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INSTITUTT FOR FORETAKSØKONOMI

DEPARTMENT OF BUSINESS AND MANAGEMENT SCIENCE

FOR 5 2015
ISSN: 1500-4066
January 2015

Discussion paper

Is Legal Pot Crippling Mexican Drug Trafficking Organizations? The Effect of Medical Marijuana Laws on US Crime

BY
Evelina Gavrilova, Takuma Kamada AND **Floris Zoutman**

Norges
Handelshøyskole
NORWEGIAN SCHOOL OF ECONOMICS

Is Legal Pot Crippling Mexican Drug Trafficking Organizations? The Effect of Medical Marijuana Laws on US Crime*

Evelina Gavrilova† Takuma Kamada‡ Floris Zoutman§

December 27, 2014

Abstract

We examine the effect of medical marijuana laws (MML) on crime treating the introduction of MML as a quasi-experiment and using three different data sources. First, using data from the Uniform Crime Reports, we find that violent crimes such as homicides and robberies decrease in states that border Mexico after MML are introduced. Second, using Supplementary Homicide Reports' data we show that for homicides the decrease is the result of a drop in drug-law and juvenile-gang related homicides. Lastly, using STRIDE data, we show that the introduction of MML in Mexican border states decreases the amount of cocaine seized, while it increases the price of cocaine. Our results are consistent with the theory that decriminalization of small-scale production and distribution of marijuana harms Mexican drug trafficking organizations, whose revenues are highly reliant on marijuana sales. The drop in drug-related crimes suggests that the introduction of MML in Mexican border states lead to a decrease in their activity in those states. Our results survive a large variety of robustness checks. Extrapolating from our results, this indicates that decriminalization of the production and distribution of drugs may lead to a drop in violence in markets where organized crime is pushed out by licit competition.

*We would like to thank Melissa Dell, Aart Gerritsen, Tetsuya Hoshino, Hajime Katayama, Cameron Laubisch, Steven Machin, Yutaka Maeda, Danilo Mandic, Mark Moore, Yoshimichi Sato, Jason Wilks, and Christopher Winship and seminar participants at the Criminal Law and Governance Workshop 2013 in Bergen and the Quantitative Methods in Sociology Workshop at Harvard University. Gavrilova would like to thank Research Council of Norway grant number 239120, and Kamada would like to thank Grand-in-Aid for Japan Society for the Promotion of Science Fellows (26-5010).

†NHH Norwegian School of Economics: Department of Business and Management Science and Norwegian Center for Taxation (NoCeT)

‡Tohoku University: Department of Behavioral Science, Graduate School of Arts and Letters; Japan Society for the Promotion of Science; Harvard University: Department of Sociology (visiting fellow)

§NHH Norwegian School of Economics: Department of Business and Management Science, NoCeT and CESifo. Corresponding author: NHH Norwegian School of Economics: Department of Business and Management Science, Helleveien 30, 5045 Bergen, Norway. Phone:+47 55959862. E-mail: floris.zoutman@nhh.no

Michael Braun, the former chief of operations for the D.E.A., told me a story about the construction of a high-tech fence along a stretch of border in Arizona. "They erect this fence," he said, "only to go out there a few days later and discover that these guys have a catapult, and they're flinging hundred-pound bales of marijuana over to the other side." He paused and looked at me for a second. "A catapult," he repeated. "We've got the best fence money can buy, and they counter us with a 2,500-year-old technology." New York Times, Keefe (2012)

1 Introduction

Most illicit drugs in the US are supplied through Mexico and every year around 6 billion dollars find their way back across the border as profit for the large drug trafficking organizations (DTOs) (Kilmer et al., 2014). DTOs are major contributors to crime in US border states. They are often allied to local gangs and the smuggling of illicit drugs is known to be paired with violence as DTOs are willing to protect their products with lethal force (National Gang Intelligence Center NGIC, 2011). Possibly as a result, Mexican border states have a 15 percent higher crime rate than inland states. As such, it is no surprise that US law enforcement has focused a large part of its efforts and resources on deterring DTOs from importing their drugs into the US. A prime example of this is given in the quote on the top of this page. Yet, as the quote indicates, even the most advanced techniques are easily avoided by the Mexican drug traffickers. In practice, US efforts to curb the import through Mexico seem to have a limited impact on the supply of drugs and crime in the US.

In this paper we argue that a different strategy may be more effective at decreasing the role of Mexican DTOs in US crime. Medical marijuana laws (MML) have been introduced in more than twenty states across the US. These laws allow the consumption and production of marijuana for medical purposes. In most states medical purposes can range from severe conditions such as cancers to milder conditions such as (perceived) headaches or back pain. They *de facto* decriminalize small-scale production of marijuana, when the drug is intended for personal use, or for sale in a marijuana dispensary.[1]

We argue that the main difference between states with and without MML is not the availability of marijuana but the origin of the drug. Many studies show marijuana is widely available in states without MML in place (E.g. National Drug Threat Assessment Report NDIC, 2011, Kilmer et al., 2014). While marijuana markets were traditionally firmly in the hands of Mexican DTOs, according to the 2011 National Drug Threat Assessment Report (NDIC, 2011), US production of marijuana has increased more than twofold in the period 2005-2009.[2]

This increase in local production of marijuana in MML states decreases the market share of Mexican DTOs in the largest drug market in the US. Therefore, MML provide a quasi-experimental variation where the increased drug production within the US hurts the profits of DTOs, in different states and at different points in time. If MML are indeed effective at decreasing the activity of these drug traffickers, we should see that MML lead to a decrease in crimes committed by DTOs and their affiliated gangs within MML states. Since DTOs and their affiliated gangs conduct most of their criminal activity in Mexican-border states, it follows that the introduction of MML should reduce drug-related crime and drug trafficking particularly in those states.

[1] A dispensary is a specialty store that sells marijuana products to patients with a prescription.

[2] We consider this estimate a lower bound, since production is measured as plants eradicated by law enforcement, while many farms are protected from eradication by MML.

Several articles in popular media suggest that MML and the later legalization of marijuana in Colorado and Washington indeed affect the activity of Mexican DTOs (e.g. articles from the Washington and Huffington Post Khazan, 2012, Miroff, 2014,Knafo, 2014). Price data also indicates that MML has had a negative impact on Mexican DTOs. The quality-adjusted price of marijuana has decreased by 6 percent in the period 2009-2012 (UNODC, 2014). However, to our knowledge a statistical analysis linking MML to criminal activity of Mexican DTOs within the US is still lacking.

