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SMOKE GETS IN YOUR EYES:
MEDICAL MARIJUANA LAWS AND TOBACCO USE

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ABSTRACT

The public health costs of tobacco consumption have been documented to be substantially larger than those of marijuana use. This study is the first to investigate the impact of medical marijuana laws (MMLs) on tobacco cigarette consumption. First, using data from the National Survey of Drug Use and Health (NSDUH), we establish that MMLs induce a 2 to 3 percentage-point increase in adult marijuana consumption, likely for both recreational and medicinal purposes. Then, using data from the NSDUH, the Behavioral Risk Factor Surveillance System (BRFSS), and the Current Population Survey Tobacco Use Supplements (CPS-TUS), we find that the enactment of MMLs leads to a 1 to 1.5 percentage-point reduction in adult cigarette smoking. We also find that MMLs reduce the number of cigarettes consumed by smokers, suggesting effects on both the cessation and intensive margins of cigarette use. Our estimated effect sizes imply substantial MML-induced tobacco-related healthcare cost savings, ranging from$4.6 to $6.9 billion per year.

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1. INTRODUCTION

Tobacco smoking is the leading preventable cause of death in the United States (CDC 2014). Consumption of tobacco cigarettes has been causally linked to respiratory health problems, heart disease, stroke, and a variety of cancers, including lung cancer, liver cancer, and colorectal cancer (U.S. Department of Health and Human Services 2014). Tobacco smokers are 25 to 26 times more likely to suffer from lung cancer—the country's most fatal cancer— than their non-smoking counterparts (Thun et al. 1997a, b; Thun et al. 2013), and are also more likely to suffer from Chronic Obstructive Pulmonary Disease (COPD), a rising cause of mortality in the United States. In total, cigarette smoking is responsible for over 480,000 deaths annually (Xu et al. 2015) and $170 billion in direct additional healthcare spending (Xu et al. 2015). Moreover, exposure to secondhand tobacco smoke is associated with a substantial increase in the probabilities of stroke and death from cardiovascular diseases (U.S. Department of Health and Human Services 2006), adding more than $5 billion in direct medical costs and another $5 billion per year in lost productivity costs (Behan et al. 2005) to the total costs of cigarette smoking.

In sharp contrast to tobacco consumption, marijuana use is linked to far lower risks of mortality and morbidity and, in fact, has some well-documented health benefits. A recent report by the National Academies of Sciences, Engineering, and Medicine (2017) concludes that while smoking marijuana on a regular basis is associated with worse respiratory symptoms (chronic cough and phlegm production) and more frequent chronic bronchitis episodes, it does not increase the risk of cancers often associated with tobacco use – that of the lungs, head, and neck – nor is there sufficient evidence to link marijuana use to an increased chronic risk of heart attack.[1] And in contrast to tobacco use, marijuana consumption effectively treats a number of health conditions, including rheumatoid arthritis (Blake et al. 2006), fibromyalgia (Fiz et al., 2011), chronic neuropathic pain (Rog et al. 2005, Ware et al. 2010), the side-effects of cancer treatments (Hall et al., 2005; Doblin and Kleinman, 1991; Vinciguerra et al., 1988) and HIV (Musty and Rossi 2001). Moreover, increased access to marijuana has been found to *reduce* mortality from drunk driving fatalities (Anderson et al. 2013), suicide (Anderson et al. 2014), and, for particular types of MMLs, opioid overdoses (Powell et al. 2015).

Recent policy reform liberalizing access to marijuana for medicinal purposes enjoys not only widespread public support (Bradford and Bradford 2016), but also the endorsement of the American Public Health Association (APHA 1995). In addition, the American Medical Association recently reversed its stance on medical marijuana, calling on the federal government to revisit its classification of marijuana as a Schedule I drug (AMA 2017). As of April 2017, 29 states and the District of Columbia had adopted medical marijuana laws (MMLs), which legalize the possession, use, and cultivation of marijuana for allowable medical purposes. In addition, Alaska, California, Colorado, the District of Columbia, Maine, Massachusetts, Nevada, Oregon, and Washington have passed more expansive legislation that allow adults ages 21 and older to legally possess up to typically one ounce of marijuana (without intent to sell) for personal consumption, including for recreational use (Marijuana Policy Project 2017). Recent studies have documented that MMLs are associated with increased marijuana consumption among adults (Anderson and Rees 2011; Wen et al. 2015; Sabia and Nguyen 2017), not only for medicinal

[1] The review found "limited evidence" between marijuana use and triggering of a heart attack, and noted that more research is needed on this link.

purposes, but also for recreational use through supply side-induced reductions in the street price of high-grade marijuana (Anderson et al. 2013).[2]

Given the proliferation of MMLs, a key concern is that these laws may generate spillovers into the market for tobacco cigarettes and potentially undermine some of the public health gains achieved through the reduction in cigarette smoking over the past three decades. One of the most significant achievements of tobacco control has been to de-normalize the act of smoking. Some health officials and policymakers have expressed concern that higher rates of marijuana use, most of which is smoked (Schauer et al. 2016), may lead to a renormalization of smoking (Schwartz 2017; Gorman 2016). Tobacco use may further increase if both marijuana are tobacco are consumed together as a "spliff" (Hammersley and Leon 2006) or if marijuana acts as a gateway for cigarette smoking. These spillovers may cause tobacco-related harms that could outweigh any benefits associated with medicinal or recreational use of marijuana.

On the other hand, by reducing the cost of obtaining marijuana for both medicinal and recreational use, MMLs may lead some tobacco smokers to substitute away from cigarettes. This could be because marijuana and tobacco are often consumed via a common method (smoking), serve a common purpose such as stress relief or enhancing the taste of food, or because MMLs lead to improved physical and mental health, thereby increasing the returns to healthier lifestyle choices. Moreover, even if MMLs do not generate high rates of cessation, they may reduce days of smoking or number of cigarettes consumed per day among smokers, which could generate important health benefits. Because cigarette smoking generates over $170 billion in additional healthcare costs (Xu et al. 2015), even modest MML-induced reductions in smoking would translate

[2] There is also some evidence of heterogeneous effects of MMLs on marijuana consumption by type of MML (Pacula et al. 2015; Wen et al. 2015).

into a significant reduction in tobacco-related mortality and morbidity, easing the public health burden of tobacco consumption.

The indirect effects of MMLs on tobacco cigarette use, which imposes substantially higher health costs, could, in fact, generate benefits (or costs) that outweigh those from the direct effects of MMLs on marijuana-related health outcomes. Understanding policy-driven spillovers into other substance use is therefore integral for designing optimal tax and regulatory policy (Pacula 1997),[3] and studies that attempt to evaluate the efficacy of liberalized marijuana policy almost always note the importance of accounting for potential spillovers of such policies on other substances (Caulkins et al. 2015). Despite cross-sectional evidence that marijuana and tobacco consumption are positively related (Agrawal et al. 2012), next to nothing is known about the effects of MMLs on tobacco use. The current study addresses this gap.[4]

Using nationally representative data available from three large surveys — the National Survey on Drug Use and Health (NSDUH), the Behavioral Risk Factor Surveillance Survey (BRFSS), and the Current Population Survey Tobacco Use Supplements (CPS-TUS) — this study comprehensively examines the effects of MMLs on marijuana and cigarette use. First, using data from the NSDUH, we document that MMLs induce a 2 to 3 percentage-point increase in adult marijuana use. Turning to cigarette smoking, data from all three datasets show that the enactment of MMLs leads to an approximately 1 to 1.5 percentage-point decline in cigarette

[3] While a wide body of research has examined the effects of cigarette taxes (Callison and Kaestner 2014; Cebula et al. 2014; Hansen et al. 2017; Carpenter and Cook 2008), informational campaigns (Adams et al. 2011; Liu and Tan, 2009), and smoking bans (Bruderl and Ludwig 2011; Demperio, 2013; Sari 2013) on tobacco use, increased attention has been paid to how changes in the prices of related substances may generate spillover effects on tobacco use. See, for example, Cameron and Williams (2002); Farrelly et al. (2001); Yoruk and Yoruk, (2011, 2013).

[4] There is evidence that MMLs may generate other physical and mental health benefits. For instance, recent studies have examined the effect of MMLs on alcohol consumption (Anderson et al. 2013; Wen et al. 2015), suicides (Anderson et al. 2014), obesity (Sabia et al. 2017), and prescription drugs (Bradford and Bradford 2016; Kim et al. 2016).

smoking, likely driven by the cessation margin given that initiation is somewhat rare among adults. We also find that MMLs reduce the number of cigarettes consumed per day among current smokers, suggesting effects on the intensive margin. In sum, our estimated effect sizes imply MML-induced tobacco-related healthcare cost savings of approximately $4.6 to $6.9 billion per year.

2. BACKGROUND

2.1 Empirical Evidence on Marijuana and Tobacco Use

A large public health literature has documented a positive association between tobacco consumption and marijuana use (see, for example, Ramo et al. 2013, 2012; Beenstock and Tahov 2002; Bentler et al. 2002; Agrawal et al. 2007; Leatherdale et al. 2007). Young adults from ages 18 to 25 are nearly 10 times more likely to have used marijuana if they have also consumed cigarettes (Lai et al. 2000). There is also evidence that those who use marijuana in young adulthood are more likely to initiate smoking cigarettes (Agrawal et al. 2008; Behrendt et al. 2009; Okoli et al. 2008; Timberlake et al. 2007) and are less likely to quit smoking cigarettes (Richter et al. 2002) than their counterparts who have abstained from marijuana.

While the public health literature has tended to characterize this pattern of results as evidence that marijuana and tobacco are complements, caution should be taken with such an interpretation. Because tobacco and marijuana use are jointly determined, the positive association observed could be driven, in part or in whole, by difficult-to-measure characteristics such as personal discount rates, personality or family background characteristics. Moreover, estimates could also be explained by reverse causality. Credibly establishing the complementarity or substitutability of tobacco and marijuana requires estimation of cross-price effects generated from plausibly exogenous shocks in prices.

A number of studies have relied on changes in cigarette taxes to identify such cross-price effects. Using data from the National Household Survey on Drug Abuse, Farrelly et al. (2001) find that increases in cigarette taxes are negatively related to (i) the probability of marijuana use for 12 to 20 year-old males and (ii) the quantity of marijuana consumed by marijuana users. Using a similar empirical approach with data from Monitoring the Future, Chaloupka et al. (1999) find that cigarette taxes are negatively related to intensity of marijuana use among users.

There is mixed evidence on whether marijuana prices and decriminalization policies affect tobacco use. Using data from the Australian National Drug Strategy Household Surveys, Cameron and Williams (2002) find that higher cannabis prices are negatively related to tobacco use, but marijuana decriminalization laws have little effect on tobacco smoking. Farrelly et al. (2001) find that larger marijuana possession penalties are unrelated to tobacco consumption.

2.2. Medical Marijuana Laws, Marijuana Use, and Spillovers

A growing body of literature finds that MMLs are associated with increased marijuana consumption among adults (Anderson and Rees 2011; Wen et al. 2015; Sabia and Nguyen 2017). Using data from the National Survey for Drug Use and Health, Wen et al. (2015) find that MMLs generate a nearly two percentage-point increase in marijuana use among adults. Sabia and Nguyen (2017) and Anderson and Rees (2011) find a similar pattern of results in the NSDUH. The presence of MML-induced increases in marijuana use among demographic groups less likely to be using marijuana for medicinal purposes (those under age 30) suggests that there are recreational spillovers of MMLs. Such an interpretation is supported by Anderson et al.

(2013), who find that MMLs lead to a 10 to 26 percent reduction in the street price of high-grade marijuana and Chu (2014), who finds that MMLs induce a 10 to 20 percent increase in marijuana possession arrests and admissions to rehabilitation centers.

In addition, health economists have also begun to explore possible spillover effects of MMLs. A number of studies have examined the effects of MMLs on binge drinking (Pacula et al. 2015; Anderson et al. 2014; Wen et al. 2015) and hard drugs (Wen et al. 2015; Choi 2015), each of which could affect the demand for tobacco.[5] Evidence on the impact of MMLs on alcohol consumption is mixed. Anderson et al. (2013) and Sabia et al. (2017) find that MMLs lead to a reduction in binge drinking, while Wen et al. (2015) find evidence of an increase in drinking. However, given that these studies examine different state MMLs, differences in findings could suggest that there are heterogeneous effects of MMLs across states (Pacula et al. 2015). There is little evidence that MMLs induce harder illicit drug use (Wen et al. 2015).

