weaker and less precisely estimated with the use of a synthetic cohort design.

The wage effects we obtain for younger males appear to be largely driven by state MMLs with provisions allowing collective cultivation for multiple patients. Descriptive evidence suggests that lethargy-inducing effects of marijuana and a substitution away from alcohol—a “social lubricant” that may be important for labor market networking—may be channels at work to explain this relationship. However, given that MMLs also appear to affect exercise and drinking among some older individuals, these mechanisms cannot explain the entire story. Future research is necessary to better understand the channels at work.

There are a number of limitations of this study worthy of note. This study uses a reduced form approach rather than a structural model. Because the CPS Outgoing Rotation Groups do

not include information on marijuana consumption, our approach does not immediately yield estimates of the wage effect of MMLs on individuals who are induced to use marijuana because of MMLs, i.e. the average treatment effect on the treated (ATET). Rather, the wage effects we obtain should be interpreted as “intent to treat” (ITT) estimates. Using Wen et al.’s (2014) estimates that find MMLs increase marijuana consumption by 16 percent on the extensive margin and 17 percent on the intensive margin among individuals over age 21, we obtain implied bounds for ATETs indicating a 14.7 to 16.9 percent decline in wages of affected young adults. Second, our data are limited in allowing us to explore all of the mechanisms through which MMLs may affect labor market outcomes—particularly cognition. Future work examining the labor market effects of medical marijuana laws as well as broader marijuana legalization laws such as those adopted recently in Colorado and Washington, will benefit from further exploiting of channels through which MMLs affect labor market outcomes.

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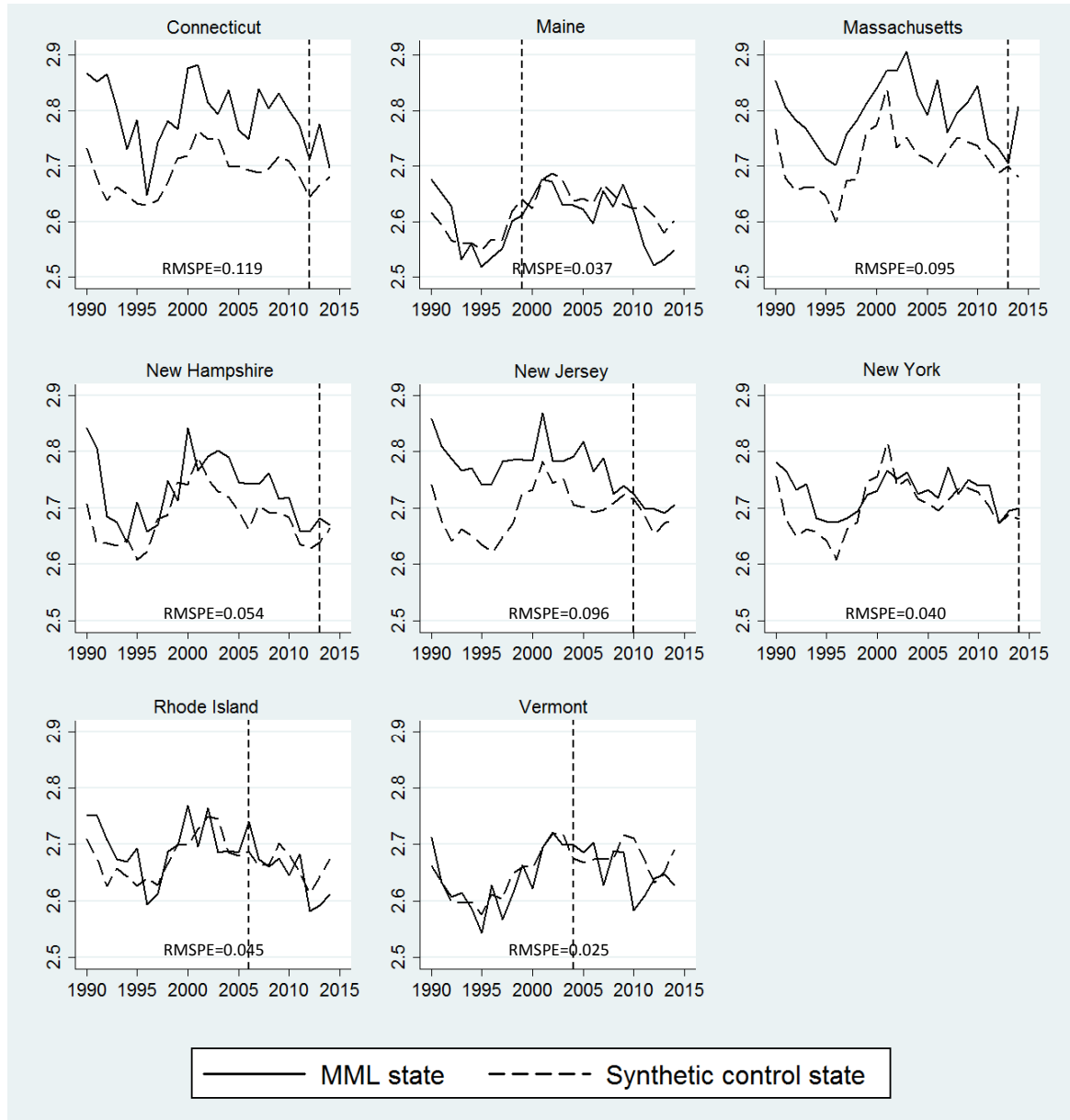
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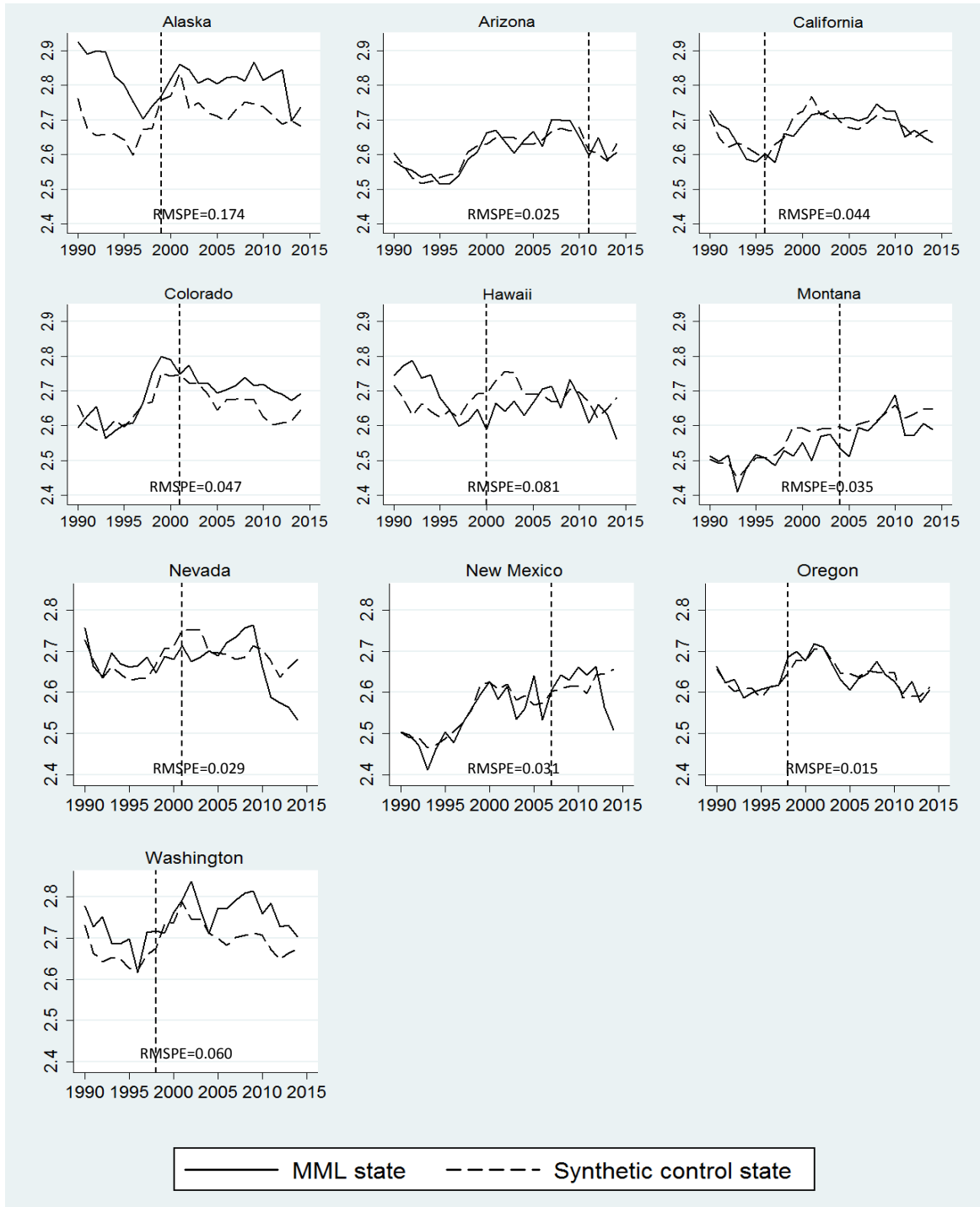
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Figure 1. Trends in Log Hourly Wages in Northeastern MML States vs. Synthetic Control States for Males Ages 20-to-29