To test our theory we use crime data from 2 different sources. First, we use the Uniform Crime Report (UCR) data which records felony crime rates for all US states. UCR is a panel data set with violent and property crime rates for each state, split into seven crime categories. Second, we use the Supplementary Homicide Reports (SHR) data. SHR gives information on the circumstances surrounding homicides committed in the US. As such, we can see whether homicides are related to drug violence. Both data sets cover the time period 1990-2012.

Our methodology is a difference-in-differences analysis where we divide states into three groups: i.) a treatment group of states with MML at the Mexican border, which is our main treatment group of interest ii.) a treatment group of inland states with MML, and iii.) a control group of states without MML. In addition, we include multiple control variables as well as state-specific linear time trends, that control for observed and unobserved time-variant heterogeneity between states.

Our results on the UCR data indicate that there is no significant relationship between the introduction of MML and crime. This confirms earlier analysis in Morris et al. (2014) and Alford (2014). However, we do find a significant negative relationship between MML and crime in states that border Mexico. In particular, we show that in those states the violent crime rates decrease significantly. Our central estimate suggest that violent crime decreases by a little less than 6 percent, with the strongest effects on robberies and homicides which decrease by 14 and 12 percent, respectively. The geographical heterogeneity in the treatment effect suggests that the decrease in crime in states that border Mexico may have had something to do with the activity of DTOs.

Moreover, a further split-up in homicides applying SHR data shows that MML decrease drug-law and juvenile-gang-related homicides by 48, and 33 percent, respectively. This split-up strongly suggests that MML decreases homicides related to drugs and gang activity. Although the decrease in drug and gang violence could potentially be unrelated to the role of Mexican DTOs, we consider it highly unlikely, since prior to MML virtually all drugs were distributed by Mexican DTOs, and a large number of gangs within Mexican border states hold direct alliances with Mexican DTOs (e.g. NDIC, 2011,NGIC, 2011).

In order to look closer into the drug market we use a third data source: the System to Retrieve Information from Drug Evidence (STRIDE) from the Drug Enforcement Administration (DEA). This data records narcotic seizures and prices of drugs, thereby allowing us to investigate the effect of MML on the market for illicit drugs. We exclude marijuana from our analysis, since MML may have a mechanical effect on the seizures of marijuana. The STRIDE data cover the period 1990-2007.

Using STRIDE data we find that MML decrease the amount of (crack and powdered) cocaine seized in states bordering Mexico. Our central estimate suggests the amount seized decreases significantly by 85 percent for powdered cocaine, and 83 percent for crack cocaine, although standard errors are very large. In addition, the price of powdered cocaine increases significantly at all distribution levels. These estimates indicate that MML in Mexican border states coincides with a negative supply shock. This gives further support to our theory that MML affect the overall activities of DTOs in border states, and furthermore, suggests that the supply of marijuana is complementary to the supply of other drugs, most prominently cocaine.[3]

We perform several robustness checks to confirm our results. Most notably, MML in Mexican border states appear to have a negative effect on property crime. However, placebo tests indicate that the estimated treatment effect is biased downward (more negative) due to heterogeneity in crime trends between treatment and control states. As such, it is unclear whether the estimated effect is indeed (entirely) the result of the MML treatment effect. No such conflict arose with a similar placebo test for violent crimes. Beside this test, we study the effect of heterogeneity in MML between states. In particular, Pacula et al. (forthcoming) and Alford (2014) note that there may be a difference between MML that only allow for home cultivation and MML that allow for marijuana dispensaries. This would be a concern, if differences in the specific allowances of MML are correlated with their geographical proximity to the border as this would contaminate our results. However, we find that as we control for differences in MML, the effect of MML on crime at the Mexican border remains. We find that violent crime at the Mexican border is unaffected by MML that allow for home cultivation, but opening the first licensed dispensary has a significant negative effect on crime, although we should note that the identification of the latter effect is weak since most states with MML open their first licensed dispensary one or two years after the adoption of MML.

We also consider the dynamic effect of MML by including lags of the treatment variable in our regression analysis. We find that the lagged coefficients are significant for violent crime. This may indicate that the full effect of MML on activity of Mexican DTOs may only appear in crime rates after a few years.

Our research is of importance to policy makers who consider legalizing or decriminalizing marijuana production in their jurisdiction. The results presented in this paper indicate that MML has a negligible direct impact on crime. However, they decrease crime indirectly by affecting the position of violent Mexican DTOs, and their affiliated gangs. We expect even stronger effects of full legalization of marijuana production, since this will allow for large-scale production by corporations, likely pushing the DTOs completely out of the profitable market for marijuana. Thus, legalization might prove to be a way to diminish the power of organized crime structures. Of course, in its decision to legalize marijuana the government should weigh these benefits against the relevant costs related to marijuana legalization.

The remainder of this article is organized as follows. The next section discusses related literature. The third section provides a theoretical link between MML and crime. The fourth section describes the data while the fifth section discusses methodology and the results. The sixth section presents robustness checks. The final section concludes.

2 Related Literature

MML have recently become a popular instrument for a variety of societal issues related to drug consumption, including crime (See e.g. Anderson et al., 2013; Chu, 2012, 2013; Pacula et al., forthcoming; Morris et al., 2014; Alford, 2014). Most related to our study are Morris et al. (2014), and Alford (2014) which investigate the relationship between MML and crime. Morris et al. (2014) find no significant relationship between MML and crime, with the exception of

[3] Note that one would expect a stronger effect on cocaine than on other drugs. First, cocaine is the second-largest drug market after marijuana. Second, Mexican DTOs have apparently replaced some of their marijuana fields with opium fields (e.g. Miroff, 2014), suggesting less complementarity between marijuana and opium-related drugs such as heroin. Third, synthetic drugs such as methamphetamine are usually produced within the US, and as such have a clear alternative distribution channels that are unrelated to the supply of marijuana.

homicides for which the relationship with MML is significantly negative. We confirm this finding, but we also show that there is a significant negative relationship between MML and crime in the Mexico border region.