Finally, a newer set of studies have examined the impact of MMLs on prescription and non-prescription drug use, as well as broader measures of physical and mental health. Bradford and Bradford (2016) examine Medicare Part D patients and find that MMLs generate a reduction in use of prescription drugs for illnesses for which marijuana could serve as an alternative treatment. And Kim et al. (2016) find that MMLs are associated with a reduction in fatal accidents involving opioids, also consistent with the hypothesis that medical marijuana and opioids are substitutes. At the same time, there is little evidence that MMLs serve as a gateway to harder illicit drug use (Wen et al. 2015). In fact, MMLs have been linked to broader improvements in physical and mental health, including improved physical mobility and reduced

[5] Clements et al. (2010), p. 204: "Empirical studies show that marijuana is closely related in consumption to at least two other goods, tobacco and alcohol…As argued by Pacula (1997)…such interrelations imply cross-commodity impacts of policy changes, so that changes in one drug market are likely to have spillover effects in related markets."

obesity (Sabia et al. 2017), as well as diminished risk of suicide (Anderson et al. 2014). However, the impact of MMLs on tobacco use, where prior studies and indications point to perhaps the strongest interactions, remains unexplored.

2.3 Channels: MMLs and Cigarette Smoking

The effect of MMLs on cigarette smoking is theoretically ambiguous and can potentially operate through both MML-induced increases in recreational and medicinal use of marijuana. If marijuana and tobacco are consumed to achieve a similar objective, such as alleviating anxiety (Bambico 2007) or enhancing the taste of food (Riggs et al. 2012; Soria-Gomez et al. 2014), then the enactment of MMLs may reduce tobacco consumption. In addition, if increases in marijuana use for medical purposes lead to improvements in physical mobility or psychological health (Sabia et al. 2017), these positive health effects could increase the gains to avoiding tobacco. Moreover, if alcohol and marijuana are substitutes (Anderson et al. 2013; Sabia et al. 2017; Crost and Guerrero 2012), and alcohol and tobacco are complements (Tauchmann et al. 2013), MMLs may reduce tobacco use via this channel. Time spent consuming marijuana may crowd-out time spent smoking cigarettes.

Finally, the shared mode through which both marijuana and tobacco are consumed by the majority of users may make it easier for some cigarette users to substitute toward marijuana. Smoking is the most prevalent mode of consuming marijuana, with 89% of adult marijuana users consuming marijuana in the form of smoking a joint (Schauer et al. 2016). Additionally, smoking a joint is also the most common form of marijuana consumption among current (86%)

and former tobacco users (93%) (Singh et al. 2016). The experience of smoking may link both cigarettes and marijuana as substitutes.[6]

While cigarette smoking remains the most common form of tobacco use, in the recent decade, use of different tobacco products has increased—particularly electronic cigarettes (e-cigarettes), smokeless tobacco, cigars, and hookah (Kasza et al. 2017).[7] Thus, the shifting nature of tobacco consumption could suggest a change in the nature of the relationship between marijuana and tobacco use.

On the other hand, MMLs could increase cigarette smoking through several behavioral pathways. If both substances are consumed together as a "spliff" (Hammersley and Leon 2006) or if marijuana acts as a "gateway" substance for other risky health behaviors, including drinking (Wen et al. 2015; Pacula et al. 2015; Yoruk and Yoruk 2011, 2013), MMLs could increase tobacco use. Moreover, MML-induced improvements in health may cause individuals to indulge in compensatory unhealthy behaviors (Radtke et al. 2011). Finally, as noted above, MML-induced increases in recreational marijuana use could re-normalize smoking, and become a gateway to cigarette smoking. Taken together, the net effect of MMLs on combustible cigarette use depends on the mechanisms at work, the purpose of consumption (e.g. recreational or medicinal), and the magnitudes of these potentially competing effects.

3. DATA

[6] Descriptive evidence from the NSDUH (based on authors' calculations from NSDUH 2014) also indicate some substitution at the intensive margin, with former marijuana users smoking cigarettes more frequently and intensively relative to those who currently use both cigarettes and marijuana. This suggests some crowding out of cigarettes for marijuana among current smokers.

[7] Sales of pouched and flavored moist snuff (smokeless tobacco) increased by 333.8% and 72.1% respectively from 2005 to 2011 (Delnevo et al., 2014). Users of multiple tobacco products have also increased, particularly among young adults, where about 40% of tobacco users (both adults and young adults) reported using multiple products (Kasza et al., 2017). Adults who smoke cigarettes and smokeless tobaccos tend to be heavier cigarette smokers in terms of quantity and frequency (Cheng et al., 2017).

Our analysis draws upon three national data sets, each of which offers distinct advantages designed to complement the others.

3.1 NSDUH

The NSDUH is an annual cross-sectional survey available from the Substance Abuse and Mental Health Services Administration (SAMHSA) that collects data from about 70,000 individuals, ages 12 and older, randomly selected from the U.S. civilian non-institutionalized population. The NSDUH collects data from residents of the households, and non-institutional group quarters (dorm, rooming houses, shelters, etc.), but does not include homeless individuals who do not use shelters or residents of institutional group quarters (jails and hospitals). This survey is well-suited for this study because it contains detailed questionnaires about individuals' illicit drug use including marijuana and tobacco consumption. State-level NSDUH data, for two-year averages, are publicly available for the period from 2002 through 2015.[8] These state averages have been used by scholars in recent policy work examining the impact of state public health regulations on tobacco use (Friedman 2015). Our data on adult marijuana and cigarette consumption is generated from approximately 536,000 adult respondents (ages 18 and older) to the NSDUH from 2002 to 2015.

We measure current (prior month) *Marijuana Use* using state-level data compiled from the following NSDUH survey item:

"How many days did you use marijuana or hashish in the past 30 days?"

[8] At present, SAMHSA does not permit individual-level restricted-use data to be made available to scholars examining the impacts of medical marijuana laws.

We set *Marijuana Use* equal to 1 if the respondent indicates a positive number of days of marijuana use and 0 otherwise. As shown in Table 1, we find that 6.8 percent of NSDUH respondents reported consuming marijuana or hashish on at least one day in the past month.

A comparable past-month state-level measure of *Cigarette Use* is generated from responses to the following questionnaire item:

"How many days did you smoke cigarettes in the past 30 days?"

If the respondent reports a positive number of days smoking cigarettes during the prior 30 days, we set *Cigarette Use* equal to 1 and set it equal to 0 otherwise. We find that 25.5 percent of NSDUH respondents reported prior 30-day cigarette use over the sample period. The NSDUH estimate of cigarette smoking is somewhat higher relative to other nationally representative surveys, including the BRFSS and CPS-TUS (see below), but the confidence interval envelopes the prevalence measures from these alternate data sources.[9]

While a key advantage of the NSDUH over other data sources is its inclusion of information on both marijuana and cigarette use, there are some limitations. First, because NSDUH data are only consistently available over the 2002 to 2015 period, early MML adopting states in the Pacific region do not contribute to identifying variation (see Table 2). These states disproportionately include MMLs with "collective cultivation" provisions that have been found to generate important spillovers to recreational marijuana (Anderson and Rees 2014a,b). In addition, state-aggregated measures do not permit an examination of heterogeneous treatment effects by demographic characteristics of individuals. To address these limitations, we turn to two alternate national datasets.

[9] See state-level tobacco estimates and the confidence intervals for the 2014-2015 here: http://samhda.s3-us-gov-west-1.amazonaws.com/s3fs-public/field-uploads/2k15StateFiles/NSDUHsaePercents2015.pdf

3.2 BRFSS

The BRFSS is a nationally representative telephone survey conducted annually by the Centers for Disease Control and Prevention (CDC) since 1984. While the BRFSS was administered only via landline phones prior to 2011, beginning with the 2011 survey, the BRFSS began adding cellular phones to their sample and weighted these respondents accordingly. Respondents ages 18 and older are asked detailed questions about their health and health behaviors, including cigarette consumption. Our analysis sample consists of approximately seven million observations drawn from repeated cross-sections of the BRFSS from 1990 to 2015.

While the BRFSS do not contain information on adult marijuana use, these data do allow us to measure *Cigarette Use* comparably to the NSDUH. To do this, we use survey responses from two sequentially asked survey items:

"Have you smoked at least 100 cigarettes in your entire life?"

"Do you now smoke cigarettes everyday, some days, or not at all?"[10]

Following CDC guidelines (2009), we generate a dichotomous measure of current smoking participation set equal to 1 if the respondent reported smoking at least 100 cigarettes in his or her lifetime and smoking "everyday" or "some days" and equal to 0 if the respondent has not smoked 100 cigarettes in his/her lifetime or does not currently smoke. A limitation of this measure is that we cannot identify new current smokers because those who do not report smoking at least 100 cigarettes in their lifetimes are not asked about current smoking. In the weighted BRFSS sample, 20.8 percent of respondents report current tobacco use (see Table 1).

[10]From 1990 to 1995, this item read simply, "Do you smoke cigarettes now?"

3.3 CPS-TUS

The Current Population Survey Tobacco Use Supplements (CPS-TUS) are sponsored by the National Cancer Institute and administered periodically as part of the Census Bureau's CPS since 1992. The CPS-TUS is based on a large nationally-representative sample containing information on about 240,000 individuals within a given survey period; it provides a key source of national, state, and sub-state level data regarding smoking and the use of other tobacco products among adults aged 18 and older. Our analysis sample consists of approximately two million adults ages 18 and older drawn from repeated cross-sections from 1992 to 2015.[11]

Smoking participation in the CPS-TUS is measured analogously to the BRFSS using responses to the following survey items:

"Have you smoked at least 100 cigarettes in your entire life?"

"Do you now smoke cigarettes every day, some days, or not at all?"

Cigarette Use is set equal to 1 if respondents answered that they have smoked at least 100 cigarettes over their lifetime and either currently smoke every day or on somedays, and is set equal to 0 otherwise. In our weighted CPS sample, 23.5 percent of respondents reported smoking in the prior 30 days (see Table 1).

While the CPS-TUS have been used in a wide set of studies examining the effects of tobacco control policies on adult smoking (Colman and Remler 2008; Liu 2010), offering large samples and consistent information on smoking behaviors, and also permits measures of smoking on the intensive margin (number of cigarettes consumed among everyday smokers), an

[11] We use data from the following TUS fielded in July 2014, January 2015, and May 2015; in May 2010, August 2010 and January 2011; in May 2006, August 2006 and January 2007; in February, June and November 2003; in June 2001, November 2001 and February 2002; in September 1998, January 1999, and May 1999; in September 1995, January 1996, and May 1996; and in September 1992, January 1993, and May 1993. An abbreviated TUS was also conducted in January 2000 and May 2000.

important disadvantage is the staggered nature of the cross-sections. In addition, like the BRFSS, the CPS surveys do not contain information on marijuana consumption.

4. METHODS

We begin by using state-level data from the NSDUH to estimate the first-stage effect of MMLs on adult marijuana use. Because publicly available state-level NSDUH data are only available in two-year averages, we estimate the following difference-in-differences model:

$$[\textit{Marijuana Use}_{st} + \textit{Marijuana Use}_{st-1}]/2 = \beta_0 + \beta_1 [\text{MML}_{st} + \text{MML}_{st-1}]/2 + \mathbf{\Phi'[X_{st} + X_{st-1}]} / 2 + \nu_s + \omega_t + \varepsilon_{st} \qquad (1)$$

Thus, for the NSDUH, each right hand side-variable is constructed as its state-specific two-year average, and our estimate of β_1 should not be contaminated by measurement error generated by these two-year averages. In the above specification, $\textit{Marijuana Use}_{st}$ measures marijuana use in state *s* at survey wave *t*, MML_{st} is an indicator for whether state *s* had enacted an MML in year *t*, and $\mathbf{X_{st}}$ is a vector of state-level time-varying controls. Included among these controls are state economic trends (unemployment rate and per capita income), demographic characteristics (share non-white, male, and college graduates), tobacco control policies (cigarette taxes, clean indoor air laws), other marijuana policies (marijuana decriminalization laws and laws that legalize marijuana use for recreational purposes), and alcohol policies (state beer tax and blood alcohol content (BAC) 0.08 drunk driving laws). In addition, ν_s is a time-invariant state effect and ω_t is a state-invariant year effect. Equation (1) is estimated via ordinary least squares (OLS). An analogous model is estimated for cigarette consumption using the NSDUH.