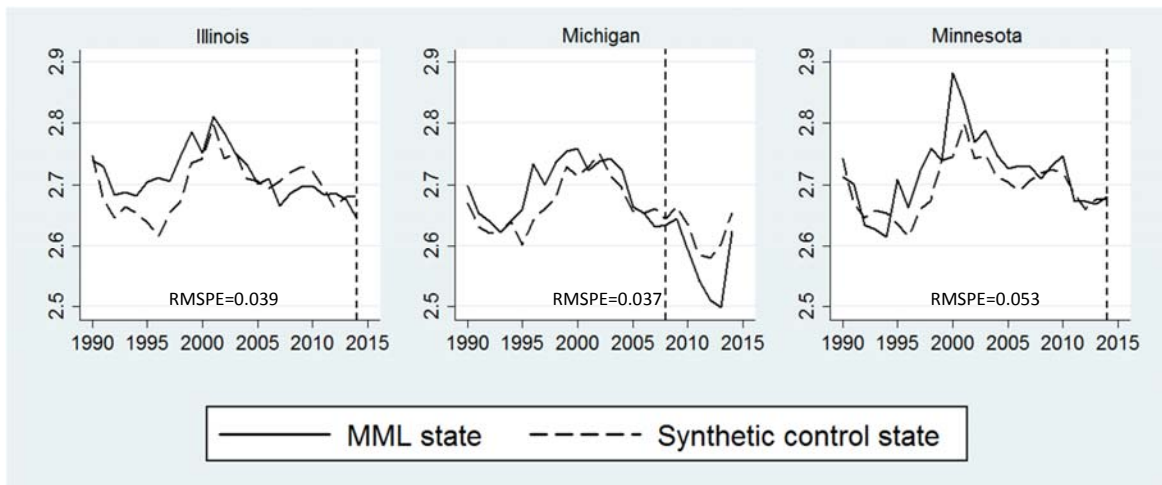
Notes: Plots come from synthetic control analysis for each state, where the synthetic control state is a linear combination of donor states that did not implement MMLs from January 1, 1990 to December 31, 2014. The vertical line denotes the year a given state's MML is enforced. RMSPE indicates the root mean square prediction error between the MML state and the synthetic control state in the pre-treatment period.

Figure 2. Trends in Log Hourly Wages in Western MML States vs. Synthetic Control States for Males Ages 20-to-29



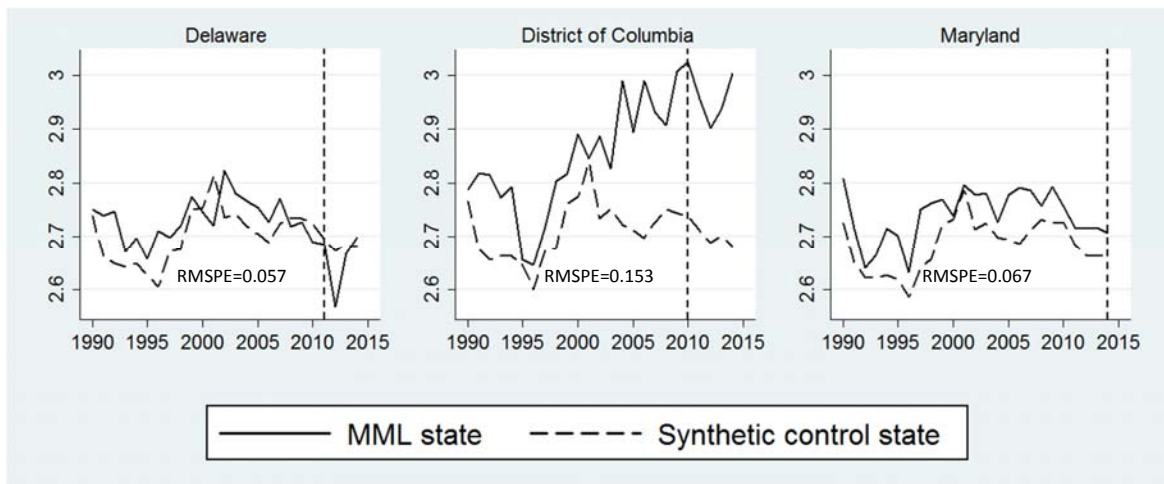
Notes: Plots come from synthetic control analysis for each state, where the synthetic control state is a linear combination of donor states that did not implement MMLs from January 1, 1990 to December 31, 2014. The vertical line denotes the year a given state's MML is enforced. RMSPE indicates the root mean square prediction error between the MML state and the synthetic control state in the pre-treatment period.

Figure 3. Trends in Log Hourly Wages in Mid-Western MML States vs. Synthetic Control States for Males Ages 20-to-29



Notes: Plots come from synthetic control analysis for each state, where the synthetic control state is a linear combination of donor states that did not implement MMLs from January 1, 1990 to December 31, 2014. The vertical line denotes the year a given state’s MML is enforced. RMSPE indicates the root mean square prediction error between the MML state and the synthetic control state in the pre-treatment period.

Figure 4. Trends in Log Hourly Wages in Southern MML States vs. Synthetic Control States for Males Ages 20-to-29



Notes: Plots come from synthetic control analysis for each state, where the synthetic control state is a linear combination of donor states that did not implement MMLs from January 1, 1990 to December 31, 2014. The vertical line denotes the year a given state’s MML is enforced. RMSPE indicates the root mean square prediction error between the MML state and the synthetic control state in the pre-treatment period.

Table 1A. Summary Statistics of Selected Variables

	Pooled	Males	Females
<i>Dependent Variables</i>			
Employment	0.616 (0.486) [6,189,607]	0.652 (0.476) [2,979,660]	0.583 (0.493) [3,209,947]
Hours	39.223 (9.874) [3,830,355]	41.469 (9.367) [1,938,600]	36.799 (9.834) [1,891,755]
Wages (2014\$)	20.879 (14.354) [3,830,355]	22.942 (15.236) [1,938,600]	18.652 (12.974) [1,891,755]
<i>Demographic Controls</i>			
Female	0.509 (0.500)	0.000 (0.000)	1.000 (0.000)
Age	39.573 (12.891)	39.402 (12.872)	39.739 (12.907)
Potential experience	20.437 (13.039)	20.302 (12.926)	20.568 (13.145)
Years of education	13.141 (2.743)	13.104 (2.809)	13.177 (2.677)
White	0.693 (0.461)	0.697 (0.459)	0.688 (0.463)
Black	0.119 (0.324)	0.110 (0.313)	0.128 (0.334)
American Indian	0.007 (0.082)	0.007 (0.081)	0.007 (0.083)
Other	0.051 (0.221)	0.050 (0.218)	0.053 (0.223)
Hispanic	0.130 (0.336)	0.136 (0.343)	0.124 (0.329)
Married	0.568 (0.495)	0.570 (0.495)	0.565 (0.496)
Widowed	0.019 (0.135)	0.007 (0.086)	0.029 (0.169)
Divorced	0.102 (0.302)	0.087 (0.281)	0.116 (0.320)
Separated	0.026 (0.158)	0.02 (0.141)	0.031 (0.174)
Never married	0.286 (0.452)	0.315 (0.465)	0.259 (0.438)
In school	0.060 (0.238)	0.060 (0.237)	0.061 (0.240)
<i>Industry Controls</i>			
Agriculture	0.015 (0.121)	0.022 (0.145)	0.008 (0.087)
Mining	0.006 (0.074)	0.009 (0.095)	0.002 (0.041)
Construction	0.058 (0.233)	0.100 (0.300)	0.012 (0.107)
Manufacturing: Non-Durable	0.060 (0.238)	0.071 (0.257)	0.048 (0.215)
Manufacturing: Durable	0.092 (0.290)	0.131 (0.337)	0.051 (0.220)
Transportation	0.045 (0.208)	0.064 (0.244)	0.026 (0.159)
Communications	0.015 (0.122)	0.017 (0.13)	0.013 (0.112)
Public utilities	0.014 (0.116)	0.021 (0.143)	0.006 (0.077)
Wholesale	0.034 (0.182)	0.046 (0.209)	0.022 (0.146)
Retail	0.164 (0.370)	0.155 (0.362)	0.173 (0.378)
Finance	0.034 (0.181)	0.025 (0.156)	0.043 (0.203)
Insurance	0.020 (0.139)	0.013 (0.113)	0.027 (0.162)
Real estate	0.014 (0.116)	0.013 (0.112)	0.015 (0.121)
Services	0.376 (0.484)	0.256 (0.436)	0.505 (0.500)
Government	0.054 (0.227)	0.058 (0.233)	0.051 (0.220)
<i>State Policy and Economic Controls</i>			
MML	0.168 (0.374)	0.170 (0.376)	0.166 (0.372)
Marijuana decriminalization law	0.337 (0.473)	0.339 (0.473)	0.336 (0.472)
Beer tax (2014\$)	0.311 (0.232)	0.310 (0.231)	0.312 (0.233)