Alford (2014) studies the effect of specific MML characteristics on crime. In particular, she finds that MML which allow for dispensaries have a positive effect on both violent and property crimes. We partly replicate this result at the Mexican border. We show that crime is negatively related to home cultivation, but positively related to the state-wide allowance of dispensaries. However, in some states, including the largest MML state California, many counties licensed dispensaries prior to their state-wide allowance (see also the discussion in Anderson and Rees, 2014). When we consider the opening date of the first licensed dispensary, we find that home cultivation has a non-significant effect on crime, while dispensaries have a negative effect on violent crime in Mexican border states. Identification of the additional effect of dispensaries is weak, since the first licensed dispensary usually opens 1 or 2 years after the introduction of MML. However, this evidence suggests that the opening of dispensaries does not increase crime.

There has also been some evidence of the effect of the decriminalization of marijuana possession on crime abroad. In particular, Adda et al. (2014) looks at the effect of depenalization on crime in a London borough. They find that overall crime fell, while possession offenses increased and persisted even after the policy ended. In another UK quasi-experiment, Braakman and Jones (forthcoming) find no effect of the 2004 decriminalization in the UK on crime and drug consumption. Unlike MML the decriminalization in the UK had no effect on the legal status of marijuana production which remained strictly illegal throughout the policy experiment.

The market for marijuana is strongly interlinked with the market for other illicit drugs. It is often argued that marijuana is a complement to the demand of other drugs, in a theory often known as the gateway drug hypothesis. According to the theory, after consumption of marijuana users are more likely to consume habitually other illicit drugs and, thus, marijuana acts as the gateway drug. However, empirical evidence is mixed, with some papers finding that consumption of marijuana causally increases the demand for other drugs (e.g. DeSimone, 1998; Ramful and Zhao, 2009), while others find no effect (e.g. Van Ours, 2003; Morral et al., 2002; Chu, 2013), and some even indicating that marijuana is a substitute to the consumption of other drugs(e.g. Model, 1993). Chu (2013) uses MML to test the gateway drug hypothesis and finds no significant effect of MML on the arrests for possession of other drugs. Moreover, using substance treatment admission data, he rather finds that MML may decrease heroin treatment admissions. We add to this literature by arguing that marijuana may also be a complement to the supply of other drugs. In particular, we show that MML lead to a negative supply shock of other illicit drugs. As such, empirical tests for the gateway hypothesis should take into account that illicit drug markets are interlinked both in demand and in supply.

In addition to the relationship between marijuana and other illicit drugs, there is another strand of the literature which examines the complementarity in demand between marijuana and alcohol use. Anderson et al. (2013) find a significant negative effect of MML on alcohol-related accidents and survey-reported alcohol use. Both results indicate that marijuana and alcohol are demand substitutes. This finding corresponds with earlier results in DiNardo and Lemieux (2001) who show that an increase in the drinking age increases marijuana consumption. On the other hand, Pacula (1998) shows that marijuana consumption decreases with the beer tax, indicating that the two goods are complements. Additionally, the results of Anderson et al. (2013) could not be replicated in Pacula et al. (forthcoming) using various other survey measures of alcohol use. We add indirectly by studying the degree of complementarity in demand between alcohol and marijuana through the effect of MML on alcohol-related homicides. With our data we do not find a significant relationship, although we should add that this may be due to the relatively small number of alcohol-related homicides.

3 Background

In this section we introduce the main theoretical framework linking MML to the supply and demand of illicit drugs and the crime rate. First, we describe the legal impact of MML on marijuana consumption and production. Second, we explain the link between MML, DTOs and the demand and supply of illicit drugs.

3.1 Legal Impact of MML

Prior to MML marijuana was strictly prohibited in some states and decriminalized in other states in a policy that typically dates back to the 1970's.[4] If the drug was prohibited, this meant that even possession and use of small quantities of marijuana could lead to punishment in jail. If the drug was decriminalized this meant that the penalty for possession of small quantities was limited to a small fine. In either case, prior to MML no state allowed for any form of production or distribution of the drug.

When a state introduces an MML it allows patients to consume marijuana for medicinal purposes. The most important of these purposes is pain reduction, and most states with MML allow doctors to prescribe marijuana as a pain killer for general complaints related to pain, such as migraines and back pain. Since it is difficult for the doctor to verify whether pain complaints are real, MML *de facto* make marijuana legally available for a large group of 'patients'.

Patients with a prescription for marijuana can generally obtain the drug in two ways. First, they are allowed to grow a limited number of plants in their own homes. Second, in some states patients can obtain marijuana from marijuana dispensaries.[5]

If dispensaries are allowed they are typically organized as co-operative associations (collectives). Members of the collective can either be producers, consumers or both. If a dispensary has x patients, the producers of the dispensary are on aggregate allowed to grow x times the number of plants allowed for a single patient. In some states/counties producers can be a member of multiple dispensaries allowing them to scale up their production substantially, but in other states/counties this is not allowed. In some states MML do not explicitly allow or disallow dispensaries. In those states dispensaries may receive a license from the county. Overall, even though farmers run the risk of federal prosecution, and legislation differs between states, it is clear that MML significantly reduces the probability of imprisonment for small-scale marijuana farmers.

In figure 1 we present a map of the United States, where states with MML are shaded. Most relevant for our study is the Mexican border region. As can be seen, in this region all states except Texas have adopted an MML.

Table 1 presents an overview of the MML. As can be seen, most states with MML allow for home cultivation from the moment the MML becomes effective. However, many states did not

[4]Nevada in 2002 and Massachusetts in 2008 are the only states that decriminalized marijuana during the time span we study in this paper. We control for decriminalization in Nevada and Massachusetts in our analysis.

[5]While MML are state policies, at the federal level all usage, sales and production of marijuana are felony offenses subject to imprisonment. However, in the US the large majority of law enforcement is employed at the state or county level. As such, the risk of federal prosecution is relatively small for small-scale operations.