For analyses using the BRFSS and the CPS-TUS, for which we have individual-level data, we estimate the following:

$$\textit{Cigarette Use}_{ist} = \beta_0 + \beta_1 \text{MML}_{st} + \mathbf{X_{st}} \Phi + \mathbf{Z_{ist}} \psi + \nu_s + \omega_t + \varepsilon_{ist} \quad (2)$$

where *Cigarette Use*$_{ist}$ measures prior 30-day cigarette use of individual *i* residing in state *s* in year *t* and $\mathbf{Z_{ist}}$ is a vector of individual-level time-varying controls including age, gender, race/ethnicity, marital status, and indicators for educational attainment. We also experimented with including month-of-survey dummies as controls; with a similar pattern of results on our estimated policy parameter. Our coefficient of interest, β_1, is identified from state-specific changes in MMLs, as noted in Table 2. During the NSDUH sample period (2002-2015), 15 states and the District of Columbia (DC) adopted MMLs. Over the sample for which we have BRFSS and CPS-TUS data, 23 states and DC had enacted MMLs. We estimate equation (2) via linear probability models; estimated marginal effects are similar across probit and logit models.

Obtaining an unbiased estimate of β_1 requires that the common trends assumption of our difference-in-differences model be satisfied. This may be a concern if (i) marijuana (or cigarette) consumption was trending differently prior to the implementation of MMLs in "treatment" versus "control" states, (ii) state-specific time-varying unobservables are correlated with both the enactment of MMLs and cigarette smoking, and (iii) states implement MMLs in response to risky health behaviors related to tobacco use.

We undertake several strategies to address this concern. First, as noted above, we control for other substance use policies in the vector $\mathbf{X}_{st}$, including beer taxes, cigarette taxes, clean indoor air laws, and marijuana decriminalization and recreational legalization laws.[12] Second, we explicitly decompose the timing of the effect based on an event study framework that controls for policy lags and leads. This specification allows us to assess whether marijuana use

[12] In addition, we explore the robustness of our estimated MML effects to controls for per-capita state Master Settlement Agreement payments (see Jayawardhana et al. 2014 for a discussion of alternate indices). Our estimates remain robust to these controls, both in terms of magnitudes and significance.

(and cigarette use) was trending differently prior to the adoption of MMLs and thus examine the robustness of estimated policy impacts to controls for MML leads. It also allows us to assess potential lags in the policy response that may be indicated due to lags in the pricing response and access to legal marijuana supply following the enactment of the MMLs.

In addition, we also explore the robustness of our findings to controls for state-specific linear time trends and higher-order time trends. For instance, our model including state-specific quadratic time trends is estimated as follows:

$$\textit{Cigarette Use}_{ist} = \beta_0 + \beta_1 \, MML_{st} + \mathbf{X_{st}}\,\Phi + \mathbf{Z_{ist}}\,\psi + \nu_s + \omega_t + \nu_s{*}t + \nu_s{*}t^2 + \boldsymbol{\varepsilon}_{ist}, \qquad (3)$$

where $\nu_s{*}t$ and $\nu_s{*}t^2$ reflect state-specific linear and quadratic time trends, respectively.

Finally, in supplementary analyses, we implement a synthetic control design approach, following Abadie et al. (2010), to ensure that treatment and control states share common pretreatment trends in cigarette smoking. The counterfactual synthetic control for each treatment state is generated as a linear combination of donor states, where donor states include all states that do not have MMLs enacted at any time between 1990 and 2015. The algorithm underlying the synthetic control design, pioneered by Abadie et al. (2010), assigns a synthetically generated weight to each donor state to minimize any pre-treatment differences in cigarette smoking and state-level covariates between each treatment and the synthetic control.[13] There are a few important advantages to a synthetic approach. Expressly forcing MML counterfactuals to have more similar pre-treatment trends may increase the probability of satisfying the common trends assumption (Sabia et al. 2016). Moreover, because we construct a counterfactual to each MML state, this approach more flexibly allows for heterogeneity in the impacts of MMLs across

[13] We require pre-treatment cigarette use to be equivalent in each pre-treatment period and control for cigarette taxes and other marijuana policies. Alternate approaches, including requiring pre-treatment outcomes to be similar in every other year and controlling for additional state-specific covariates generated a similar pattern of results.

different states. Synthetic estimates are generated by regressing the difference in the tobacco consumption rate between treatment and synthetic control states on a post-MML indicator and generate standard errors following Donald and Lang (2007). Together, the approaches described above should minimize the likelihood that our estimated policy impacts are contaminated by endogenous policy adoption or state-specific time-varying unobservables correlated with both MML adoption and tobacco cigarette use.[14]

Table 2 shows the effective dates of MMLs enacted since 1990, as well as information on the date at which several provisions of MMLs were implemented. We also provide enactment dates for provisions that allow for home collective cultivation of marijuana for multiple patients (Anderson et al. 2013), the presence of at least one state-run dispensary (Pacula et al. 2015), use of marijuana for non-specific pain (Sabia et al. 2017), and require registries of medical marijuana patients (Wen et al. 2015; Sabia and Nguyen 2017).

5. RESULTS

Tables 3 through 8 below present our main findings. We focus on estimates of β_1 for ease of presentation; estimates on the coefficients of controls are presented in Online Appendix Table 1. All regressions are weighted and standard errors are clustered at the state level to account for arbitrary correlation in the error structure across individuals within states and over time (Bertrand et al. 2004).

5.1 NSDUH Findings on Marijuana and Tobacco Use

[14] In an additional robustness check available upon request, we find that estimated policy impacts are robust to controls for anti-marijuana legalization sentiment.

In Panel I of Table 3, we use NSDUH data to estimate equation (1). Column (1) shows a parsimonious specification including only state and year fixed effects. We find that the enactment of an MML leads to an 0.8 percentage-point increase in the rate of marijuana use. Relative to the mean value of marijuana use, this represents an approximately 12 percent increase. The inclusion of controls for socioeconomic and demographic factors (column 2), and economic conditions in the state (column 3), and other marijuana, cigarette, and alcohol policies (columns 4 and 5) has little impact on the magnitude of the estimated MML effect.

These findings do not appear to be explained by pre-existing trends. In Figure 1, we show an event study analysis, presenting 95 percent confidence intervals (CIs) around estimates of three years of leads up to MML adoptions, the year of the MML law change (year "0"), and one, two and three years or more after enactment. Models that generate these CIs control for only state and year fixed effects. The event study shows no evidence that marijuana use was trending differently prior to the adoption of MMLs; lead effects are close to zero and statistically insignificant. Furthermore, it is validating that any increases in marijuana use materialize only after the adoption of the law, with the largest impacts occurring in the years following the enactment of MMLs. This finding is consistent with evidence that MML-induced declines in the street price of high grade marijuana (Anderson et al. 2013) and MML-permitted dispensary openings (Pacula et al. 2015) often lag the enactment of state MMLs, resulting in a lagged consumption effect.[15]

[15] The access, availability and prices of marijuana will likely depend upon the risks associated with using, possessing, and cultivating or distributing marijuana, each of which is likely to occur with a lag (Pacula et al. 2015).

In Panel II of Table 3, we present estimated coefficients on leads and lags of MMLs in two-way fixed effects models that include controls for the full set of observables.[16] These models confirm that MMLs induce a two to three percentage point increase in marijuana use (Wen et al. 2015; Sabia and Nguyen 2017).[17]

Turning to tobacco cigarette smoking in Table 4, we find that MML-induced increases in marijuana use may have substituted for cigarette smoking. Results in Panel I show that the enactment of an MML leads to a statistically insignificant 0.3 percentage-point decline in prior 30-day cigarette use, representing about a one percent decline in the average rate of cigarette use. However, this result masks an important lagged effect of MMLs on cigarette consumption. In the years following the passage of an MML (see Figure 2 and Panel II of Table 4), there is evidence that MMLs induce a significant decline in tobacco cigarette use. Estimated longer-run effects of MMLs on cigarette smoking (based on fully-specified dynamic models in Panel II) are closer to about 1.1 to 3.0 percentage points, consistent with important declines in smoking. The event study analysis shows that this effect is not explained by differential smoking pre-trends.

In sum, results from the NSDUH indicate that MMLs have induced substitution toward marijuana and away from tobacco cigarettes, which may yield important public health benefits. Next, we turn to the BRFSS and CPS-TUS, which have the advantages of (i) allowing for greater MML policy variation, (ii) permitting an examination of the intensive margin of tobacco use, and

[16] It should be noted that coefficients in models including three years of leads and up to three or more years of lags are not identified from the same states. Alternate specifications based on such a "balanced panel" of states identifying all pre- and post-MML coefficients show that the effects of MMLs tend to occur with a lag, but with less evidence of jumps across post-treatment years.

[17] These first-stage effects are important for gauging the credibility of spillover effects on other substances, including cigarette use and generally bound the smoking response in absolute magnitude. Because most adults are not affected by MMLs, the estimated reduced-form smoking response (an intent-to-treat or ITT response) is an average across two groups – those affected by the medicinal marijuana legislation and those who are not.

(iii) allowing an estimation of heterogeneous impacts of MMLs, each of which may inform the recreational and medicinal mechanisms at work.

5.2 BRFSS and CPS-TUS Results

Panels I and II of Table 5 present estimates of equation (2), from the BRFSS and the CPS-TUS respectively, for prior 30-day cigarette use. Consistent with results from the NSDUH, we find consistent evidence that MMLs reduce tobacco cigarette smoking across both datasets, with estimated marginal effects of 0.4 to 0.8 percentage points. It is validating that the magnitude of the effect is stable with the addition of state-level economic and policy controls (columns 3-5), consistent with the hypothesis that MML adoption is generally unrelated to these characteristics, and similar across both datasets.[18]

Estimates from the BRFSS and the CPS-TUS translate into effect sizes of approximately two to three percent relative to sample means. In principle, the MML-induced cigarette smoking effects we observe at the extensive margin could reflect shifts on either the initiation or cessation margin. However, given that the vast majority of ever smokers (84%) initiate tobacco use at age 18 or earlier and virtually no one initiates after age 21, our estimates likely reflects shifts on the cessation margin.

The remaining panels of Table 5 show estimates of the effects of MMLs on other margins of cigarette consumption. While imprecisely estimated, MMLs appear to reduce the probability of being a daily smoker (Panel III) by about 1.2 to 2.3 percent relative to the sample mean. The vast majority of current smokers (about 74%; Table 1) tend to be everyday smokers, and this

[18] The confidence intervals overlap across both sets of estimates, and the point estimate for each dataset is contained in the confidence interval for the estimate based on the other dataset. Online Appendix Table 2 shows robustness of findings with controls for a smaller subset of controls (cigarette taxes and marijuana policies); the pattern of results is similar.

suggestive decline in everyday smoking could reflect a transition to non-smoking or non-daily smoking.

Because measures of cigarettes smoked are not consistently available in all waves, we turn to the CPS-TUS in Panels IV and V, to specifically assess whether MMLs affected cigarette consumption at the intensive margin. Here we find stronger evidence that MMLs reduce the intensity of smoking, as measured by the number of cigarettes consumed among everyday smokers (Panel IV), rather than reduce days of smoking (Panel V). Specifically, we find that MMLs reduce number of cigarettes consumed by about 0.3 to 0.4 cigarettes daily.[19] This result is consistent with descriptive evidence from the NSDUH that current co-users of both marijuana and cigarettes smoke fewer cigarettes than current cigarette users only who had previously also used marijuana.

The decline in smoking at the intensive margin may reflect the common mode through which both cigarettes and marijuana are consumed, as MMLs cause some current cigarette users to cut back on the number of cigarettes smoked as they raise their consumption of marijuana.

5.3 Sensitivity Checks

In Table 6, we examine the sensitivity of the above estimates to state-specific time-varying characteristics that could be correlated with the enactment of MMLs and tobacco consumption. First, we add controls for policy leads to address the concern that our estimated policy impacts could have captured pre-treatment cigarette smoking trends. After controlling for differential pre-treatment trends (up to 3 years and 5 years of policy leads in columns 1 and 2 respectively), the estimated association between MMLs and cigarette consumption actually

[19] These are smokers in the CPS who are consistently asked the question about the number of cigarettes consumed.

increases slightly in absolute magnitude. MMLs are associated with about a one percentage-point decline in past-month smoking for models based on the BRFSS (Panel I) and about a 0.6 to 0.9 percentage point decline in smoking for models based on the CPS-TUS (Panel II). Effects on the number of cigarettes smoked among daily smokers (Panel III) remain virtually unchanged when we control for the policy leads.