Cigarette tax (2014\$)	0.928 (0.776)	0.930 (0.774)	0.926 (0.777)
GDP per person ages 18-64 (2014\$)	78,852.18 (14,740.58)	78,882.80 (14,653.71)	78,822.62 (14,823.9)
Minimum wage (2014\$)	7.333 (0.703)	7.336 (0.704)	7.331 (0.701)
N	6,189,607	2,979,660	3,209,947

Notes: Weighted means of the dependent variables, demographic controls and state controls are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. Standard deviations are in parentheses and number of observations in brackets.

Table 1B. Summary Statistics of Dependent Variables by Age Groups

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
Employment	0.616 (0.486) [6,189,607]	0.425 (0.494) [260,249]	0.652 (0.476) [1,289,255]	0.680 (0.466) [1,464,569]	0.662 (0.473) [1,480,498]	0.519 (0.500) [1,695,036]
Hours	39.223 (9.874) [3,830,355]	28.057 (12.011) [114,498]	37.660 (10.157) [851,953]	40.288 (9.308) [997,335]	40.471 (9.079) [983,448]	39.766 (9.579) [883,121]
Wages (2014\$)	20.879 (14.354) [3,830,355]	9.601 (5.241) [114,498]	15.398 (9.660) [851,953]	21.825 (13.983) [997,335]	23.822 (15.167) [983,448]	24.025 (16.355) [883,121]
<i>Panel II: Males Sample</i>						
Employment	0.652 (0.476) [2,979,660]	0.425 (0.494) [130,858]	0.692 (0.462) [621,919]	0.739 (0.439) [700,506]	0.688 (0.463) [713,095]	0.541 (0.498) [813,282]
Hours	41.469 (9.367) [1,938,600]	29.902 (12.286) [57,158]	39.396 (9.989) [436,154]	42.749 (8.446) [516,955]	42.974 (8.283) [489,409]	42.067 (8.932) [438,924]
Wages (2014\$)	22.942 (15.236) [1,938,600]	10.087 (6.214) [57,158]	16.109 (9.856) [436,154]	23.530 (14.443) [516,955]	26.790 (15.979) [489,409]	27.313 (17.410) [438,924]
<i>Panel III: Female Sample</i>						
Employment	0.583 (0.493) [3,209,947]	0.426 (0.494) [129,391]	0.613 (0.487) [667,336]	0.623 (0.485) [764,063]	0.637 (0.481) [767,403]	0.499 (0.500) [881,754]
Hours	36.799 (9.834) [1,891,755]	26.175 (11.421) [57,340]	35.723 (9.992) [415,799]	37.450 (9.448) [480,380]	37.866 (9.138) [494,039]	37.441 (9.650) [438,924]
Wages (2014\$)	18.652 (12.974) [1,891,755]	9.106 (3.955) [57,340]	14.602 (9.373) [415,799]	19.642 (13.127) [480,380]	20.731 (11.548) [494,039]	20.701 (14.474) [438,924]

Notes: Weighted means of the dependent variables are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. Standard deviations are in parentheses and number of observations in brackets.

Table 2. State Medical Marijuana Law Effective Dates

State	Effective Date
Alaska	March 4, 1999
Arizona	April 14, 2011
California	November 6, 1996
Colorado	June 1, 2001
Connecticut	October 1, 2012
Delaware	July 1, 2011
Washington, D.C.	July 26, 2010
Hawaii	December 28, 2000
Illinois	January 1, 2014
Maine	December 22, 1999
Maryland	June 1, 2014
Massachusetts	January 1, 2013
Michigan	December 4, 2008
Minnesota	May 30, 2014
Montana	November 11, 2004
Nevada	October 1, 2001
New Hampshire	July 23, 2013
New Jersey	October 1, 2010
New Mexico	July 1, 2007
New York	July 5, 2014
Oregon	December 3, 1998
Rhode Island	January 3, 2006
Vermont	July 1, 2004
Washington	November 3, 1998

Notes: The effective dates for states adopting MMLs between 1990 and 2010 are collected from Anderson, Hansen, and Rees (2013). For states that implemented an MML between 2011 and 2014, the effective are updated from the National Conference of State Legislatures (2014), and Wen et al. (2014).

Table 3. Difference-in-Difference Estimates of the Effect of MMLs on Employment

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Baseline difference-in-difference estimates</i>						
Pooled	0.002 (0.003)	-0.011 (0.008)	0.002 (0.004)	0.006 (0.004)	0.004 (0.004)	-0.000 (0.004)
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
Males	0.003 (0.003)	-0.011 (0.012)	-0.001 (0.003)	0.006 (0.004)	0.008 (0.005)	0.003 (0.005)
	2,979,660	130,858	621,919	700,506	713,095	813,282
Females	0.002 (0.004)	-0.010 (0.009)	0.005 (0.006)	0.006 (0.005)	-0.001 (0.004)	-0.003 (0.005)
N	3,209,947	129,391	667,336	764,063	767,403	881,754
<i>Panel II: Difference-in-difference estimates with state-specific linear time trends</i>						
Pooled	0.001 (0.003)	0.003 (0.006)	0.006 (0.003)	0.001 (0.004)	0.001 (0.004)	-0.002 (0.004)
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
Males	0.003 (0.004)	0.008 (0.010)	0.005 (0.005)	0.004 (0.005)	0.005 (0.004)	-0.002 (0.004)
N	2,979,660	130,858	621,919	700,506	713,095	813,282
Females	0.001 (0.004)	0.001 (0.009)	0.006 (0.005)	-0.002 (0.005)	-0.003 (0.004)	-0.001 (0.006)
N	3,209,947	129,391	667,336	764,063	767,403	881,754

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects and year fixed effects. Demographic controls include gender, race/ethnicity, age (linear and squared), education, marital status, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Table 4. Difference-in-Difference Estimates of the Effect of MMLs on Log Hours

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Baseline difference-in-difference estimates</i>						
Pooled	-0.002 (0.003)	-0.004 (0.008)	-0.006 (0.004)	-0.001 (0.003)	0.000 (0.002)	-0.002 (0.003)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Males	-0.002 (0.002)	-0.004 (0.013)	-0.004 (0.004)	-0.002 (0.002)	-0.001 (0.002)	0.001 (0.003)
	1,938,600	57,158	436,154	516,955	489,409	438,924
Females	-0.002 (0.004)	-0.002 (0.009)	-0.007 (0.005)	-0.000 (0.004)	0.001 (0.004)	-0.006 (0.005)
N	1,891,755	57,340	415,799	480,380	494,039	444,197
<i>Panel II: Difference-in-difference estimates with state-specific linear time trends</i>						
Pooled	0.001 (0.002)	0.016 (0.010)	0.003 (0.003)	-0.001 (0.003)	0.001 (0.002)	-0.001 (0.002)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Males	0.000 (0.002)	0.015 (0.017)	0.002 (0.003)	-0.004 (0.003)	-0.001 (0.002)	0.002 (0.003)
	1,938,600	57,158	436,154	516,955	489,409	438,924
Females	0.002 (0.002)	0.018 (0.022)	0.003 (0.004)	0.002 (0.003)	0.003 (0.004)	-0.005 (0.003)
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects and year fixed effects. Demographic controls include gender, race/ethnicity, age (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Table 5. Difference-in-Difference Estimates of the Effect of MMLs on Log Wages