Table 1: Medical Marijuana Laws

State	Date Active	Home Cultivation	Dispensaries	Dispensaries Open
Alaska	04.03.1999	Yes	No	No
Arizona	14.12.2010	Yes	Yes	2012[a]
California	06.11.1996	Yes	2004	1997[b]
Colorado	01.06.2001	Yes	2009	2009[a]
Connecticut	01.10.2012	No	No	No
DC	27.07.2010	No	Yes	No
Delaware	01.07.2011	No	Yes	No
Hawaii	28.12.2000	No	No	No
Maine	22.12.1999	Yes	2009	2011[a]
Michigan	04.12.2008	Yes	No	2010[a]
Montana	02.11.2004	Yes	No	2009[a]
Nevada	01.10.2001	Yes	No	2011[a]
New Jersey	18.07.2010	No	Yes	2012[a]
New Mexico	01.07.2007	Yes	Yes	2009[c]
Oregon	03.12.1998	Yes	No	2010[a]
Rhode Island	03.01.2006	Yes	2009	No
Vermont	01.07.2004	Yes	2011	No
Washington	03.11.1998	Yes	No	2010[a]

Notes: The table presents MML and their specific provisions up to the year 2012. The second column presents the date the law became active, the third column shows whether there is a statewide allowance for home cultivation, the fourth column gives the same information about dispensaries, and the last column shows the date when the first licensed dispensary opened. "No" means that the original MML does not allow for the feature in question, while "Yes" means the contrary. Whenever some feature is allowed in a later amendment to original law the year is given. For example, in California MML became active in 1996. Home cultivation was immediately allowed, while dispensaries were not allowed statewide until 2004. 1997 is the date in which the first licensed dispensary opened. All information except the final column comes from `procon.org`.

[a] Source: Anderson and Rees (2014)

[b] Source: Novack (2012)

[c] Source: DEA (2013)

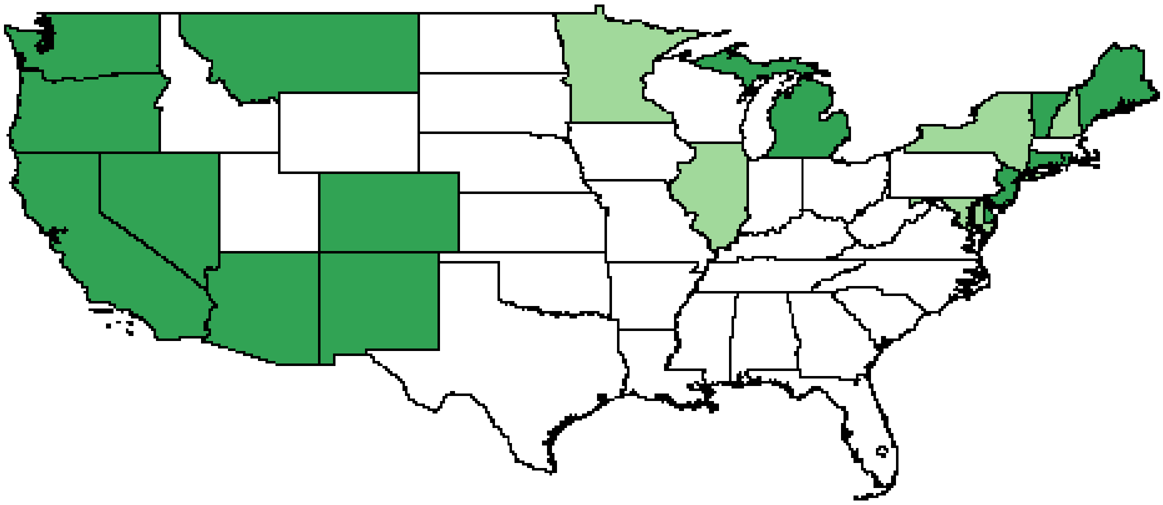

Figure 1: Map of Medical Marijuana Laws
Notes: This graph shows the states in which MML have been introduced. Not shown are Alaska and Hawaii, which have also introduced MML. Dark shade corresponds to states that have introduced MML until the end of 2012, while light shaded are state that have introduced MML after the beginning of 2013.

immediately allow for dispensaries at the moment of adoption of MML. For example, California endorsed an MML in 1996, but only amended the law to specifically allow for dispensaries in 2004. Regulations concerning dispensaries vary by state and even by county basis. The most interesting case in this respect is California. In California the first unlicensed dispensary opened in 1992, 4 years prior to the adoption of the MML. In 1997, the first county-licensed dispensary was opened and the state was documented to have at least 55 dispensaries by 2003, 1 year prior to explicit statewide allowance for dispensaries (Gieringer, 2003). Moreover, some states allow for dispensaries but do not have one, or saw the first one opening some years after the specific allowance. Therefore, we have added a column to the table with the date in which the state first opened a licensed dispensary. These dates are partly the result of work by Anderson and Rees (2014) and of a report by DEA (2013) which documents the opening of dispensaries for some states. In the case of California these sources could not confirm the first opening of a licensed dispensary. Therefore, we conducted a Google search to see when the state opened its first licensed dispensary. Several sources, among which Novack (2012), confirmed that the first licensed dispensary opened in 1997 in San Francisco.

MML appear to have increased the supply and demand of both legal (medical), and illegal marijuana within the US. Turning first to demand, Pacula et al. (forthcoming) find that MML lead to an increase in self-reported use of marijuana. Chu (2012) shows there is a positive relationship between MML and marijuana-related arrests, indicating that when MML are in place, illegal demand for marijuana increases. Although we are not aware of a similar study in the US, Walsh et al. (2013) shows that MML in Canada also substantially increase the demand for (legal) medical marijuana.

On the supply side NDIC (2011) shows that the illegal production of marijuana within the US as measured by plants eradicated has increased twofold in the period 2005-2009.[6] To our knowledge no data is available on the growth in production of (legal) medical marijuana, but given the large number of dispensaries on, for example, the popular website `http://www.`

[6]The increase in illegal marijuana production may be explained by the fact that law enforcement agencies within MML states do not have the means to distinguish between medical and illegally grown marijuana.

weedmaps.org, it appears as if legal production covers a large part of the marijuana market.

Overall it appears that production of marijuana within the US has grown faster than demand. Kilmer et al. (2014) show that demand has grown, by a pace of 46 percent in the period 2005-2009, while the data in NDIC (2011) indicate that illegal production alone has grown by more than a 100 percent. As such, MML have very likely lead to a drop in market share of the Mexican DTOs.

3.2 DTOs, Drugs and Crime

In Mexico there are 7 major DTOs that control almost all the drug trade between Mexico and the US (NDIC, 2011). Through most of our sample the Tijuana Cartel, located on the Mexican West-Coast, is the largest DTO. However, in recent years this cartel is falling into decay, and the Sinola Cartel located in the center of Mexico has replaced its role as Mexico's largest drug cartel. Sinola's annual revenue is estimated at 3 billion US dollar (Fortune Magazine Matthews, 2014).