In columns 3 and 4, we further control for state-specific time-varying unobservables by adding state-specific linear and quadratic time trends. These estimates should be interpreted with caution given that the inclusion of parametric state-specific time trends will reduce identifying variation available to estimate policy impacts, and may also be problematic if residual trends in smoking do not strictly follow this parametric structure.[20] Nevertheless, our main effects remain robust. Across both the BRFSS and the CPS-TUS (Panel I and II respectively), these fully-saturated models continue to indicate about a 0.7 to 0.9 percentage point decline in past-month cigarette use. Effects at the intensive margin, however, while remaining negative, decrease in magnitude and are less precisely estimated (Panel III, columns 3 and 4).

Next, to check whether our estimates are driven by differential pre-trends, we undertake a synthetic control design following Abadie et al. (2010) to ensure that the treatment and control states share common pre-treatment trends in cigarette smoking. Trends in tobacco cigarette use in each MML state and its synthetic control are shown in Online Appendix Figures 1 through 24.[21] These figures show common (often identical) tobacco cigarette consumption trends in the pre-MML enactment period, after which a divergence in tobacco smoking occurs in the majority

[20] The addition of state linear trends substantially reduces the identifying variation in the policy measure by almost 60%. In addition, Wolfers (2006) cautions against adding state-specific linear trends since such trends may confound both the state-specific time-varying unobservable as well as any dynamic effects of the policy itself.
[21] Online Appendix Table 3 shows weights generated for donor states that comprise each MML state's synthetic control.

of states. Table 7 presents the point estimates and inferential statistics based on Donald and Lang (2007). Estimates of the effect of MMLs on past-month cigarette smoking are negative for nearly all states, and in all cases but one (Montana) where the effects are statistically significant, we find that MMLs are associated with a decline in smoking participation. While there is some heterogeneity in the policy response across states, the effect magnitudes are centered around a one to two percentage point decline, similar to the effect sizes discussed for prior specifications. These findings suggest that the relationship between MMLs and cigarette use is not contaminated by differential pre-trends.

5.4 Heterogeneity in Effects of MMLs

We explore heterogeneity in the effects of MMLs on cigarette use by age in Online Appendix Table 4. This may be important given that MMLs have been found to have larger effects on both younger adults under 30 (Anderson et al. 2013) and older adults over 50 (Sabia et al. 2017), and use of marijuana by younger vs. older adults may differentially reflect use for recreational vs. medicinal purposes. Comparing patterns across age groups, there is some suggestive evidence of stronger effects among young adults ages 18 to 25, particularly for past cigarette smoking at the extensive margin, which may reflect the relatively high prevalence of marijuana use for this age group. Marijuana use for this age group is more likely to reflect recreational (as opposed to medicinal) use,[22] and the reduction in smoking likely reflects the substitution from cigarettes to recreational marijuana use among these younger adults.[23]

[22] About 64% of current marijuana users, ages 18-25, report being in excellent or very good health, compared to only 39% of older marijuana users (ages 50+) (NSDUH 2014).
[23] Specifically, Sabia and Nguyen (2017) find that MMLs raise frequent marijuana use (defined as consumption on 20 or more of the last 30 days) by 10-20 percent, particularly for individuals under the age of 30.

We also find relatively stronger negative effects on smoking (both at the extensive and intensive margins) among older adults ages 55 and up across both datasets, a population for whom MML-induced increases in marijuana use have been observed (Sabia and Nguyen 2017). The larger effects among older adults may be consistent with MML-induced marijuana consumption for medical purposes potentially improving physical mobility (Sabia et al. 2017) or mental health (Anderson et al. 2013), and in turn reducing patients' reliance on cigarettes as a form of self-medication (Saffer and Dave 2005).[24]

Finally, we assess heterogeneity in the average MML response across differing types of state MMLs. Table 8 presents estimates for four particular dimensions of the MMLs: whether a state (i) has specific allowances for medical marijuana use for general pain rather than particular medical conditions; (ii) allows home collective cultivation of marijuana for multiple patients[25]; (iii) legally permits dispensaries to operate (effective date of first dispensary opening)[26]; and (iv) mandates the maintenance of a state-run patient registry for eligible patients.

Panel I presents estimates based on the BRFSS, Panel II presents estimates from the CPS-TUS for cigarette consumption and Panel III presents the estimates based on the CPS-TUS for the number of cigarettes smoked per day. Columns (1) through (4) separately include effective state implementation of the four specific dimensions of the MMLs noted above and column (5) includes all components in the same specification. As expected, provision-specific estimates in column (5) are quite imprecise due to a high degree of collinearity among different policy components (see the discussion in Wen et al. 2015). Estimates in Table 8 suggest that the

[24] We also assessed heterogeneity in the effects of MMLs by gender, since the consumption of tobacco and marijuana together as a "spliff" is much more common among males than females (Ramo et al. 2013). We do not find strong evidence however that the policy impacts differ significantly across males and females.

[25] The measure of home cultivation we currently use in the paper is home cultivation of marijuana for multiple patients ("Collective Cultivation" as defined in Table 8).

[26] Our current dispensary measure captures the date at which we identify the first marijuana dispensary opening in the state, which we concede may be more endogenous than the law's enactment (due by consumer demand).

decline in tobacco consumption appears to persist across each type of MML, with no one specific provision driving the result. This would suggest that both recreational and medicinal pathways may be important drivers in the reduction in smoking.

6. CONCLUSIONS

With the proliferation of state laws allowing for medical marijuana use and several states considering similar legislation, public health professionals and policymakers have expressed concerns that these policies may have unintended spillovers that adversely affect health.[27] Previous work has considered outcomes related to problematic alcohol use (Anderson and Rees 2011, 2013; Wen et al. 2015), illicit drug use (Wen et al. 2015), and body weight (Sabia et al. 2017), but this study is the first to examine the tobacco-related effects of MMLs.

First, using data from the NSDUH, we document that MMLs induce a 2 to 3 percentage-point increase in marijuana use. Turning to cigarette smoking, data from all three datasets show that the enactment of MMLs leads to a 1 to 1.5 percentage-point reduction in tobacco cigarette smoking, consistent with the hypothesis that marijuana and tobacco cigarettes are substitutes. Where we find negative effects on smoking, these are generally driven by both young adults (18 to 25) and older adults (55 and older), suggesting that there may be both recreational and medicinal reasons for substitution into marijuana from cigarettes. We also find evidence that MMLs are associated with a reduction in the number of cigarettes consumed per day among current smokers, consistent with effects at the intensive margin as well as the extensive margin. Among everyday smokers, MMLs are associated with a reduction of 0.3 to 0.4 cigarettes smoked

[27] Twelve states (IN, IA, KY, MO, NE, NC, OK, SC, TN, TX, UT, WI) have pending legislation or amended ballot measures in 2017; WV passed legislation in 2017; and similar legislation failed in three states in 2017 (KS, MS, VA). See: http://medicalmarijuana.procon.org/view.resource.php?resourceID=002481

per day. Given that smoking is the most common mode to consume marijuana and tobacco, this reduction in the intensity of smoking may indicate that some current smokers reduce the number of cigarettes smoked as they raise marijuana consumption.

The potential health care cost savings from MML-induced reductions in cigarette consumption are substantial.   Xu et al. (2015) estimated annual health care costs related to cigarette smoking of $170 billion, which translates to approximately $1,847 (deflated to 2014 dollars) in added health care costs each year per smoker. Our estimates suggest that MMLs reduce smoking prevalence by 2.5 to 3.75 million, translating into tobacco-related healthcare cost savings of about $4.6 to 6.9 billion per year, which represents a substantial public health gain.[28]

Our study underscores the importance of quantifying and incorporating policy-driven spillovers when attempting to evaluate the pros and cons of liberalized marijuana policy. Though the average cigarette use response to MMLs is modest, it may still generate considerable public health gains given the substantial mortality and morbidity costs imposed by tobacco use. Our study adds to a growing body of evidence showing that the spillover effects of MMLs are generally positive and health-promoting.

[28] There are a number of assumptions underlying this estimate. First, the estimate from Xu et al. (2015) does not incorporate secondhand smoking costs, which represent important negative externality costs. Second, this estimate does not reflect the costs of reductions in smoking at the intensive margin. Finally, while there may be public health costs associated with increased marijuana use among some, particularly respiratory illness and (possibly) amotivation syndrome, there are also well-documented health benefits of marijuana use, as noted above.

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Figure 1. Event-Study Analysis, Marijuana Consumption, NSDUH

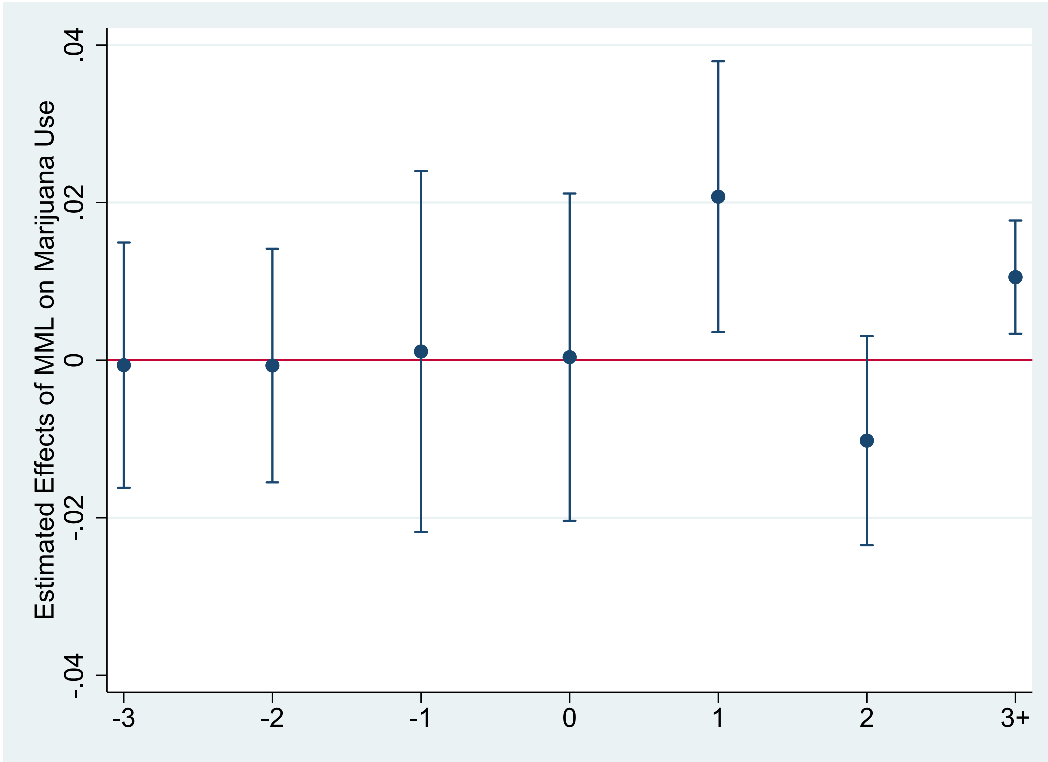


Figure 2. Event-Study Analysis, Cigarette Consumption, NSDUH

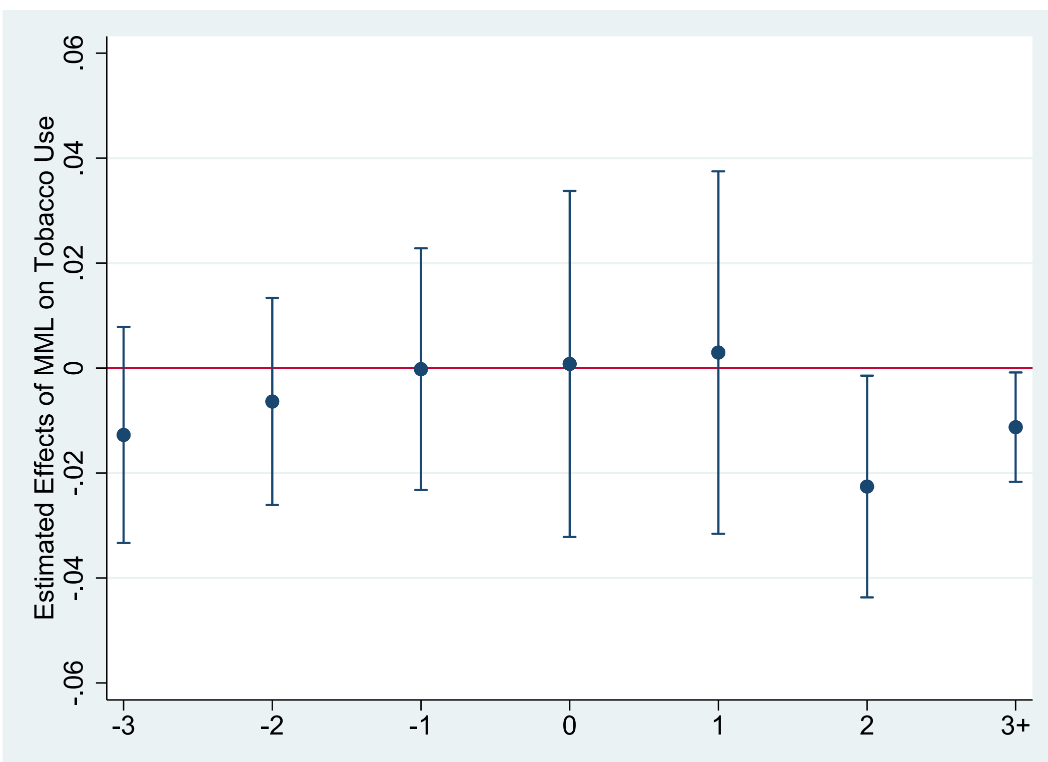


Table 1. Means of Marijuana and Tobacco Use and Selected Controls, NSDUH, BRFSS, CPS-TUS