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Baseline difference-in-difference estimates</i>						
Pooled	-0.010 (0.009)	-0.002 (0.005)	-0.021 (0.012)	-0.011 (0.011)	-0.005 (0.007)	-0.003 (0.010)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Males	-0.010 (0.010)	-0.009 (0.006)	-0.025* (0.012)	-0.013 (0.012)	-0.000 (0.009)	-0.001 (0.012)
	1,938,600	57,158	436,154	516,955	489,409	438,924
Females	-0.009 (0.008)	0.005 (0.007)	-0.015 (0.011)	-0.008 (0.010)	-0.010 (0.007)	-0.005 (0.008)
N	1,891,755	57,340	415,799	480,380	494,039	444,197
<i>Panel II: Difference-in-difference estimates with state-specific linear time trends</i>						
Pooled	-0.010 (0.007)	-0.006 (0.010)	-0.018 (0.010)	-0.011 (0.011)	-0.005 (0.006)	-0.006 (0.005)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Males	-0.010 (0.008)	-0.007 (0.010)	-0.028* (0.012)	-0.014 (0.012)	0.001 (0.005)	-0.002 (0.006)
	1,938,600	57,158	436,154	516,955	489,409	438,924
Females	-0.010 (0.007)	-0.004 (0.013)	-0.007 (0.009)	-0.008 (0.012)	-0.012 (0.007)	-0.011 (0.007)
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects and year fixed effects. Demographic controls include gender, race/ethnicity, potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Table 6. Robustness of Estimates to Control for Anti-Marijuana Legalization Sentiment

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
Employment	0.002 (0.003)	0.002 (0.006)	0.006 (0.003)	0.001 (0.004)	0.001 (0.004)	-0.002 (0.004)
N	6,013,148	252,964	1,251,894	1,422,844	1,438,119	1,647,327
Hours	0.003 (0.004)	0.008 (0.011)	0.005 (0.005)	0.004 (0.005)	0.005 (0.004)	-0.001 (0.004)
N	3,714,767	110,631	825,393	967,815	954,140	856,788
Wages	0.001 (0.004)	-0.002 (0.009)	0.007 (0.005)	-0.002 (0.005)	-0.003 (0.004)	-0.001 (0.006)
N	3,714,767	110,631	825,393	967,815	954,140	856,788
<i>Panel II: Males</i>						
Employment	0.002 (0.002)	0.012 (0.010)	0.002 (0.003)	-0.003 (0.003)	0.005 (0.002)	0.006 (0.004)
N	2,892,780	127,186	603,679	679,955	692,118	789,842
Hours	-0.000 (0.002)	0.015 (0.017)	0.002 (0.003)	-0.004 (0.003)	-0.002 (0.002)	0.002 (0.003)
N	1,879,174	55,219	422,395	501,257	474,559	425,744
Wages	-0.010 (0.008)	-0.007 (0.010)	-0.028* (0.012)	-0.014 (0.012)	0.001 (0.005)	-0.002 (0.006)
N	1,879,174	55,219	422,395	501,257	474,559	425,744
<i>Panel III: Females</i>						
Employment	0.000 (0.003)	0.001 (0.007)	0.004 (0.004)	-0.002 (0.004)	-0.004 (0.002)	-0.002 (0.005)
N	3,120,368	125,778	648,215	742,889	746,001	857,485
Hours	0.002 (0.002)	0.017 (0.023)	0.004 (0.004)	0.002 (0.003)	0.003 (0.004)	-0.005 (0.003)
N	1,835,593	55,412	402,998	466,558	479,581	431,044
Wages	-0.010 (0.007)	-0.004 (0.013)	-0.008 (0.009)	-0.007 (0.012)	-0.013 (0.007)	-0.011 (0.007)
N	1,835,593	55,412	402,998	466,558	479,581	431,044

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Table 7. Robustness of Estimates of the Effect of MMLs on Log Wages to Controls for Policy Leads and Lags

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
4 Years Prior	0.009 (0.004)	0.011 (0.009)	0.012 (0.007)	0.014* (0.007)	0.008 (0.006)	0.009 (0.004)
3 Years Prior	0.003 (0.005)	-0.007 (0.013)	-0.000 (0.008)	-0.007 (0.007)	0.009 (0.007)	0.003 (0.005)
2 Years Prior	0.001 (0.009)	0.024 (0.023)	-0.006 (0.010)	0.001 (0.012)	0.006 (0.012)	0.001 (0.009)
1 Year Prior	0.002 (0.009)	0.015 (0.022)	-0.008 (0.008)	0.000 (0.013)	0.004 (0.012)	0.002 (0.009)
Year of law changed	-0.004 (0.012)	-0.000 (0.021)	-0.008 (0.015)	0.002 (0.015)	-0.008 (0.011)	-0.004 (0.012)
1 Year After	-0.005 (0.014)	0.004 (0.023)	-0.009 (0.014)	-0.004 (0.025)	-0.004 (0.010)	-0.005 (0.014)
2 Years After	-0.016 (0.012)	-0.005 (0.027)	-0.018 (0.013)	-0.028 (0.016)	-0.006 (0.012)	-0.016 (0.012)
3+ Years After	-0.009 (0.009)	0.025 (0.032)	-0.005 (0.010)	-0.009 (0.012)	-0.014 (0.010)	-0.009 (0.009)
χ^2 of $\sum(\beta_{leads}) = 0$	0.364	0.574	0.012	0.050	0.766	2.065
p-value	0.549	0.452	0.914	0.824	0.386	0.157
χ^2 of $\sum(\beta_{yrchange}, \beta_{lags}) = 0$	0.592	0.069	0.815	0.410	0.642	0.322
p-value	0.445	0.794	0.371	0.525	0.427	0.573
N	3,830,355	114,498	851,953	997,335	983,448	883,121
<i>Panel II: Males</i>						
4 Years Prior	0.004 (0.006)	0.015 (0.012)	-0.008 (0.007)	0.007 (0.007)	0.013* (0.006)	0.003 (0.012)
3 Years Prior	0.003 (0.008)	-0.012 (0.013)	-0.008 (0.012)	0.012 (0.006)	0.005 (0.013)	0.003 (0.008)
2 Years Prior	-0.001 (0.007)	-0.005 (0.019)	-0.027 (0.014)	0.004 (0.005)	0.007 (0.007)	0.013 (0.009)
1 Year Prior	-0.011 (0.014)	-0.012 (0.023)	-0.029 (0.015)	-0.014 (0.012)	-0.014 (0.012)	0.017 (0.016)
Year of law changed	-0.010 (0.014)	-0.008 (0.019)	-0.043* (0.018)	-0.008 (0.015)	-0.000 (0.012)	0.010 (0.012)
1 Year After	-0.009 (0.016)	-0.017 (0.023)	-0.032 (0.022)	-0.016 (0.017)	0.009 (0.013)	-0.000 (0.018)
2 Years After	-0.019 (0.016)	-0.010 (0.017)	-0.056* (0.021)	-0.026 (0.023)	0.001 (0.012)	0.005 (0.010)
3+ Years After	-0.010 (0.012)	-0.005 (0.025)	-0.038* (0.018)	-0.011 (0.014)	0.000 (0.011)	0.006 (0.012)