The main activity of Mexican DTOs is drug distribution. Within Mexico DTOs are strictly geographically separated, and each controls its own territory and smuggling routes into the US. Once the drugs enter the US, DTOs sell their drugs to affiliated gangs. The affiliated gangs each have a presence in at least one of the four Mexican border states. This likely indicates that representatives of the DTOs do not often venture farther North than the border states.[7] The affiliated gangs distribute the drugs further into the US (NGIC, 2011; NDIC, 2011).

DTOs and their affiliated gangs are well-known for their contribution to violent crime along the Mexican border. In particular, they have been known to engage in kidnapping, assaults, robberies and homicides in Mexico and in the US (NGIC, 2011; NDIC, 2011). Perhaps as a result, crime rates in states on the Mexican border are 15 percent higher than in inland states.

Drugs sold by the DTOs can be roughly categorized into four categories: marijuana, cocaine, opium-based drugs of which heroin is the most important, and synthetic drugs, most prominently methamphetamine. All DTOs are diversified and sell a range of these drug products. This diversification strategy is likely optimal, since DTOs and their owners do not have access to capital markets. Diversification allows drug kingpins to smooth their consumption. Moreover, retained earnings of one drug can be used to pay investment cost on other drugs.

In this respect, marijuana plays a special role. Heroin and other opium-related drugs are usually imported from South-America or Asia. Mexico has recently increased its production of poppy plants (UNODC, 2010, 2014), from which heroin is produced, but even locally produced poppy has to go through laboratory refinement in order to create heroin. Cocaine has to be purchased from Columbian DTOs. Production of synthetics requires laboratory equipment. As such, production of each of these drugs, in particular at the large scale required for the DTOs, requires major investment. On the other hand, marijuana can be grown in Mexico with almost zero up-front cost, and it is the largest drug market in the US. Finally, prior to MML Mexico had a virtual monopoly on marijuana in the sense that they were by far the largest producer of marijuana in North America (UNODC, 2010, 2014). Therefore, marijuana is probably a major cash crop for the DTOs. As such, it is likely that proceeds of marijuana are used for investment in the other drugs[8].

If MML introduced in a state on the Mexican border causes the state to produce more marijuana this can have severe repercussions on DTOs and their affiliated gangs. Smuggling

[7] We have established this by cross-checking the list of gangs allied to Mexican DTOs with the list of gangs that are active in each state in NGIC (2011).

[8] This has also been asserted in several media articles, e.g. Keefe (2012)

routes to the state decrease in value as both the demand and the price for one of the major drugs falls. Moreover, the DTOs may have less cash available to invest in the other drugs. Therefore, in the medium to long run we expect a (partial) retreat of DTOs from states with MML at the Mexican border. This leads to a decrease in crimes committed by the DTOs, as well as a decrease in the supply of illicit drugs in the state.

Anecdotal evidence supporting this theory is the demise of the Tijuana cartel. The main smuggling routes for the Tijuana cartel lead to California which was the first state to introduce MML in 1996. Part of the demise of this cartel may therefore be explained by MML in California.[9] In addition, articles in popular media suggest that locally produced marijuana is affecting the profits and activities of DTOs as discussed in the introduction.

We can study this theory in more detail using crime data. In particular, if MML affect crime through their effect on DTOs we would expect that the treatment effect of MML on crime is stronger (more negative) in Mexican border states than in inland states. Moreover, we would expect that the strongest decrease occurs in drug - and gang-related crimes such as homicides, assaults and robberies. In addition, whenever the circumstances behind the crime can be established, we expect those circumstances to be related to drugs or gangs.

The theory also predicts a decrease in overall supply of drugs from Mexico. Hence, we can use drug data to establish whether MML decrease drug seizures, excluding marijuana seizures, in Mexican border states, and whether they increase their market price. Therefore, in the remainder of our paper we aim to establish whether MML have decreased crime and drug smuggling in Mexican border states. Moreover, we establish the circumstances behind the drop in crime in Mexican border states when possible.

3.3 Alternative Theories

MML may have also affected crime through different channels. Goldstein (1985) discusses three main channels through which drugs can affect criminal activity. First, through the 'pharmacological channel drugs may increase aggression, and therefore, violent crime. Second, there is an 'economic channel' in that drug users may resort to crime in order to finance their drug habit. Finally, there may be 'systemic channel' because drug contracts cannot be enforced in the courts, and hence, disputes between drug market participants are often solved with violence.

Moreover, according to the drug gateway hypothesis, after consumption of marijuana users are more likely to consume habitually other illicit drugs and, thus, marijuana acts as a gateway drug. If this is the case MML may have increased the demand for other drugs.[10]

However, unlike the DTO channel, these alternative channels do not have a clear geographical dimension. For example, if MML increase the demand for heroin through the gateway drug hypothesis, we would expect this to occur in both New Mexico, and Washington.[11] However, when the drop in crime is specific to Mexican-border states, DTOs are the most likely channel.

[9] Other factors have also contributed to the demise of the Tijuana cartel. In particular, Mexican law enforcement started a campaign against the DTO in 2006. In one of our robustness checks we control for this increase in law enforcement to see if the drop in crime is not (in part) the result of increased law enforcement in Mexico. We find that this is not the case.

[10] Evidence on the gateway drug hypothesis is mixed with some papers finding that consumption of marijuana increases the demand for other drugs (e.g. DeSimone, 1998; Ramful and Zhao, 2009), while others find no effect (e.g. Van Ours, 2003; Morral et al., 2002; Chu, 2013), and some even indicating that marijuana is a substitute to the consumption of other drugs(e.g. Model, 1993).

[11] Of course, this only holds under the assumption that New Mexico and Washington introduce MML with similar provisions. Therefore, in our robustness analysis we also pay attention to the specific provisions of MML in each state.

4 Data Description

We use three different data sets to test the effect of MML on crime in Mexican border states. First, we use UCR data (1990-2012) for data on overall crime rates. Second, we use SHR data (1990-2012), which allows us to examine the homicides by circumstances. Lastly, STRIDE data (1990-2007) on illicit drug seizures and price allows us to examine the relationship between MML and illicit drug markets. In this section we describe each of our datasets in turn.