	NSDUH[a] (2002-2015)	BRFSS (1990-2015)	CPS-TUS (1992-2015)
Marijuana and Tobacco Measures			
Marijuana Consumption	0.068 (0.020)	.	.
Cigarette Consumption	0.255 (0.038)	0.208 (0.406)	0.235 (.424)
Everyday Cigarette Consumption	-	0.154(0.361)	0.156 (.363)
Cigarettes Consumed Per Day	-	-	17.90 (9.29)
Days of Smoking Per Month	-	-	27.90 (6.08)
Selected Controls			
Medical Marijuana Law	0.250 (0.442)	0.178 (0.382)	0.180 (0.384)
Cigarette Taxes (2015 $)	1.25 (0.892)	0.964 (0.813)	0.910 (0.760)
Beer Taxes (2015 $)	0.299 (0.248)	0.312 (0.236)	0.311 (0.231)
Marijuana Decriminalization Law	0.295 (0.454)	0.339 (0.473)	0.335 (0.472)
Marijuana Legalization Law	0.011 (0.093)	0.005 (0.074)	0.005 (0.071)
Zero Tolerance Law	1.00 (0.00)	0.819 (0.378)	0.849 (0.352)
BAC08 Law	0.950 (0.197)	0.677 (0.461)	0.630 (0.469)
Clean Indoor Air Law – Government Buildings	0.882 (0.320)	0.804 (0.397)	0.801 (0.399)
Clean Indoor Air Law – Private Sector Buildings	0.692 (0.457)	0.600 (0.490)	0.585 (0.493)
Clean Indoor Air Law -- Restaurants	0.750 (0.428)	0.665 (0.472)	0.659 (0.474)
Clean Indoor Air Law – Shopping Center	0.573 (0.487)	0.403 (0.490)	0.372 (0.483)
Clean Indoor Air Law – Public Schools	0.953 (0.207)	0.924 (0.265)	0.925 (0.363)
Clean Indoor Air Law – Private Schools	0.756 (0.427)	0.704 (0.456)	0.698 (0.459)
Per capita income (2015 $)	43,963.10 (6,777.31)	41,827.13 (6,725.96)	41,778.22 (6,573.62)
Unemployment Rate	6.36 (1.87)	6.16 (1.93)	5.81 (1.93)
Male	0.492 (0.007)	0.483 (0.500)	0.476 (0.499)
Education (HS/College)	0.294 (0.056)	0.286 (0.452)	0.318 (0.466)
Black	0.125 (0.095)	0.109 (0.311)	0.113 (0.316)
N	357*	6,970,691	2,044,577

*NSDUH data are available at the state-level in two-year averages, drawn from approximately 536,000 adult survey respondents over the sample period.

Notes: Weighted means obtained using state-level data drawn from the National Survey for Drug Use and Health (2002 to 2013), individual-level data drawn from the Behavioral Risk Factor Surveillance System (1990 to 2015), and the Current Population Survey Tobacco Use Supplements (1992 to 2015).

Table 2. Effective Dates of Medical Marijuana Laws

State	MML	MML Provisions			
		Collective cultivation	Dispensary	Non-specific pain	Registry
	(1)	(2)	(3)	(4)	(5)
Alaska	03/1999	n/a	n/a	03/1999	03/1999
Arizona	04/2011	04/2011	12/2012	04/2011	04/2011
Arkansas	11/2016	n/a	n/a	11/2016	11/2016
California	11/1996	11/1996	11/1996	11/1996	n/a
Colorado	06/2001	06/2001	07/2005	06/2001	06/2001
Connecticut	05/2012	n/a	08/2014	n/a	05/2012
Delaware	07/2011	n/a	06/2015	07/2011	07/2011
Washington, D.C.	07/2010	n/a	07/2013	n/a	07/2010
Florida	01/2017	n/a	n/a	n/a	01/2017
Hawaii	12/2000	n/a	n/a	12/2000	12/2000
Illinois	01/2014	n/a	11/2015	n/a	01/2014
Maine	12/1999	n/a	04/2011	n/a	12/2009
Maryland	06/2014	n/a	n/a	06/2014	06/2014
Massachusetts	01/2013	n/a	06/2015	n/a	01/2013
Michigan	12/2008	12/2008	12/2009	12/2008	n/a
Minnesota	05/2014	n/a	07/2015	n/a	05/2014
Montana	11/2004	11/2004	04/2009	11/2004	n/a
Nevada	10/2001	10/2001	08/2015	10/2001	10/2001
New Hampshire	07/2013	n/a	04/2016	07/2013	07/2013
New Jersey	10/2010	n/a	12/2012	10/2010	10/2010
New Mexico	07/2007	n/a	06/2009	n/a	07/2007
New York	07/2014	n/a	01/2016	n/a	07/2014
North Dakota	12/2016	n/a	n/a	12/2016	12/2016
Oregon	12/1998	12/1998	11/2009	12/1998	01/2007
Ohio	08/2016	n/a	n/a	08/2016	08/2016
Pennsylvania	05/2016	n/a	n/a	05/2016	05/2016
Rhode Island	01/2006	01/2006	04/2013	01/2006	01/2006
Vermont	07/2004	n/a	06/2013	07/2007	07/2004
Washington	11/1998	07/2011	04/2009	11/1998	n/a

Notes: Dates of effective MMLs are updated using Table 1 and Appendix Table 2A of Anderson et al. (2013) and Table 1 on p. 69 of Wen et al. (2015) using Elliott (2009, 2011); Marijuana Policy Project (2015); Ritter (2010); Saker (2009); Schwartz (2011) and Stucke (2009).

Table 3. The Effects of Medical Marijuana Laws on Adult Marijuana Consumption, NSDUH

			Panel I: Baseline Estimates		
MML	0.0080**	0.0074**	0.0068**	0.0077***	0.0077***
	(0.0031)	(0.0031)	(0.030)	(0.0021)	(0.0021)
State & year FEs?	Yes	Yes	Yes	Yes	Yes
Demographics?	No	Yes	Yes	Yes	Yes
Economic conditions?	No	No	Yes	Yes	Yes
Marijuana & cig policies?	No	No	No	Yes	Yes
Alcohol policies?	No	No	No	No	Yes
N	357	357	357	357	357
			Panel II: MML Leads and Lags		
Three Years Prior		-0.0021	-0.0030	-0.0043	-0.0014
		(0.0062)	(0.0074)	(0.0079)	(0.0078)
Two Years Prior		0.0019	0.0032	0.0063	-0.0014
		(0.0047)	(0.0066)	(0.0073)	(0.0078)
One Year Prior	-0.0019	-0.0040	-0.0063	-0.0111	0.0011
	(0.0051)	(0.0063)	(0.0094)	(0.0110)	(0.0112)
MML	0.0076***	0.0075***			
	(0.0021)	(0.0028)			
Year of Law Change			0.0095	0.0156*	0.0004
			(0.0073)	(0.0090)	(0.0106)
One Year (+) After			0.0071**	0.0013	0.0208***
			(0.0032)	(0.0067)	(0.0088)
Two Years (+) After				0.0086**	-0.0102
				(0.0034)	(0.0068)
Three Years (+) After					0.0105***
					(0.0037)
Sum of Year of Law			*0.0166***	*0.0255****	*0.0215**
Change, Lagged Effects			*F = 4.86*	*F = 7.91*	*F = 2.91*
F-test (p-value)			*(p = 0.03)*	*(p = 0.01)*	*(p = 0.09)*
All controls?	Yes	Yes	Yes	Yes	Yes
N	357	357	357	357	357

***Significant at 1% level **at 5% level *at 10% level

Notes: Weighted OLS estimates obtained using data from the National Survey of Drug Use and Health from 2002-2015. State-level demographic controls include share non-white, male, and college educated. State economic controls include state per capita income and the state unemployment rate. State marijuana and cigarette policies include cigarette taxes, clean indoor air laws, and marijuana decriminalization and legalization laws. State alcohol policies include beer taxes, zero tolerance drunk driving laws, and blood alcohol content (.08) driving laws. Standard errors corrected for clustering at the state-level are in parentheses.

Table 4. The Effects of Medical Marijuana Laws on Adult Cigarette Consumption, NSDUH

			Panel I: Baseline Estimates		
MML	-0.0031	-0.0028	-0.0030	-0.0027	-0.0027
	(0.0038)	(0.0036)	(0.0036)	(0.0037)	(0.0036)
State & year FEs?	Yes	Yes	Yes	Yes	Yes
Demographics?	No	Yes	Yes	Yes	Yes
Economic conditions?	No	No	Yes	Yes	Yes
Marijuana & cig policies?	No	No	No	Yes	Yes
Alcohol policies?	No	No	No	No	Yes
N	357	357	357	357	357
			Panel II: MML Leads and Lags		
Three Years Prior		-0.0066	-0.0156	-0.0148	-0.0127
		(0.0119)	(0.0103)	(0.0102)	(0.0105)
Two Years Prior		-0.0139	-0.0007	-0.0026	-0.0064
		(0.0115)	(0.0086)	(0.0089)	(0.0100)
One Year Prior	0.0091	0.0138	-0.0010	-0.0069	-0.0002
	(0.0103)	(0.0139)	(0.0112)	(0.0105)	(0.0118)
MML	-0.0023	-0.0069			
	(0.0035)	(0.0045)			
Year of Law Change			0.0129	0.0091	0.0008
			(0.0101)	(0.0156)	(0.0168)
One Year (+) After			-0.0113*	-0.0076	0.0030
			(0.0058)	(0.0135)	(0.0176)
Two Years (+) After				-0.0123**	-0.0226**
				(0.0052)	(0.0107)
Three Years (+) After					-0.0113***
					(0.0053)
Sum of Year of Law Change, Lagged Effects			*0.0016*	*-0.0108*	*-0.0301**
F-test (p-value)			*F = 0.02*	*F = 0.68*	*F = 2.93*
			(p = 0.88)	*(p = 0.41)*	*(p = 0.09)*
All controls?	Yes	Yes	Yes	Yes	Yes
N	357	357	357	357	357

***Significant at 1% level **at 5% level *at 10% level

Notes: Weighted OLS estimates obtained using data from the National Survey of Drug Use and Health from 2002-2015. State-level demographic controls include share non-white, male, and college educated. State economic controls include state per capita income and the state unemployment rate. State marijuana and cigarette policies include cigarette taxes, clean indoor air laws, and marijuana decriminalization and legalization laws. State alcohol policies include beer taxes, zero tolerance drunk driving laws, and blood alcohol content (.08) driving laws. Standard errors corrected for clustering at the state-level are in parentheses.