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
χ^2 of $\sum(\beta_{leads}) = 0$	0.03	0.058	2.547	0.125	0.109	0.883
p-value	0.864	0.811	0.117	0.725	0.743	0.352
χ^2 of $\sum(\beta_{yrchange}, \beta_{lags}) = 0$	0.772	0.28	4.798	0.955	0.051	0.205
p-value	0.384	0.599	0.033	0.333	0.822	0.653
N	1,938,600	57,158	436,154	516,955	489,409	438,924
<i>Panel III: Females</i>						
4 Years Prior	0.009 (0.004)	0.011 (0.009)	0.012 (0.007)	0.014* (0.007)	0.008 (0.006)	0.007 (0.007)
3 Years Prior	0.003 (0.005)	-0.007 (0.013)	-0.000 (0.008)	-0.007 (0.007)	0.009 (0.007)	0.015** (0.005)
2 Years Prior	0.001 (0.009)	0.024 (0.023)	-0.006 (0.010)	0.001 (0.012)	0.006 (0.012)	0.002 (0.007)
1 Year Prior	0.002 (0.009)	0.015 (0.022)	-0.008 (0.008)	0.000 (0.013)	0.004 (0.012)	0.012 (0.010)
Year of law changed	-0.004 (0.012)	-0.000 (0.021)	-0.008 (0.015)	0.002 (0.015)	-0.008 (0.011)	-0.001 (0.013)
1 Year After	-0.005 (0.014)	0.004 (0.023)	-0.009 (0.014)	-0.004 (0.025)	-0.004 (0.010)	0.002 (0.012)
2 Years After	-0.016 (0.012)	-0.005 (0.027)	-0.018 (0.013)	-0.028 (0.016)	-0.006 (0.012)	-0.013 (0.009)
3+ Years After	-0.009 (0.009)	0.025 (0.032)	-0.005 (0.010)	-0.009 (0.012)	-0.014 (0.010)	-0.009 (0.010)
χ^2 of $\sum(\beta_{leads}) = 0$	0.364	0.574	0.012	0.05	0.766	2.065
p-value	0.549	0.452	0.914	0.824	0.386	0.157
χ^2 of $\sum(\beta_{yrchange}, \beta_{lags}) = 0$	0.592	0.069	0.815	0.41	0.642	0.322
p-value	0.445	0.794	0.371	0.525	0.427	0.573
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Table 8. Synthetic Difference-in-Difference Estimates of the Effect of MMLs on Log Wages for Males Ages 20-to-29

Northeastern States			
<i>Connecticut</i>	<i>Maine</i>	<i>Massachusetts</i>	<i>New Hampshire</i>
-0.048	-0.027	-0.022	-0.041
(0.066)	(0.020)	(0.058)	(0.034)
{0.786}	{0.750}	{0.571}	{0.929}
[75]	[200]	[50]	[100]
<i>New Jersey</i>	<i>New York</i>	<i>Rhode Island</i>	<i>Vermont</i>
-0.065	-0.005	-0.030	-0.021
(0.046)	(0.028)	(0.027)	(0.021)
{0.964}	{0.643}	{0.929}	{0.143}
[75]	[75]	[75]	[150]
Western States			
<i>Alaska</i>	<i>Arizona</i>	<i>California</i>	<i>Colorado</i>
-0.080**	0.005	-0.015	0.039*
(0.029)	(0.018)	(0.016)	(0.017)
{0.964}	{0.464}	{0.964}	{0.964}
[75]	[175]	[100]	[125]
<i>Hawaii</i>	<i>Montana</i>	<i>Nevada</i>	<i>New Mexico</i>
-0.058	-0.008	-0.038	0.002
(0.043)	(0.015)	(0.024)	(0.035)
{0.929}	{0.679}	{0.929}	{0.179}
[50]	[150]	[75]	[125]
	<i>Oregon</i>	<i>Washington</i>	
	-0.007	0.007	
	(0.012)	(0.017)	
	{0.643}	{0.964}	
	[175]	[100]	
Mid-Western States			
<i>Illinois</i>	<i>Michigan</i>	<i>Minnesota</i>	
-0.054	-0.072**	-0.035	
(0.039)	(0.017)	(0.030)	
{0.500}	{0.393}	{0.964}	
[75]	[100]	[125]	
Southern States			
<i>Delaware</i>	<i>District of Columbia</i>	<i>Maryland</i>	
-0.067	0.135	-0.024	
(0.037)	(0.089)	(0.072)	
{0.750}	{0.286}	{0.679}	
[100]	[50]	[100]	

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using state-year data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects and year fixed effects. Control states are selected by the procedure developed by Abadie et al. (2010) and regressions are weighted using the synthetic control weights. Wild bootstrapped standard errors are in parentheses, p-values calculated based on a raking of states of the ratio post-mean-squared-prediction-error to the pre-mean-squared-prediction error after implementing the synthetic approach for each of the potential donor states in braces, and the number of observations in brackets.

Table 9. Exploring Mechanisms—Difference-in-Difference Estimates of the Effect of MMLs on Exercising and Drinking, BRFSS 1990-2013

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
Vigorous Days	0.003 (0.018)	-0.144 (0.083)	-0.054** (0.020)	-0.025 (0.020)	0.020 (0.030)	0.024 (0.027)
Mean	1.559	2.501	1.942	1.723	1.589	1.288
N	1,225,377	21,728	151,783	250,240	317,107	484,519
Number of Drinks	-0.656* (0.297)	-1.076 (0.922)	-1.749** (0.491)	-0.679 (0.481)	-0.385 (0.390)	-0.471 (0.246)
Mean	11.482	10.171	14.121	11.066	11.590	10.793
N	3,725,215	73,072	498,919	783,972	925,599	1,443,653
<i>Panel II: Males</i>						
Vigorous Days	0.014 (0.031)	-0.189** (0.071)	-0.080 (0.044)	0.039 (0.032)	0.012 (0.060)	0.028 (0.029)
Mean	1.865	3.086	2.400	2.067	1.858	1.535
N	486,220	10,539	59,583	96,715	126,862	192,521
Number of Drinks	-0.744 (0.465)	-3.115* (1.527)	-2.581** (0.937)	-0.746 (0.687)	-0.464 (0.718)	-0.389 (0.402)
Mean	18.350	14.598	23.440	18.274	17.939	17.114
N	1,470,496	34,572	197,744	301,411	367,472	569,297
<i>Panel III: Females</i>						
Vigorous Days	-0.004 (0.018)	-0.106 (0.113)	-0.033 (0.029)	-0.069* (0.029)	0.021 (0.021)	0.030 (0.045)
Mean	1.358	1.949	1.645	1.522	1.410	1.125
N	739,157	11,189	92,200	153,525	190,245	291,998
Number of Drinks	-0.363** (0.136)	0.299 (1.388)	-0.987** (0.259)	-0.282 (0.285)	-0.045 (0.201)	-0.361* (0.159)
Mean	6.879	6.015	7.741	6.355	7.322	6.632
N	2,166,627	36,075	283,277	456,785	536,148	854,342

**Significant at 1% level * at 5% level

Notes: Unweighted negative binomial estimates for the number of days the respondent engaged in vigorous activities and unweighted OLS estimates for the number of drinks are obtained using data from the 1990 to 2013 Behavioral Risk Factor Surveillance System. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and quadratic), education, and marital status. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Table 10. Heterogeneity in the Effects of MMLs on Log of Wages

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Collective Cultivation</i>						
Pooled	-0.024** (0.008)	-0.022* (0.011)	-0.039** (0.012)	-0.030** (0.011)	-0.012 (0.007)	-0.016* (0.007)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Males	-0.025* (0.010)	-0.020 (0.011)	-0.050** (0.017)	-0.033** (0.010)	-0.008 (0.006)	-0.007 (0.011)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
Females	-0.025** (0.007)	-0.024 (0.014)	-0.026** (0.008)	-0.029* (0.012)	-0.017 (0.011)	-0.025** (0.005)
N	1,891,755	57,340	415,799	480,380	494,039	444,197
<i>Panel II: Home Cultivation</i>						
Pooled	-0.015 (0.010)	-0.017 (0.010)	-0.027 (0.014)	-0.017 (0.014)	-0.009 (0.007)	-0.010 (0.007)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Males	-0.017 (0.010)	-0.015 (0.010)	-0.037* (0.018)	-0.022 (0.013)	-0.004 (0.006)	-0.007 (0.010)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
Females	-0.013 (0.009)	-0.016 (0.014)	-0.015 (0.010)	-0.013 (0.016)	-0.015 (0.011)	-0.012 (0.008)
N	1,891,755	57,340	415,799	480,380	494,039	444,197
<i>Panel III: Pain</i>						
Pooled	-0.015 (0.011)	0.000 (0.019)	-0.027* (0.013)	-0.022 (0.013)	-0.006 (0.008)	-0.008 (0.008)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Males	-0.019 (0.013)	-0.009 (0.016)	-0.038* (0.017)	-0.026 (0.013)	-0.008 (0.008)	-0.003 (0.011)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
Females	-0.013 (0.009)	0.011 (0.022)	-0.015 (0.009)	-0.018 (0.013)	-0.006 (0.008)	-0.013* (0.006)
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. Each coefficient represents a result from separate weighted regressions that include state fixed effects, year fixed effects and state specific time trends. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, potential experience (linear and squared), education, marital status, and industry classification. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 1. Robustness of Estimates with the Use of Alternative MML Effective Dates to Indicate Whether a State Has an Effective MML in the Entire Year