4.1 Uniform Crime Reports

All local US law enforcement agencies collect data on reported crimes. Summaries of this data are submitted to the FBI and reported as the Uniform Crime Reports (UCR). The data include the number of violent and property crimes reported per year in each state per 100,000 inhabitants. Violent crime is subdivided in the following categories: homicide, robbery, aggravated assault, and forcible rape. Property crime is subdivided in burglary, larceny theft, and motor vehicle theft. Unfortunately, not all crime types are reported in the UCR data. Among others, UCR data does not contain information about crimes that are often linked to criminal organizations in general (and Mexican DTOs specifically) such as, drug crimes, kidnapping, human trafficking, (credit card) fraud, and extortion. With respect to drug crimes, we try to circumvent this by using the STRIDE data described below. Unfortunately, to our knowledge no common data source exists for the other crimes, and as a result we exclude them from our analysis. Table 2 presents summary statistics.

4.2 Supplementary Homicide Reports

The Supplementary Homicide Reports (SHR) data provide incident level information of a homicide, as reported by the UCR agencies, and collected by the FBI. The data include information of the relationship between a victim and an offender, demographic characteristics of both the victim and offender, types of weapon used and circumstances behind the homicide. Of particular interest for our study are the circumstances. The SHR data classify circumstances behind homicides into 21 categories of which the following five (9 percent of the homicides in the SHR) are related to our study: drug law (3.9 %), juvenile gang (1.5 %), gangland (0.9 %), homicides committed under the influence of drugs (0.7 %) and homicides committed under the influence of alcohol (2 %). Drug law homicides are homicides that are related to a violation of narcotic drug laws (e.g. drug trafficking or manufacturing), juvenile gang homicides are homicides that are related to a juvenile gang, gangland homicides are all homicides related to organized crime (except juvenile gangs), and the other two categories speak for themselves. Whenever a homicide may fall under multiple categories, for example an organized crime related homicide committed under the influence of drugs, it is only reported under the more serious offense.

4.3 STRIDE Data

Data on the drug market come from the STRIDE dataset provided by the Drug Enforcement Administration (DEA). STRIDE data records seizures and (undercover) purchases of drugs by law enforcement officers. It provides rich information including the number of seizures, the quantity seized and the price for each purchase. Drugs are divided in 5 categories: marijuana, powdered cocaine, crack cocaine, methamphetamine, and heroin. For the purpose of this study we ignore marijuana, since MML may have a mechanical effect on the seizures of marijuana.

Table 2: Summary Statistics

Dataset	Variable	Mean	Std. Dev	Min	Max	Obs
A. UCR[a]	Overall Violent Crime	477.74	305.97	65.35	2921.80	1173
	Homicide	6.23	7.19	0.16	80.60	1173
	Robbery	135.73	135.11	6.40	1266.38	1173
	Aggravated Assault	300.17	179.92	34.09	1557.61	1173
	Forcible Rape	35.51	12.74	11.15	98.64	1173
	Overall Property Crime	3765.25	1153.51	1619.61	9512.09	1173
	Burglary	806.57	308.42	296.46	2170.61	1173
	Larceny Theft	2578.17	730.42	1188.87	5833.75	1173
	Motor Vehicle Theft	380.59	244.48	69.49	1839.89	1173
B. SHR[a]	Drug Law	0.29	1.14	0	24.41	1130
	Juvenile Gang	0.09	0.29	0	2.66	1130
	Gangland	0.04	0.08	0	0.75	1130
	Under the Influence of Alcohol	0.09	0.15	0	1.26	1130
	Under the Influence of Drugs	0.04	0.08	0	0.99	1130
C. STRIDE						
Quantity	Powder Cocaine	1201240	4488958	0	61600000	898
	Crack Cocaine	259573.4	1073935	0	18300000	898
	Methamphetamine	128577	492704.5	0	7804662	898
	Heroin	145400.9	586064.2	0	9332651	898
Bust Count	Powder Cocaine	130.40	180.94	0	1280	898
	Crack Cocaine	175.81	485.17	0	5418	898
	Methamphetamine	70.99	159.14	0	1578	898
	Heroin	91.90	172.01	0	1268	898
Price by distribution levels[b]	Powder Cocaine Street Level	615.23	650.94	25.28	2884.74	600
	Powder Cocaine Low Distribution	205.94	272.93	8.73	2125.78	683
	Powder Cocaine High Distribution	61.35	73.81	3.53	1683.39	789
	Powder Cocaine Wholesale	33.07	13.62	2.01	85.82	746
	Crack Cocaine Street Level	487.37	529.61	17.44	2828.28	603
	Crack Cocaine Low Distribution	129.89	133.92	6.93	1504.50	724
	Crack Cocaine Wholesale	38.61	16.48	2.16	110.07	717
	Methamphetamine Street Level	375.19	434.46	3.54	2952.32	535
	Methamphetamine Low Distribution	75.42	71.40	2.22	969.65	573
	Methamphetamine Wholesale	25.13	26.09	2.07	321.18	422
	Heroin Street Level	957.58	1235.31	8.05	9266.34	537
	Heroin Low Distribution	396.02	623.06	10.33	7305.00	576
	Heroin Wholesale	113.66	84.62	8.10	746.04	592
D. Treatment Variables	MML	0.14	0.34	0	1	1173
	MML at Mexico Border	0.02	0.15	0	1	1173
	MML Rest	0.11	0.32	0	1	1173
	Home Cultivation Mexico Border	0.02	0.15	0	1	1173
	Home Cultivation Rest	0.11	0.31	0	1	1173
	Dispensary Legalization Mexico Border	0.02	0.12	0	1	1173
	Dispensary Legalization Rest	0.02	0.14	0	1	1173
	Dispensary Operating Mexico Border	0.02	0.13	0	1	1173
	Dispensary Operating Rest	0.02	0.14	0	1	1173
E. Control variables	Male Ratio	0.49	0.01	0.47	0.53	1173
	Portion of African American	0.11	0.12	0.00	0.65	1173
	Portion of Hispanics	0.08	0.09	0.00	0.47	1173
	Portion of Age 15-24	0.14	0.01	0.12	0.20	1173
	Portion of Age 25-34	0.14	0.02	0.11	0.22	1173
	Unemployment Rate	5.66	1.90	2.30	13.80	1173
	Income per capita (log)	10.26	0.30	9.48	11.22	1173
	Decriminalization Laws	0.23	0.42	0	1	1173

The table presents the summary statistics of the variables used in the estimation of the results. The first super row present statistics from the Uniform Crime Reports dataset, the second super row presents statistics from the Supplementary Homicide Reports dataset, the third super row present statistics from the System to Retrieve Information from Drug Evidence dataset. The fourth super row presents our MML independent variables, while the last super row presents the control variables.