Table 5. The Effect of Medical Marijuana Laws on Adult Cigarette Consumption, BRFSS and CPS-TUS

	Panel I: BRFSS, Any Cigarette Use				
MML	-0.0084***	-0.0075***	-0.0072***	-0.0064***	-0.0059***
	(0.0026)	(0.0020)	(0.0021)	(0.0022)	(0.0022)
N	6,970,691	6,970,691	6,970,691	6,970,691	6,970,691
	Panel II: CPS-TUS, Any Cigarette Use				
MML	-0.0066***	-0.0040**	-0.0037**	-0.0037**	-0.0039**
	(0.0020)	(0.00155)	(0.0017)	(0.0017)	(0.0017)
N	2,044,577	2,044,577	2,044,577	2,044,577	2,044,577
	Panel III: Everyday Smoking, BRFSS				
MML	-0.0027	-0.0035	-0.0025	-0.0021	-0.0019
	(0.0024)	(0.0022)	(0.0022)	(0.0022)	(0.0022)
N	6,109,297	6,109,297	6,109,297	6,109,297	6,109,297
	Panel IV: Cigarettes Per Day, CPS-TUS				
MML	-0.425***	-0.367***	-0.363***	-0.300***	-0.303***
	(0.104)	(0.0846)	(0.0788)	(0.0903)	(0.0901)
N	235,159	235,159	235,159	235,159	235,159
	Panel V: Days of Smoking Per Month, CPS-TUS				
MML	-0.158	-0.122	-0.120	-0.147*	-0.142
	(0.102)	(0.0926)	(0.0920)	(0.0855)	(0.0872)
N	376,761	376,761	376,761	376,761	376,761
State & year FEs?	Yes	Yes	Yes	Yes	Yes
Demographics?	No	Yes	Yes	Yes	Yes
Economic conditions?	No	No	Yes	Yes	Yes
Marijuana & cig policies?	No	No	No	Yes	Yes
Alcohol policies?	No	No	No	No	Yes

***Significant at 1% level **at 5% level *at 10% level

Notes: All estimates are weighted. Demographic controls include gender, age, educational attainment, race/ethnicity, marital status, and state-level share non-white and college educated. State economic controls include state per capita income and the state unemployment rate. State marijuana and cigarette policies include cigarette taxes, clean indoor air laws, and marijuana decriminalization and legalization laws. State alcohol policies include beer taxes, zero tolerance drunk driving laws, and blood alcohol content (.08) driving laws. Standard errors corrected for clustering at the state-level are in parentheses. All regressions include state fixed effects and year fixed effects.

Table 6. Sensitivity of Estimates to Controls for Policy Leads and State-Specific Time Trends

	Added Controls for 3 Years of Policy Leads **(1)**	*Added Controls for 5 Years of Policy Leads* **(2)**	*Column (2) + State Linear Trend* **(3)**	*Column (2) + State Quadratic Trend* **(4)**
	Panel I: BRFSS, Any Smoking			
MML	-0.0098***	-0.0114***	-0.00605**	-0.00673**
	(0.0023)	(0.0027)	(0.0025)	(0.0029)
N	6,970,691	6,970,691	6,970,691	6,970,691
	Panel II: CPS-TUS, Any Smoking			
MML	-0.0057**	-0.0085***	-0.0068***	-0.0085***
	(0.0022)	(0.0021)	(0.0024)	(0.0026)
N	2,044,577	2,044,577	2,044,577	2,044,577
	Panel III: CPS-TUS, Cigarettes Per Day			
MML	-0.3922***	-0.3531**	-0.0744	-0.1340
	(0.1148)	(0.1357)	(0.1954)	(0.1882)
N	235,159	235,159	235,159	235,159

***Significant at 1% level **at 5% level *at 10% level
Notes: All estimates are weighted. Demographic controls include gender, age, educational attainment, race/ethnicity, marital status, and state-level share non-white and college educated. State economic controls include state per capita income and the state unemployment rate. State marijuana and cigarette policies include cigarette taxes, clean indoor air laws, and marijuana decriminalization and legalization laws. State alcohol policies include beer taxes, zero tolerance drunk driving laws, and blood alcohol content (.08) driving laws. Standard errors corrected for clustering at the state-level are in parentheses. All regressions include state fixed effects and year fixed effects.

Table 7. Synthetic Control Estimates of the Effect of MMLs on Cigarette Smoking

	Alaska	*Arizona*	*California*	*Colorado*
MML	-0.0101**	-0.0151**	-0.0058	-0.0299***
	(0.0047)	(0.0064)	(0.0047)	(0.0040)
N	25	26	26	26
	Connecticut	*Delaware*	*D.C.*	*Hawaii*
MML	-0.0039	-0.0071	0.0052	-0.0005
	(0.0063)	(0.0077)	(0.0075)	(0.0044)
N	26	26	25	26
	Illinois	*Maine*	Maryland	Massachusetts
MML	-0.0106*	-0.0087*	-0.0034	-0.0040
	(0.0058)	(0.0045)	(0.0064)	(0.0057)
N	26	26	26	26
	Michigan	Minnesota	*Montana*	*Nevada*
MML	-0.0171	0.0062	0.0142***	-0.0551***
	(0.0112)	(0.0100)	(0.0039)	(0.0079)
N	26	26	26	24
	New Hampshire	*New Jersey*	*New Mexico*	New York
MML	-0.0073	-0.0075*	0.0013	-0.0066
	(0.0089)	(0.0043)	(0.0047)	(0.0092)
N	26	25	26	26
	Oregon	*Rhone Island*	*Vermont*	*Washington*
MML	-0.0041	-0.0131***	-0.0115***	-0.0200***
	(0.0037)	(0.0035)	(0.0026)	(0.0042)
N	26	25	26	26

***Significant at 1% level **at 5% level *at 10% level
Notes: Estimates generated by regressing the difference in the treatment and synthetic control state on an indicator for an MML Standard errors generated following Donald and Lang (2007). Donor states include those states that did not implement an MML between 1990 and 2015.

Table 8. Exploring Heterogeneity in Effects of Tobacco Use by Different Types of Medical Marijuana Laws

	Panel I: Cigarette Consumption, BRFSS				
	(1)	(2)	(3)	(4)	(5)
MML-Pain	-0.0045*				-0.0046
	(0.0025)				(0.0051)
MML-Collective Cultivation		-0.0028			0.0015
		(0.0027)			(0.0053)
MML-Dispensaries			-0.0012		0.0019
			(0.0023)		(0.0023)
MML-Registry				-0.0061**	-0.0047
				(0.0024)	(0.0030)
N	6,970,691	6,970,691	6,970,691	6,970,691	6,970,691
	Panel II: Cigarette Consumption, CPS-TUS				
MML-Pain	-0.0055**				-0.0027
	(0.0018)				(0.0031)
MML-Collective Cultivation		-0.0067***			-0.0046
		(0.0024)			(0.0026)
MML-Dispensaries			-0.0035*		0.00049
			(0.0018)		(0.0026)
MML-Registry				-0.0013	0.0006
				(0.0024)	(0.0025)
N	2,044,577	2,044,577	2,044,577	2,044,577	2,044,577
	Panel III: Cigarettes Per Day, CPS-TUS				
MML-Pain	-0.3042***				-0.2433
	(0.0904)				(0.2370)
MML-Collective Cultivation		-0.3168***			-0.0708
		(0.0932)			(0.2880)
MML-Dispensaries			-0.2261**		-0.0349
			(0.0998)		(0.0927)
MML-Registry				-0.1254	0.0179
				(0.1440)	(0.1387)
N	235,159	235,159	235,159	235,159	235,159

***Significant at 1% level **at 5% level *at 10% level

Notes: Weighted difference-in-difference estimates obtained from the Behavioral Risk Factor Surveillance Survey and the Current Population Survey Tobacco Use Supplements. The full period includes the years 1990 through 2015. State-specific time-varying controls include beer taxes, cigarette taxes, clean indoor air laws, zero tolerance laws, blood alcohol content (.08) driving laws, marijuana decriminalization and legalization laws, state per capita income, the unemployment rate, share of non-white population, and share of population graduating from college. Demographic controls include age, educational attainment, race/ethnicity, and marital status. All regressions include state fixed effects and year fixed effects.

Appendix Figures 1-6.
Synthetic Control Analysis of the Effect of MML on Cigarette Smoking, BRFSS

Figure 1: Alaska

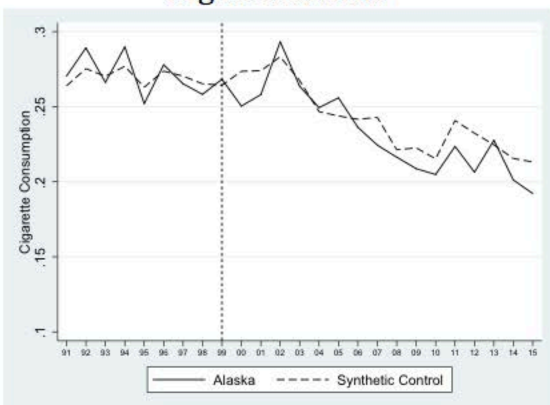


Figure 2: Arizona

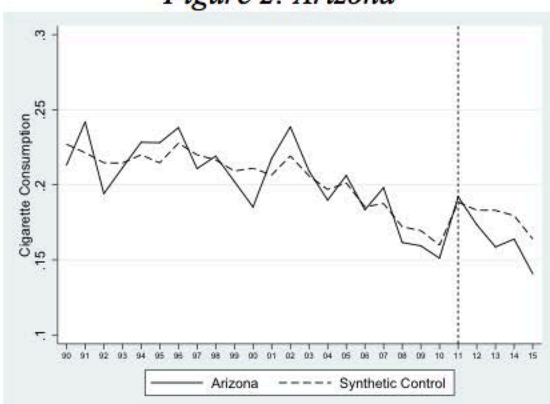


Figure 3: California

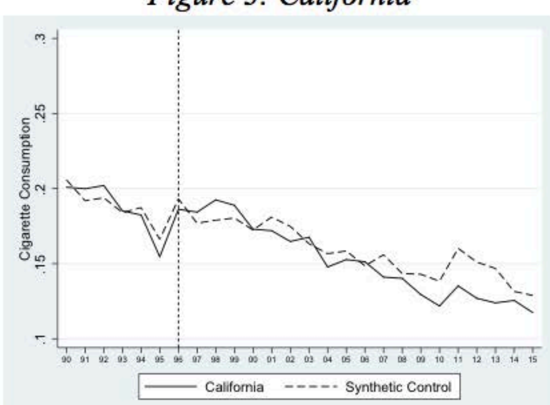


Figure 4: Colorado

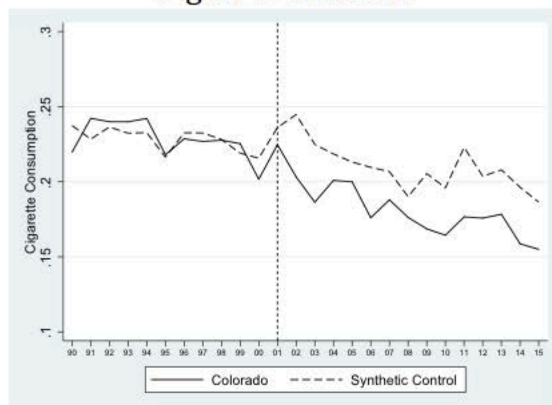


Figure 5: Connecticut

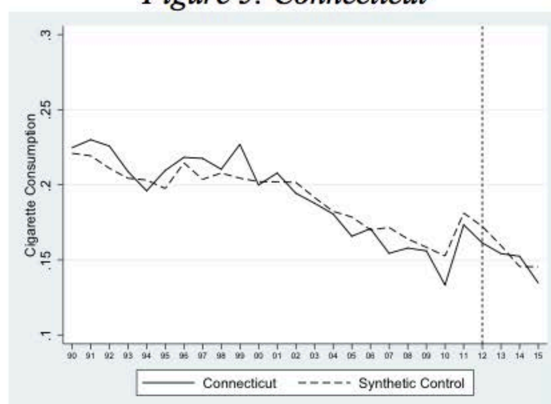
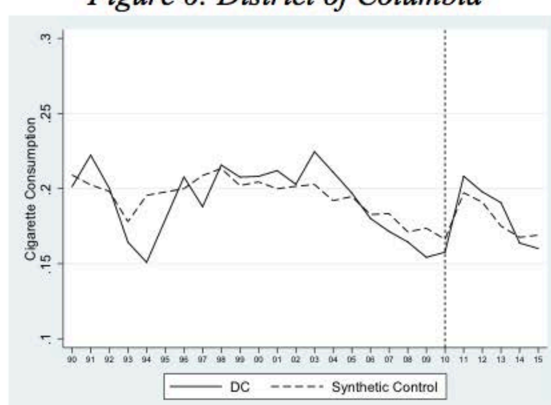


Figure 6: District of Columbia



Alaska (1991-2015)
Notes: Donor states include those states that did not implement an MML between 1990 and 2015. Wyoming, Arkansas and Kansas excluded from donor states due to missing years in BRFSS.