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
Employment	0.002 (0.003)	0.005 (0.007)	0.006* (0.003)	0.002 (0.004)	0.003 (0.004)	-0.003 (0.005)
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
Hours	0.001 (0.002)	0.018 (0.010)	0.004 (0.003)	-0.001 (0.002)	0.001 (0.003)	-0.002 (0.002)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Wages	-0.012 (0.007)	-0.006 (0.011)	-0.018 (0.012)	-0.015 (0.011)	-0.007 (0.005)	-0.009* (0.005)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
<i>Panel II: Males</i>						
Employment	0.002 (0.004)	0.009 (0.010)	0.005 (0.005)	0.003 (0.005)	0.007 (0.004)	-0.005 (0.005)
N	2,979,660	130,858	621,919	700,506	713,095	813,282
Hours	-0.000 (0.003)	0.013 (0.018)	0.001 (0.003)	-0.004 (0.003)	-0.001 (0.003)	0.001 (0.003)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
Wages	-0.013 (0.009)	-0.011 (0.009)	-0.028 (0.015)	-0.013 (0.009)	-0.011 (0.009)	-0.028 (0.015)
N	-0.013	-0.011	-0.028	-0.013	-0.011	-0.028
<i>Panel III: Females</i>						
Employment	0.002 (0.004)	0.003 (0.010)	0.008 (0.005)	-0.000 (0.004)	-0.002 (0.004)	-0.000 (0.007)
N	3,209,947	129,391	667,336	764,063	767,403	881,754
Hours	0.003 (0.002)	0.023 (0.020)	0.006 (0.004)	0.001 (0.003)	0.002 (0.004)	-0.006 (0.004)
N	1,891,755	57,340	415,799	480,380	494,039	444,197
Wages	-0.011 (0.006)	-0.000 (0.014)	-0.008 (0.009)	-0.012 (0.012)	-0.012 (0.007)	-0.013* (0.005)
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 2. Robustness of Estimates with the Use of Alternative MML Effective Dates to Indicate Whether a State Has an Effective MML at Any Time in a Given Year

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
Employment	-0.000 (0.004)	-0.000 (0.007)	0.002 (0.005)	-0.001 (0.004)	0.002 (0.004)	-0.004 (0.004)
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
Hours	0.000 (0.002)	0.013 (0.010)	0.000 (0.003)	-0.000 (0.002)	-0.001 (0.002)	-0.001 (0.002)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Wages	-0.011 (0.009)	-0.007 (0.014)	-0.021* (0.010)	-0.013 (0.012)	-0.008 (0.007)	-0.002 (0.007)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
<i>Panel II: Males</i>						
Employment	0.002 (0.004)	0.007 (0.007)	0.003 (0.006)	0.004 (0.005)	0.006 (0.006)	-0.004 (0.004)
N	2,979,660	130,858	621,919	700,506	713,095	813,282
Hours	-0.001 (0.002)	0.014 (0.016)	-0.002 (0.003)	-0.003 (0.002)	-0.003 (0.002)	0.002 (0.002)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
Wages	-0.014 (0.010)	-0.009 (0.013)	-0.030* (0.013)	-0.020 (0.011)	-0.005 (0.008)	0.001 (0.009)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
<i>Panel III: Females</i>						
Employment	-0.002 (0.004)	-0.006 (0.012)	0.001 (0.006)	-0.006 (0.005)	-0.001 (0.004)	-0.004 (0.006)
N	3,209,947	129,391	667,336	764,063	767,403	881,754
Hours	0.002 (0.002)	0.013 (0.021)	0.003 (0.004)	0.003 (0.003)	-0.001 (0.004)	-0.004 (0.003)
N	1,891,755	57,340	415,799	480,380	494,039	444,197
Wages	-0.008 (0.008)	-0.003 (0.017)	-0.011 (0.007)	-0.006 (0.013)	-0.012 (0.009)	-0.005 (0.007)
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 3. State Medical Marijuana Laws by Specific Provisions

State	Provisions		
	Collective Cultivation	Home Cultivation	Pain
Alaska		Yes	Yes
Arizona	Yes	Yes	Yes
California	Yes	Yes	Yes
Colorado	Yes	Yes	Yes
Connecticut			
Delaware			Yes
Washington, D.C.			
Hawaii		Yes	Yes
Illinois			
Maine		Yes	Yes
Maryland			Yes
Massachusetts	Yes	Yes	
Michigan			Yes
Minnesota			
Montana	Yes	Yes	Yes
Nevada	Yes	Yes	Yes
New Hampshire			
New Jersey			Yes
New Mexico		Yes	
New York			
Oregon	Yes	Yes	Yes
Rhode Island	Yes	Yes	Yes
Vermont		Yes	Yes
Washington	Yes	Yes	Yes

Appendix Table 4. Robustness of Estimates of the Effect of MMLs with the Alternative Definition of Employment

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Baseline difference-in-difference estimates</i>						
Pooled	0.003 (0.002)	-0.011 (0.009)	0.000 (0.004)	0.002 (0.002)	0.004* (0.002)	0.006 (0.004)
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
Males	0.003 (0.002)	-0.012 (0.013)	-0.003 (0.004)	0.001 (0.003)	0.008** (0.002)	0.010 (0.006)
	2,979,660	130,858	621,919	700,506	713,095	813,282
Females	0.003 (0.003)	-0.009 (0.007)	0.003 (0.005)	0.003 (0.004)	-0.001 (0.002)	0.002 (0.004)
N	3,209,947	129,391	667,336	764,063	767,403	881,754
<i>Panel II: Difference-in-difference estimates with state-specific linear time trends</i>						
Pooled	0.001 (0.002)	0.006 (0.006)	0.004 (0.002)	-0.002 (0.002)	0.001 (0.002)	0.001 (0.004)
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
Males	0.002 (0.002)	0.011 (0.010)	0.003 (0.003)	-0.003 (0.003)	0.005 (0.002)	0.005 (0.004)
N	2,979,660	130,858	621,919	700,506	713,095	813,282
Females	0.000 (0.003)	0.004 (0.007)	0.004 (0.004)	-0.002 (0.004)	-0.004 (0.002)	-0.002 (0.005)
N	3,209,947	129,391	667,336	764,063	767,403	881,754

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects and year fixed effects. Demographic controls include gender, race/ethnicity, age (linear and squared), education, marital status, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 5. Robustness of Log Wage Estimates to Correct for Selection Bias Using the Heckman Model

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
Pooled	-0.011 (0.008)	-0.003 (0.011)	-0.015 (0.010)	-0.012 (0.011)	-0.006 (0.006)	-0.005 (0.006)
N	6,101,945	259,153	1,276,013	1,443,124	1,455,536	1,668,119
Males	-0.012 (0.009)	0.001 (0.011)	-0.024* (0.011)	-0.015 (0.012)	0.001 (0.005)	-0.000 (0.006)
N	2,926,099	130,191	613,767	687,168	697,912	797,061
Females	-0.010 (0.006)	-0.004 (0.013)	-0.006 (0.009)	-0.010 (0.011)	-0.014 (0.008)	-0.010 (0.007)
N	3,175,846	128,962	662,246	755,956	757,624	871,058

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 6. Robustness of Estimates with the Use of MML Effective Dates Preferred by Powell et al.'s (2015)