[a] All UCR and SHR crime statistics are measured as the number of crimes per 100,000 inhabitants.

[b] Powdered cocaine quantities smaller than 2 grams are classified as street level, quantities between 2 and 10 grams are low distribution level, quantities between 10 and 50 gram are high distribution level, and quantities larger than 50 are considered wholesale level. For crack cocaine quantities smaller than 1 gram are street level, quantities between 1 and 15 gram are distribution level and quantities greater than 15 are wholesale level. For methamphetamine quantities smaller than 0.1 gram are excluded, quantities between 0.1 and 10 gram are considered street level, quantities between 10 and 100 grams are distribution level and quantities greater than 100 grams are wholesale level. For heroin quantities quantities smaller than 0.1 gram are excluded, quantities between 0.1 and 1 gram are considered retail level, quantities between 1 and 10 grams are distribution level and quantities greater than 10 grams are wholesale level.

Our STRIDE data runs from 1990 up to 2007, since the data is only released several years after analysis. STRIDE data only provides information on samples of drugs which are send to the DEA lab for analysis. Unfortunately, not all drugs seized in the US are sent to the DEA lab. As such, STRIDE data does not contain information on all drug seizures in the US, and the sample may not be representative for drug seizures in the country. With regard to the amount of seizures and the quantity seized this issue will not bias our result unless the measurement error is correlated to the introduction of MML which we consider unlikely.

However, issues with the price data have been well established in the literature (Arkes et al., 2008). First, we adjust for inflation and report all prices in 1990 US dollars. Second, the data contains some outliers which are likely the result of a mistake at data entry. Therefore, for powdered and crack cocaine, and methamphetamine, prices per gram less than \$2 as well as more than \$3000 are excluded. For heroin, prices per gram less than \$7.5 and more than \$ 10000 are excluded. Third, for some years some states report zero seizures to the DEA. We consider it unlikely that a state has zero drug seizures during a year and therefore treat these zeros as missing observations. Our results are not qualitatively affected if we use zeros instead of missing values. Finally, the price of drugs differs significantly by the distribution level at which the drugs are purchased. Drugs purchased at the wholesale level tend to be cheaper than the same drug sampled at the retail (street) level for the simple reason that each distribution level takes a profit margin. Hence, a comparison of price data between states and over time is not possible unless we classify the price by the distribution level at which the drug is seized. We follow the recommendations given in Arkes et al. (2008). In particular, we distinguish between small seizures which are likely the result of seizures at the retail level, medium seizures which we classify as distribution level seizures, and large seizures which we classify as wholesale level seizures. The exact overview of our classification as well as summary statistics are given in table 2. Arkes et al. (2008) show that this classification scheme leads to consistent pattern in price comparison between metropolitan areas and over time.

4.4 MML and Control Variables

Our main independent variable is a dummy variable for introduction of MML. An overview of the relevant dates and characteristics of each law can be found in table 1 in section 3.1.

Control variables in our analysis come from the following three data sources: National Cancer Institute, the U.S. Census Bureau, Bureau of Labor Statistics and the Bureau of Economic Analysis. We include as control variables for our analysis the shares in the population of: males, African Americans, Hispanics, people aged between 15-24 and people aged between 25-34. Furthermore, we add unemployment rates, (log) income per capita and a dummy when a state decriminalizes marijuana (instead of endorsing an MML). Each of these statistics is known to correlate with the crime rate (see e.g. Tauchen, 2010). Moreover, we consider it plausible that these variables may be correlated with the introduction of MML. Therefore, the estimate of the treatment effect may be biased if we do not control for these variables in our analysis. Summary statistics are presented in table 2.

5 Methodology and Results

5.1 Empirical Strategy

We test our theory empirically with a fixed-effect regression of the following form:

$$\ln y_{st} = \beta^{MB} D_{st} B_s + \beta^{rest} D_{st}(1 - B_s) + \alpha_s + \gamma_t + \nu X_{st} + \sum_{s=1}^{S} \delta_s t + \varepsilon_{st},$$

where y_{st} is the outcome variable in state s and period t, D_{st} is the treatment dummy which takes value zero if a state has not (yet) enacted MML in period t and one in if the state has enacted an MML, B_s is a dummy which takes value one if a state is located at the Mexican border and zero otherwise, α_s are state-fixed effects, γ_t are time-fixed effects, X_{st} is a vector of control variables, the term $\sum_{s=1}^{S} \delta_s t$ are state-linear time trends and ε_{st} is the error term. The outcome variables are (logs of) different crime rates, drug seizures, and drug prices, such as the property crime rate, the homicide rate, the number of cocaine seizures or the price of heroin.

In the regression equation parameter β^{MB} captures the effect of an MML on the outcome variable in Mexican border states, while β^{rest} measures the effect of an MML in states that are not located on the Mexican border. Our theory can be tested statistically by establishing whether the treatment effect, β^{MB}, is significantly smaller than zero for the relevant outcome variables. We estimate our model through population-weighted OLS and cluster the standard errors at the state level.

In order to get an unbiased estimate of the treatment effect in border states, it is crucial to choose the correct specification. The simplest version of our regression equation without control variables and state-linear time trends is equivalent to a simple difference-in-differences specification with two treatment groups, i.) States at the Mexican border with MML, and ii.) Inland states with MML, and a control group; states without MML. However, the validity of the standard difference-in-differences methodology depends on whether the outcome variable in treated and untreated states evolves according to a common trend. The common-trend assumption may be violated for two reasons.

First, states that introduce an MML may differ from states that do not introduce an MML in time-variant observable characteristics. This is an issue if the observable characteristic is correlated to both the crime rate and the presence of MML, since in that case the estimate of the treatment effect may be biased. To control for time-variant observable characteristics we add a number of control variables that may be correlated to crime as well as the introduction of MML in X_{st}. The control variables are listed in section 4.4.

Second, states in the treatment group may differ from the control group in time-variant unobservable characteristics. These time-variant characteristics may for example correspond to time-variant culture or the political climate in a state. To control for this issue we add state-specific linear time trends in our main specification. These trends terms capture all unobserved heterogeneity that evolves linearly over time. Unfortunately, we cannot guarantee that all unobserved heterogeneity evolves linearly over time. Therefore, we assess the robustness of our main analysis with respect to time-variant heterogeneity through a placebo treatment which we describe in section 6.