Online Appendix Figures 7-12.
Synthetic Control Analysis of the Effect of MML on Cigarette Smoking, BRFSS

Figure 7: Delaware

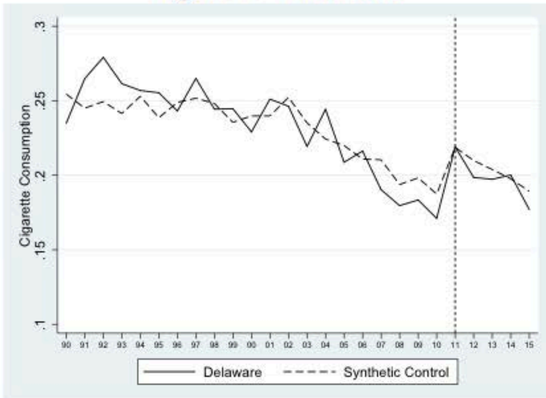


Figure 8: Hawaii

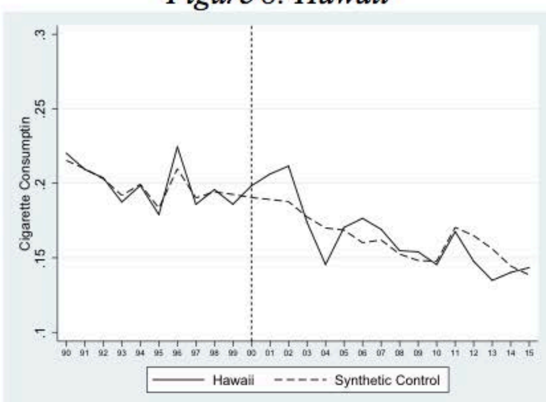


Figure 9: Illinois

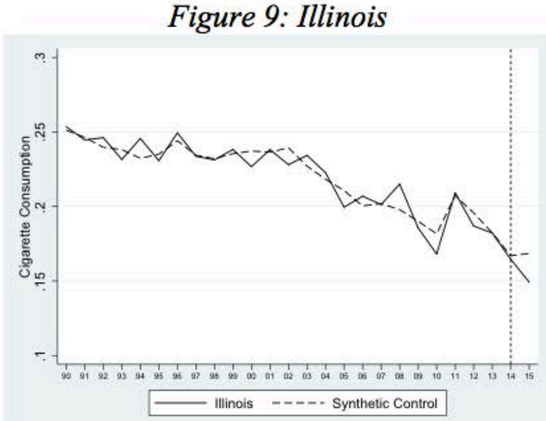


Figure 10: Maine

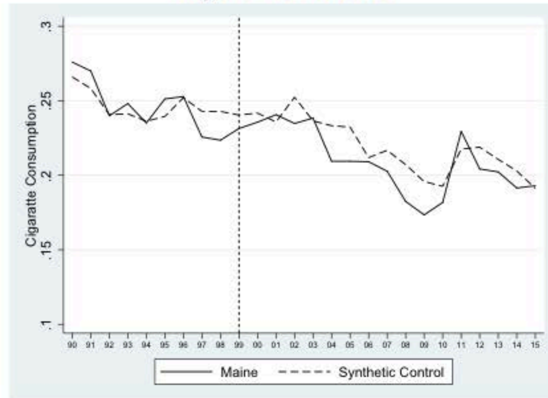


Figure 11: Massachusetts

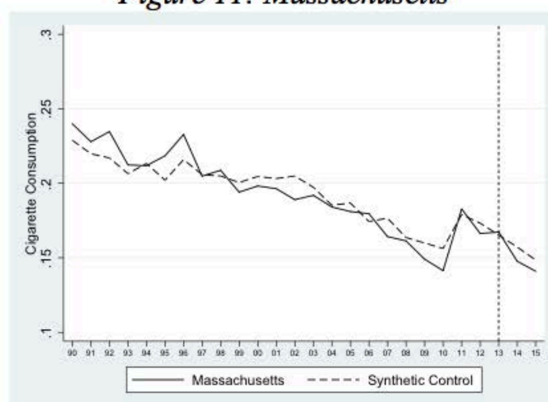
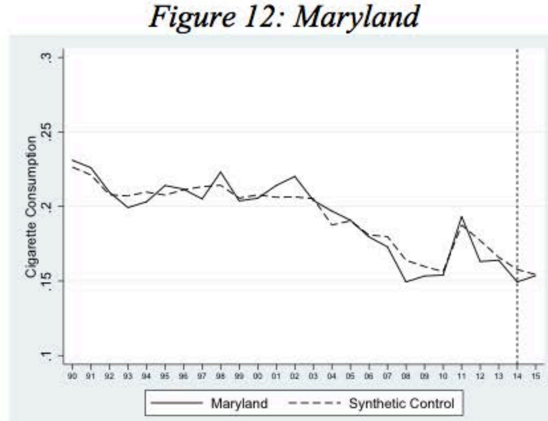


Figure 12: Maryland



Notes: Donor states include those states that did not implement an MML between 1990 and 2015. Wyoming, Arkansas and Kansas excluded from donor states due to missing years in BRFSS.

Online Appendix Figures 13-18.
Synthetic Control Analysis of the Effect of MML on Cigarette Smoking, BRFSS

Figure 13: Michigan

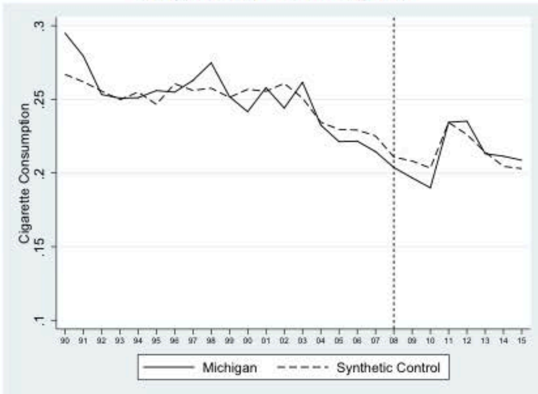


Figure 14: Minnesota

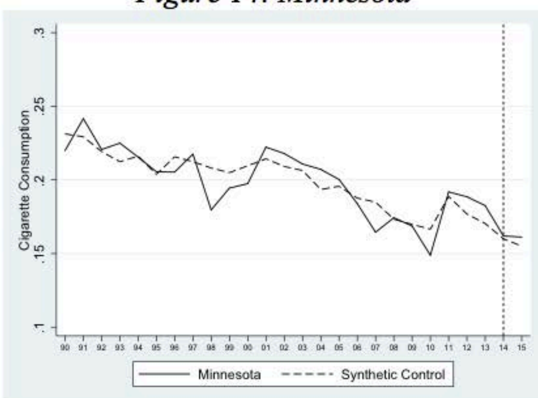


Figure 15: Montana

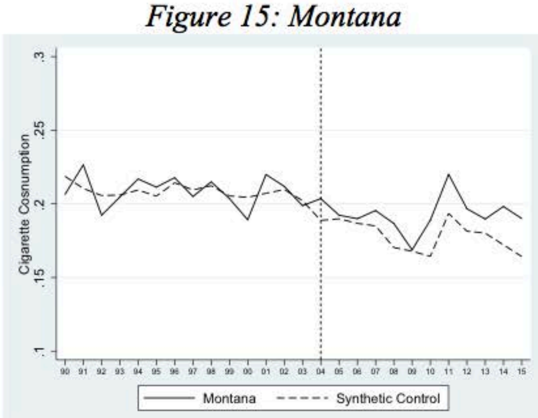


Figure 16: New Hampshire

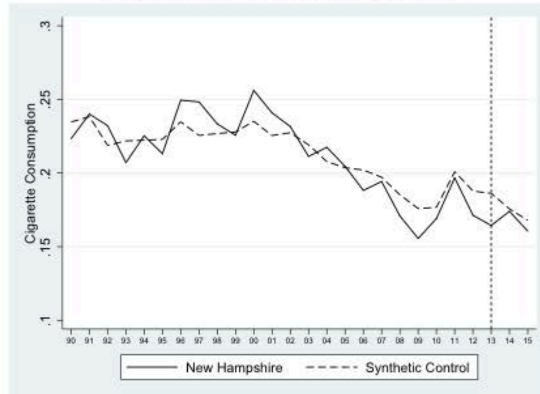


Figure 17: New Jersey

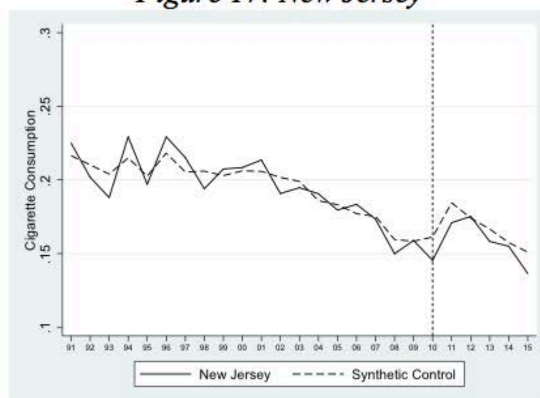
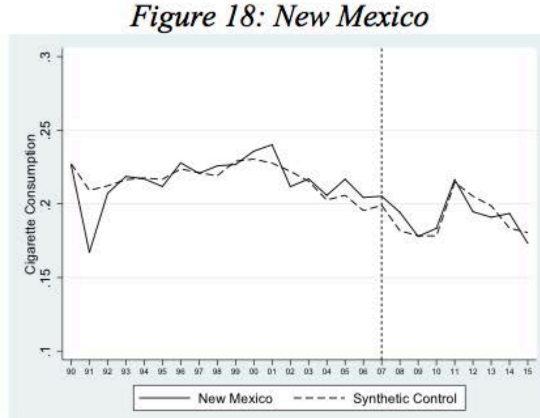


Figure 18: New Mexico



New Jersey (1991-2015), Nevada (1992-2015)
Note: Donor states include those states that did not implement an MML between 1990 and 2015. Wyoming, Arkansas and Kansas excluded from donor states due to missing years in BRFSS.

Online Appendix Figures 19-24.
Synthetic Control Analysis of the Effect of MML on Cigarette Smoking, BRFSS