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
Employment	0.002 (0.003)	0.004 (0.006)	0.006* (0.003)	0.001 (0.004)	0.002 (0.003)	-0.003 (0.004)
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
Hours	0.001 (0.002)	0.019* (0.009)	0.003 (0.003)	-0.001 (0.002)	0.001 (0.002)	-0.002 (0.002)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
Wages	-0.009 (0.007)	-0.005 (0.011)	-0.018 (0.011)	-0.010 (0.012)	-0.006 (0.006)	-0.007 (0.005)
N	3,830,355	114,498	851,953	997,335	983,448	883,121
<i>Panel II: Males</i>						
Employment	0.003 (0.004)	0.011 (0.009)	0.005 (0.005)	0.004 (0.005)	0.007 (0.004)	-0.002 (0.004)
N	2,979,660	130,858	621,919	700,506	713,095	813,282
Hours	-0.000 (0.002)	0.016 (0.017)	0.002 (0.003)	-0.004 (0.003)	-0.001 (0.002)	0.001 (0.002)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
Wages	-0.010 (0.008)	-0.008 (0.010)	-0.027* (0.012)	-0.013 (0.012)	0.001 (0.005)	-0.003 (0.005)
N	1,938,600	57,158	436,154	516,955	489,409	438,924
<i>Panel III: Females</i>						
Employment	0.001 (0.004)	0.000 (0.010)	0.007 (0.004)	-0.002 (0.005)	-0.003 (0.004)	-0.002 (0.006)
N	3,209,947	129,391	667,336	764,063	767,403	881,754
Hours	0.002 (0.002)	0.022 (0.022)	0.002 (0.004)	0.002 (0.003)	0.002 (0.004)	-0.004 (0.003)
N	1,891,755	57,340	415,799	480,380	494,039	444,197
Wages	-0.009 (0.007)	-0.002 (0.014)	-0.008 (0.009)	-0.007 (0.012)	-0.012 (0.007)	-0.011 (0.006)
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 7. Robustness of Estimates the Effect of MMLs on Employment to Control for Policy Leads and Lags

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
4 Years Prior	0.001 (0.003)	0.007 (0.006)	0.004 (0.004)	-0.002 (0.004)	-0.002 (0.003)	0.002 (0.004)
3 Years Prior	0.001 (0.002)	-0.003 (0.008)	0.004 (0.004)	-0.002 (0.005)	-0.004 (0.005)	0.006 (0.005)
2 Years Prior	0.001 (0.004)	-0.002 (0.009)	0.000 (0.005)	0.001 (0.003)	0.006 (0.007)	0.000 (0.004)
1 Year Prior	-0.003 (0.004)	-0.003 (0.011)	-0.000 (0.006)	-0.002 (0.005)	0.004 (0.005)	-0.008 (0.005)
Year of law changed	0.000 (0.005)	-0.008 (0.007)	0.007 (0.007)	-0.005 (0.006)	0.003 (0.006)	-0.002 (0.006)
1 Year After	0.002 (0.005)	0.000 (0.010)	0.005 (0.005)	0.002 (0.008)	0.006 (0.006)	-0.003 (0.006)
2 Years After	-0.000 (0.005)	0.015 (0.010)	0.004 (0.005)	0.000 (0.006)	-0.004 (0.007)	-0.004 (0.006)
3+ Years After	0.005 (0.006)	0.016 (0.011)	0.013* (0.006)	0.007 (0.007)	0.004 (0.008)	-0.003 (0.005)
χ^2 of $\sum(\beta_{leads}) = 0$	0.001	0.001	0.25	0.184	0.11	0.001
p-value	0.976	0.979	0.619	0.67	0.742	0.977
χ^2 of $\sum(\beta_{yrchange}, \beta_{lags}) = 0$	0.132	0.558	2.331	0.054	0.119	0.343
p-value	0.718	0.459	0.133	0.818	0.731	0.561
N	6,189,607	260,249	1,289,255	1,464,569	1,480,498	1,695,036
<i>Panel II: Males</i>						
4 Years Prior	0.002 (0.003)	0.014 (0.009)	0.005 (0.006)	0.001 (0.005)	0.005 (0.003)	-0.002 (0.005)
3 Years Prior	0.005 (0.003)	-0.018* (0.009)	0.006 (0.006)	0.003 (0.006)	0.006 (0.007)	0.009 (0.006)
2 Years Prior	0.003 (0.004)	-0.008 (0.012)	0.006 (0.007)	0.009* (0.003)	0.009 (0.008)	-0.002 (0.005)
1 Year Prior	-0.001 (0.006)	-0.002 (0.010)	0.005 (0.008)	0.007 (0.005)	0.004 (0.010)	-0.011 (0.006)
Year of law changed	0.002 (0.006)	-0.011 (0.012)	0.009 (0.008)	0.003 (0.007)	0.008 (0.010)	-0.005 (0.006)
1 Year After	0.003 (0.004)	0.004 (0.014)	0.002 (0.006)	0.010 (0.007)	0.011 (0.007)	-0.006 (0.005)
2 Years After	0.005 (0.006)	0.032 (0.017)	0.010 (0.010)	0.008 (0.006)	0.006 (0.007)	-0.003 (0.006)
3+ Years After	0.010 (0.008)	0.013 (0.013)	0.018 (0.009)	0.014 (0.007)	0.016 (0.011)	-0.000 (0.008)
χ^2 of $\sum(\beta_{leads}) = 0$	0.607	0.348	1.011	3.273	0.894	0.123
p-value	0.44	0.558	0.32	0.076	0.349	0.728
χ^2 of $\sum(\beta_{yrchange}, \beta_{lags}) = 0$	1.027	1.039	2.032	3.051	1.598	0.557

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
p-value	0.316	0.313	0.16	0.087	0.212	0.459
N	2,979,660	130,858	621,919	700,506	713,095	813,282
<i>Panel III: Females</i>						
4 Years Prior	-0.001 (0.002)	0.000 (0.010)	0.005 (0.003)	-0.007 (0.004)	-0.008 (0.004)	0.006 (0.006)
3 Years Prior	-0.003 (0.003)	0.013 (0.013)	0.002 (0.005)	-0.009 (0.006)	-0.012* (0.006)	0.005 (0.005)
2 Years Prior	-0.001 (0.003)	0.004 (0.018)	-0.005 (0.006)	-0.007 (0.005)	0.004 (0.007)	0.002 (0.005)
1 Year Prior	-0.005 (0.004)	-0.004 (0.017)	-0.004 (0.008)	-0.012 (0.006)	0.005 (0.004)	-0.005 (0.007)
Year of law changed	-0.001 (0.005)	-0.002 (0.015)	0.007 (0.008)	-0.014 (0.008)	-0.002 (0.005)	0.002 (0.007)
1 Year After	0.001 (0.006)	-0.002 (0.016)	0.007 (0.006)	-0.008 (0.008)	-0.000 (0.008)	-0.001 (0.008)
2 Years After	-0.006 (0.006)	0.000 (0.019)	-0.002 (0.008)	-0.009 (0.008)	-0.014 (0.007)	-0.003 (0.011)
3+ Years After	0.000 (0.006)	0.021 (0.018)	0.008 (0.008)	-0.001 (0.007)	-0.008 (0.007)	-0.004 (0.009)
χ^2 of $\sum(\beta_{leads}) = 0$	0.935	0.086	0.008	4.638	0.56	0.166
p-value	0.338	0.771	0.928	0.036	0.458	0.685
χ^2 of $\sum(\beta_{yrchange}, \beta_{lags}) = 0$	0.081	0.1	0.697	1.86	1.036	0.023
p-value	0.777	0.753	0.408	0.179	0.314	0.879
N	3,209,947	129,391	667,336	764,063	767,403	881,754

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 8. Robustness of Estimates of the Effect of MMLs on Log Hours to Controls for Policy Leads and Lags