Figure 19: Nevada

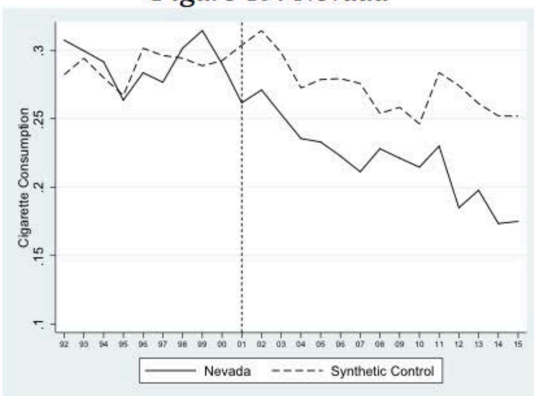


Figure 20: New York

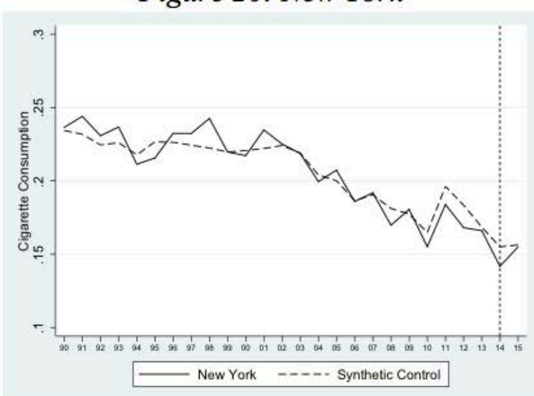


Figure 21: Oregon

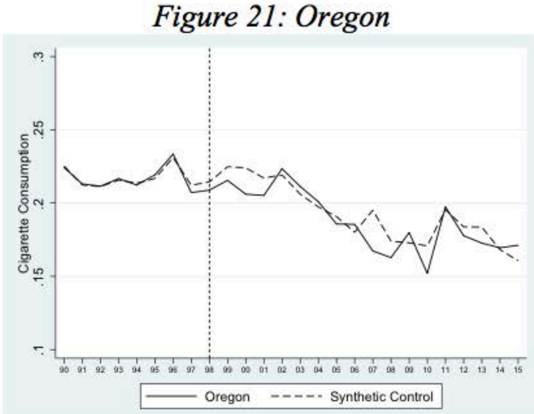


Figure 22: Rhode Island

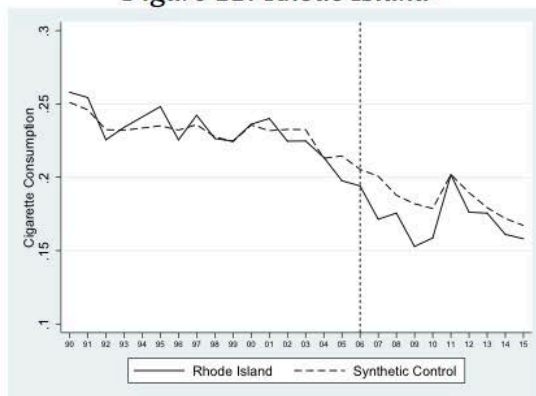


Figure 23: Vermont

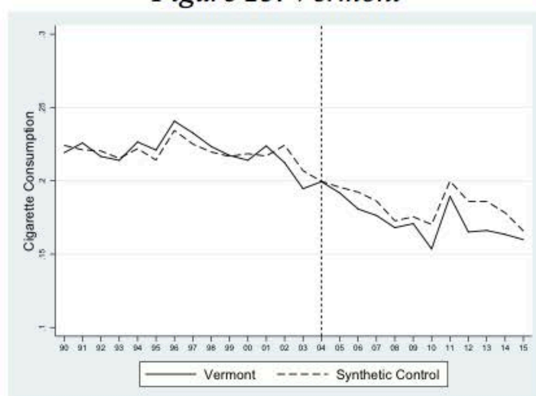
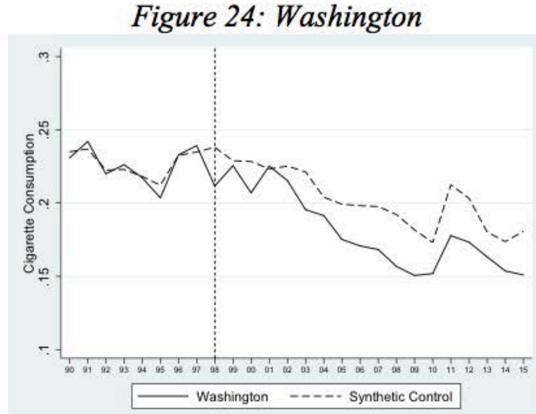


Figure 24: Washington



Notes: Donor states include those states that did not implement an MML between 1990 and 2015. Wyoming, Arkansas and Kansas excluded from donor states due to missing years in BRFSS.

Appendix Table 1. Coefficients on Control Variables

	NSDUH		BRFSS	CPS-TUS
	Marijuana Use	Cigarette Use	Cigarette Use	Cigarette Use
Medical marijuana law	0.00770***	-0.00266	-0.0059***	-0.0039**
(MML)	(0.00213)	(0.00373)	(0.0022)	(0.0017)
Recreational marijuana	0.04104***	-0.01725*	0.0015	-0.0023
legalization law (RMLL)	(0.01128)	(0.00935)	(0.0026)	(0.0043)
Marijuana decriminalization	0.01228***	-0.00295	-0.0033	-0.0011
law (MDL)	(0.00366)	(0.00584)	(0.0048)	(0.0038)
Non-White[a]	-0.05757	-0.20322	-0.198***	-0.176***
	(0.07813)	(0.12233)	(0.0482)	(0.0330)
College Grad[a]	0.04819	-0.06663	-0.0874**	-0.139***
	(0.05350)	(0.09981)	(0.0356)	(0.0352)
Male[a]	-0.51006	2.54407**	0.0440***	0.0483***
	(0.85490)	(1.17877)	(0.0038)	(0.0029)
Clean indoor air (CIA) Law:	0.00241	0.00596	0.0064*	-0.0002
Government building	(0.00280)	(0.00387)	(0.0038)	(0.0021)
CIA Law: private sector	0.00271	0.00318	0.0020	0.0066***
buildings	(0.00238)	(0.00411)	(0.0039)	(0.0023)
CIA Law: restaurants	-0.00247	0.00440	-0.0010	0.0000
	(0.00246)	(0.00473)	(0.0037)	(0.0024)
CIA Law: shopping centers	-0.00101	-0.00778**	0.0008	-0.0018
	(0.00184)	(0.00344)	(0.0038)	(0.0015)
CIA Law: public schools	-0.00014	0.01116	0.0124***	0.00151
	(0.00318)	(0.00722)	(0.0034)	(0.0025)
CIA Law: private schools	0.00216	0.00140	-0.0056	-0.0011
	(0.00205)	(0.00338)	(0.00400)	(0.0028)
Log Per Capita Income	-0.04336*	0.00177	0.0338*	0.0343
(2015$)	(0.02394)	(0.04156)	(0.0193)	(0.0390)
Log Unemployment Rate	-0.00360	0.00588	-0.0050	0.0014
	(0.00709)	(0.00866)	(0.0042)	(0.0149)
Log Beer Tax (2015$)	-0.00062	-0.00845	0.0004	-0.0019
	(0.00587)	(0.00536)	(0.0033)	(0.0022)
Log Cigarette Tax (2015$)	-0.00218	-0.00427*	-0.0020	-0.0033***
	(0.00165)	(0.00215)	(0.0012)	(0.0011)
BAC08 Law	-0.00033	0.00033	0.0040*	-0.0012
	(0.00237)	(0.00536)	(0.0021)	(0.0018)
Zero Tolerance Drunk	--	--	-0.0018	0.0001
Driving Law			(0.0030)	(0.0023)
N	357	357	6,970,691	2,044,577

***Significant at 1% level **at 5% level *at 10% level

Notes: Weighted OLS estimates obtained using data from the National Survey of Drug Use and Health from 2002-2015. State-level demographic controls include share non-white, male, and college educated. State economic controls include state per capita income and the state unemployment rate. State marijuana and cigarette policies include cigarette taxes, clean indoor air laws, and marijuana decriminalization and legalization laws. State alcohol policies include beer taxes, zero tolerance drunk driving laws, and blood alcohol content (.08) driving laws. Standard errors corrected for clustering at the state-level are in parentheses.

[a]These variables are measured at the state-level for the NSDUH and range from 0 to 100; these variables are measured at the individual-level for the BRFSS and CPS-TUS and take on the values of 0 or 1.

Appendix Table 2. Estimated Effect of MMLs on Marijuana and Cigarette Use with Limited Controls

***Significant at 1% level **at 5% level *at 10% level

	NSDUH		BRFSS	CPS-TUS
	Marijuana Use	Cigarette Use	Cigarette Use	Cigarette Use
MML	0.00754***	-0.00269	-0.0078***	-0.0058***
	(0.00214)	(0.00357)	(0.0025)	(0.0018)
N	357	357	6,970,691	2,044,577

All models include controls for state fixed effects, year fixed effects, marijuana legalization and decriminalization laws, and cigarette taxes.

Appendix Table 3. Synthetic Weights on Cigarette Use, BRFSS

	MML States												
	AK	*AZ*	*CA*	*CO*	*CT*	*DE*	*DC*	*HI*	*IL*	*ME*	*MD*	*MA*	*MI*
Donor States													
Alabama	-	-	-	-	-	-	.466	-	-	-	-	-	-
Florida	-	.111	-	-	-	-	-	-	-	.020	.289	.166	-
Georgia	-	-	-	-	-	-	-	-	-	-	-	-	-
Idaho	-	-	-	-	-	-	-	-	-	-	-	-	-
Indiana	-	-	-	-	-	-	-	-	.034	-	-	-	-
Iowa	-	.229	-	-	-	-	-	-	-	-	-	-	-
Kentucky	.296	-	-	-	-	-	-	-	-	-	-	-	.176
Louisiana	-	-	-	-	-	-	-	.053	-	-	-	-	.103
Mississippi	-	-	-	.229	-	-	-	-	-	-	-	-	-
Missouri	-	-	-	-	-	-	-	-	-	-	-	-	-
Nebraska	-	.027	-	-	-	-	.037	-	-	.238	.118	-	.028
North Carolina	.574	-	-	-	-	.315	-	-	.162	.055	-	.063	.297
North Dakota	-	-	-	-	-	-	-	-	-	-	-	-	-
Ohio	-	-	-	-	-	-	-	.024	-	-	.036	-	-
Oklahoma	-	-	.151	.203	-	-	-	-	-	-	-	-	-
South Carolina	.130	-	-	-	-	-	-	-	-	.121	-	.075	.020
South Dakota	-	-	-	.043	.089	.169	.146	-	-	-	.139	-	.095
Tennessee	-	.256	-	-	-	.135	-	.046	-	.321	-	.099	.02
Texas	-	-	-	-	.217	-	-	-	.396	.003	.085	.058	-
Utah	-	.246	.604	.094	.290	-	.330	.468	-	-	.215	.355	-
Virginia	-	.132	-	.430	-	.278	-	-	-	-	-	-	-
West Virginia	-	-	-	-	-	-	-	-	-	-	-	-	-
Wisconsin	-	-	.245	-	.403	.104	.021	.409	.408	.242	.119	.204	.261

Appendix Table 3, Continued

	MML States										
Donor States	*MN*	*MO*	*NV*	*NH*	*NJ*	*NM*	*NY*	*OR*	*RI*	*VT*	*WA*
Alabama	-	-	-	-	-	.036	-	-	-	-	-
Florida	.324	.126	-	.203	.239	-	.132	-	.414	-	-
Georgia	-	-	-	-	-	.363	-	-	-	-	.025
Idaho	-	-	-	.206	-	-	-	.354	-	-	-
Indiana	-	-	-	-	-	-	-	.030	-	-	-
Iowa	-	.229	-	.197	-	-	-	-	-	.209	-
Kentucky	-	-	.803	-	-	-	-	-	-	-	-
Louisiana	-	.030	-	-	.057	-	-	-	-	-	-
Mississippi	-	.091	-	-	-	-	-	-	-	-	-
Missouri	-	-	-	-	-	-	-	-	-	-	.247
Nebraska	-	-	-	-	-	-	-	-	.071	-	-
North Carolina	-	-	-	-	-	-	-	-	.174	-	-
North Dakota	-	-	-	-	-	.364	-	.080	-	.124	-
Ohio	-	-	-	.100	.150	.152	-	.264	-	-	-
Oklahoma	.138	-	.197	-	-	-	-	-	-	-	-
South Carolina	-	-	-	-	-	-	-	-	-	-	-
South Dakota	-	.035	-	-	-	-	.071	-	.007	-	.233
Tennessee	.026	-	-	-	-	-	-	-	-	-	-
Texas	.034	-	-	-	-	-	.546	.147	.178	-	-
Utah	.247	.298	-	.018	.327	.084	.056	.125	.002	.106	.150
Virginia	-	.034	-	-	.017	-	-	-	-	.325	-
West Virginia	-	.114	-	-	-	-	-	-	-	-	-
Wisconsin	.231	.042	-	.277	.210	-	.196	-	.171	.229	.318

Appendix Table 4. Age-Specific Estimates of the Effect of MMLs on Tobacco Use, BRFSS and CPS-TUS

	Ages 18-to-25 (1)	**Ages 26-to-54** (2)	**Ages 55+** (3)
	Panel I: Cigarette Smoking, BRFSS		
MML	-0.0134***	-0.0039	-0.0070***
	(0.0049)	(0.0036)	(0.0022)
N	470,712	3,231,447	3,221,534
	Panel II: Everyday Smoking, BRFSS		
MML	-0.0019	-0.0012	-0.0016
	(0.0065)	(0.0034)	(0.0017)
N	382,172	2,808,064	2,919,061
	Panel III: Cigarette Smoking, CPS-TUS		
MML	0.0003	-0.0011	-0.0102***
	(0.0038)	(0.0026)	(0.0016)
N	265,089	1,128,283	651,205
	Panel IV: Cigarettes Per Day, CPS-TUS		
MML	0.0867	-0.3163***	-0.4664**
	(0.1641)	(0.0937)	(0.2151)
N	26,962	154,323	53,874

***Significant at 1% level **at 5% level *at 10% level

Notes: Weighted difference-in-difference estimates obtained from the Behavioral Risk Factor Surveillance Survey and the Current Population Survey Tobacco Use Supplements. -specific time-varying controls include beer taxes, cigarette taxes, clean indoor air laws, zero tolerance laws, blood alcohol content (.08) driving laws, marijuana decriminalization and legalization laws, state per capita income, the unemployment rate, share of non-white population, and share of population graduating from college. Demographic controls include age, educational attainment, race/ethnicity, and marital status. All regressions include state fixed effects and year fixed effects.