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
<i>Panel I: Pooled Sample</i>						
4 Years Prior	0.001 (0.002)	-0.001 (0.010)	-0.005 (0.005)	0.001 (0.003)	0.004* (0.002)	0.001 (0.003)
3 Years Prior	-0.001 (0.003)	0.007 (0.013)	-0.006 (0.003)	-0.004 (0.002)	0.004 (0.003)	0.000 (0.005)
2 Years Prior	-0.001 (0.002)	-0.008 (0.014)	-0.007 (0.004)	0.001 (0.003)	-0.003 (0.004)	0.002 (0.004)
1 Year Prior	-0.002 (0.001)	-0.008 (0.015)	-0.005 (0.004)	0.001 (0.002)	-0.004 (0.003)	-0.001 (0.004)
Year of law changed	-0.000 (0.002)	-0.013 (0.017)	-0.004 (0.004)	0.001 (0.003)	-0.001 (0.003)	0.001 (0.002)
1 Year After	0.001 (0.002)	0.042* (0.020)	0.003 (0.004)	-0.002 (0.003)	0.002 (0.003)	-0.005 (0.004)
2 Years After	-0.002 (0.002)	0.006 (0.015)	-0.000 (0.003)	-0.006* (0.003)	-0.002 (0.002)	-0.002 (0.006)
3+ Years After	0.004 (0.002)	0.034 (0.019)	0.000 (0.005)	-0.001 (0.003)	0.006 (0.003)	0.002 (0.003)
χ^2 of $\sum(\beta_{leads}) = 0$	0.26	0.081	4.253	0.007	0.042	0.037
p-value	0.613	0.777	0.044	0.934	0.839	0.847
χ^2 of $\sum(\beta_{yrchange}, \beta_{lags}) = 0$	0.180	1.994	0.019	1.220	0.498	0.232
p-value	0.673	0.164	0.890	0.275	0.484	0.632
N	3,830,355	114,498	851,953	997,335	983,448	883,121
<i>Panel II: Males</i>						
4 Years Prior	-0.001 (0.002)	0.005 (0.014)	-0.003 (0.006)	-0.002 (0.003)	0.001 (0.003)	-0.001 (0.005)
3 Years Prior	-0.002 (0.002)	-0.012 (0.021)	-0.005 (0.004)	-0.001 (0.003)	-0.002 (0.003)	0.000 (0.005)
2 Years Prior	-0.004* (0.002)	0.000 (0.024)	-0.010** (0.004)	-0.004 (0.003)	-0.007* (0.003)	0.003 (0.004)
1 Year Prior	-0.004 (0.003)	-0.009 (0.014)	-0.008 (0.006)	-0.001 (0.003)	-0.006 (0.003)	-0.001 (0.006)
Year of law changed	-0.004 (0.003)	0.008 (0.024)	-0.005 (0.005)	-0.006* (0.003)	-0.007** (0.002)	0.003 (0.005)
1 Year After	-0.002 (0.002)	0.021 (0.017)	-0.000 (0.004)	-0.005 (0.003)	-0.003 (0.004)	-0.002 (0.005)
2 Years After	-0.004 (0.003)	-0.015 (0.039)	-0.003 (0.005)	-0.009** (0.002)	-0.004 (0.003)	0.003 (0.007)
3+ Years After	0.002 (0.003)	0.038 (0.022)	0.001 (0.005)	-0.002 (0.002)	-0.001 (0.005)	0.006 (0.004)

	All Ages	Ages 18-to-19	Ages 20-to-29	Ages 30-to-39	Ages 40-to-49	Ages 50-to-64
χ^2 of $\sum(\beta_{\text{leads}}) = 0$	3.192	0.093	3.713	0.925	3.441	0.003
p-value	0.08	0.762	0.060	0.341	0.069	0.953
χ^2 of $\sum(\beta_{\text{yrchange}}, \beta_{\text{lags}}) = 0$	0.961	0.419	0.278	7.421	2.286	0.298
p-value	0.332	0.521	0.600	0.009	0.137	0.587
N	1,938,600	57,158	436,154	516,955	489,409	438,924

Panel III: Females

4 Years Prior	0.002 (0.002)	-0.008 (0.015)	-0.006 (0.006)	0.003 (0.004)	0.006* (0.003)	0.003 (0.004)
3 Years Prior	0.000 (0.004)	0.023 (0.021)	-0.007 (0.006)	-0.008 (0.004)	0.010* (0.005)	0.000 (0.006)
2 Years Prior	0.001 (0.003)	-0.016 (0.013)	-0.003 (0.007)	0.005 (0.004)	0.001 (0.006)	0.001 (0.006)
1 Year Prior	-0.000 (0.002)	-0.006 (0.023)	-0.002 (0.005)	0.001 (0.004)	-0.003 (0.005)	-0.000 (0.005)
Year of law changed	0.003 (0.002)	-0.033 (0.030)	-0.002 (0.005)	0.008 (0.004)	0.005 (0.004)	-0.001 (0.005)
1 Year After	0.003 (0.004)	0.069* (0.032)	0.005 (0.008)	-0.001 (0.006)	0.005 (0.006)	-0.009 (0.005)
2 Years After	-0.001 (0.002)	0.028 (0.029)	0.001 (0.005)	-0.004 (0.005)	-0.003 (0.005)	-0.008 (0.006)
3+ Years After	0.004 (0.003)	0.032 (0.025)	-0.001 (0.008)	-0.002 (0.006)	0.012* (0.005)	-0.003 (0.005)
χ^2 of $\sum(\beta_{\text{leads}}) = 0$	0.073	0.026	2.286	0.016	0.934	0.065
p-value	0.788	0.873	0.137	0.899	0.338	0.800
χ^2 of $\sum(\beta_{\text{yrchange}}, \beta_{\text{lags}}) = 0$	2.338	0.877	0.022	0.02	1.437	2.175
p-value	0.133	0.353	0.881	0.889	0.236	0.147
N	1,891,755	57,340	415,799	480,380	494,039	444,197

**Significant at 1% level * at 5% level

Notes: Weighted OLS estimates are obtained using data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. All regressions include state fixed effects, year fixed effects and state specific linear time trends. Demographic controls include gender, race/ethnicity, age (linear and squared)/potential experience (linear and squared), education, marital status, industry classification, and whether the respondent enrolls in school. State level policy and economic controls include marijuana decriminalization laws, state level alcohol and cigarette taxes, minimum wages, and per capita GDP. Standard errors corrected for clustering on the state are in parentheses.

Appendix Table 9. State Weights Implied by Synthetic Control Method

	AL	AR	FL	ID	IN	KY	LA	MO	NC	ND	OH	OK	PA	SC	SD	TX	UT	VA	WI	WV	WY
AK	0.981	...	...	0.019
AZ	0.693	...	...	...	...	...	...	0.017	...	0.132	...	...	...	0.022	0.104	...	...	...	0.032
CA	0.183	0.224	...	...	...	...	0.592	...	...	...
CO	0.362	...	...	0.279	...	...	...	...	...	...	0.207	0.152	...	...
CT	0.679	...	...	...	...	0.321	...	...	...
DE	0.807	0.142	...	0.051
DC	1.000	...	...	...
HI	1.000	...	...	...	...	...	...	...	...
IL	0.377	...	...	...	...	0.623	...	...	...
ME	0.316	...	0.105	0.148	...	...	...	...	...	...	...	0.031	0.319	0.060	0.020	...	...	...	...	...	...
MD	0.294	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.701	...	...	0.006
MA	1.000	...	...	...
MI	0.235	...	0.296	...	...	...	...	...	0.469	...	...
MN	0.008	...	0.291	...	...	...	...	0.636	0.065	...	...
MT	...	0.214	...	...	...	0.093	...	...	...	0.291	...	...	...	...	0.294	...	...	...	...	...	0.108
NV	0.794	...	...	...	...	0.206	...	...	...
NH	0.051	...	...	...	...	...	...	...	...	...	...	...	...	0.498	0.451	...	...
NJ	0.512	...	...	...	...	0.488	...	...	...
NM	0.286	...	0.012	...	...	0.234	0.467	...	...	...	...	...
NY	0.209	...	...	...	...	0.791	...	...	...
OR	...	0.055	...	0.154	0.018	...	...	...	0.236	...	...	...	0.444	...	...	...	...	...	0.093	...	...
RI	0.114	...	0.886	...	...	...	...	...	...	...	...
VT	0.118	...	...	...	...	...	0.682	...	0.036	...	...	...	...	0.011	0.153
WA	0.323	...	...	...	...	0.517	0.160	...	...

Notes: Each row presents the positive synthetic weights for each MML state. Control states are selected by the procedure developed by Abadie et al. (2010) using state-year data from the 1990 to 2014 Current Population Survey Outgoing Rotation Groups. Other states receiving zero weight which did not adopt an MML between 1990 and 2014 include: Georgia, Iowa, Kansas, Mississippi, Nebraska, and Tennessee.