5.2 UCR Results

Table 3 shows our main results. In column 1 we see that a general MML dummy has a non-significant impact on the violent crime rate. This finding corresponds with results in Morris et al. (2014) and Alford (2014). However, columns 2 and 3 show that the effect of MML on violent crime is significantly negative at states bordering Mexico. In the simple difference-in-difference model without control variables and linear time trends, the estimate suggest that the introduction of MML reduces violent crime by approximately 20 percent.[12]

When we include control variables and state-specific linear time trends the estimated coefficient decreases. This suggests that observed heterogeneity, as well as linearly evolving unobserved heterogeneity between states bias the coefficient downward. This could be the case if, for example, states that are more likely to introduce MML are also more likely to have a downward trend in crime rates. Hence, the model in column 2 may be misspecified. However, even after we control for these observables and unobservables, the coefficient is still significantly negative and our preferred specification, presented in column 3, suggests that the introduction of MML decrease the violent crime rate at the Mexican border states by approximately 5.8 percent. The coefficient for non-border states is never significant, indicating that we cannot reject the null hypothesis that MML did not affect the violent crime rate in those states.

Table 3: The Effect of Medical Marijuana Laws on Crime

	(1)	(2)	(3)	(4)	(5)	(6)
	Violent Crime			Property Crime		
MML Mexico Border		-0.223***	-0.059***		-0.182***	-0.134***
		(0.062)	(0.020)		(0.038)	(0.027)
MML Rest		0.067	0.010		-0.025	0.050**
		(0.050)	(0.033)		(0.034)	(0.023)
MML	-0.021			-0.033		
	(0.022)			(0.036)		
Constant	9.092*	6.513***	9.516*	9.280**	8.590***	10.413***
	(5.414)	(0.044)	(5.308)	(3.781)	(0.039)	(3.733)
State fixed effects	x	x	x	x	x	x
Year fixed effects	x	x	x	x	x	x
Control variables	x		x	x		x
State specific trends	x		x	x		x
Observations	1,173	1,173	1,173	1,173	1,173	1,173
R-squared	0.980	0.925	0.980	0.972	0.912	0.974

Notes: The dependent variable in columns 1-3 is the log of the violent crime rate per 100,000 inhabitants in state s at time t as measured in the UCR data. The dependent variable in columns 4-6 is the property crime rate. The MML variables are dummies which take value one from the moment MML are enacted. The included control variables are an indicator for decriminalization policy, the unemployment rate, logged income per capita, the share of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2012. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

The findings for the property crime rate are similar to our findings for the violent crime

[12] We use the approximation suggested in Kennedy (1981) to interpret the estimated coefficient, c as a semi-elasticity ϵ_c. The transformation suggested in the article is: $\epsilon_c = \exp(c - V(c)) - 1$, where c is the estimated coefficient and $V(c)$ its variance.

rate. Column 4 shows that MML do not have a significant effect on property crime, again confirming the findings in the literature. However, the effect in Mexican border-states is significantly negative. The estimate presented in column 6 suggests that the introduction of MML decreased property crime at the Mexican border states by approximately 12.6 percent. On the other hand, the coefficient presented in column 6 for non-border states is significantly positive indicating that MML increased crime at non-border states. This indicates that MML lead to an increase in property crime in non-border states of about 5.1 percent. However, both results on property crime have to be interpreted with caution. A placebo test in the next section shows that the estimated results on property crime are strongly driven by differences in crime trends between treatment and control states. In particular, in the placebo test the positive effect on inland states disappears completely, while the negative effect on crime in Mexican border states decreases significantly. As such, the estimated coefficients are likely an overestimate of the actual treatment effect.

Table 4: The Effect of MML Split per Crime

	(1) Homicide	(2) Robbery	(3) Aggravated Assault	(4) Forcible Rape	(5) Burglary	(6) Larceny Theft	(7) Motor Vehicle Theft
MML Mexico Border	-0.120**	-0.151***	-0.024	0.034	-0.126***	-0.085***	-0.351***
	(0.047)	(0.034)	(0.027)	(0.039)	(0.031)	(0.026)	(0.063)
MML Rest	-0.046	0.018	-0.006	0.055	0.068***	0.037**	0.114
	(0.035)	(0.045)	(0.036)	(0.035)	(0.025)	(0.017)	(0.075)
Constant	-1.268	3.397	10.839	5.094	12.544**	10.133***	1.494
	(7.843)	(6.409)	(6.893)	(5.249)	(5.033)	(3.561)	(6.390)
Observations	1,173	1,173	1,173	1,173	1,173	1,173	1,173
R-squared	0.951	0.982	0.974	0.961	0.978	0.974	0.971

Note: The dependent variable in each column is the log of the crime rate per 100,000 inhabitants of the crime listed in the column header in state s at time t. In the UCR data crimes in column 1-4 are listed as violent crimes, while crimes in column 5-7 are property crimes. The MML variables are dummies which take value one from the moment MML are enacted. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalization policy, the unemployment rate, logged income per capita, and the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2012. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 4 splits the results of our preferred model with state-linear-time trends and control variables by detailed crime category. The dependent variable in each column is the log of the crime rate reported in the column head. As can be seen, MML at the border has a significant negative effect on the violent crimes homicide and robbery. The effect on aggravated assault and forcible rape is non-significant. For violent crimes our central estimates suggests that homicides decrease by 11.5 percent and robberies decrease by 14.1 percent. Our estimates shows that MML decrease property crimes at the border, and increases property crime in non-border states, but again this result should be interpreted with caution.

The results on violent crime are in line with our theory as outlined in section 3. In particular, violent crimes such as robbery and homicide, which are linked to both Mexican DTOs and gangs associated with DTOs, decrease after introduction of MML in the Mexican border region where we know that DTOs have a strong influence on the crime rate. Forcible rape is unaffected, and this crime is indeed not commonly associated to systemic drug violence. More surprising is perhaps the non-significant effect of MML on aggravated assaults in Mexican border states, since assaults are often linked to drug violence. This could for example be explained by the fact that victims of drug violence are unlikely to report the crime to the police.

5.3 Supplementary Homicide Results

Table 5 shows result from the supplementary homicide data. The dependent variable in the reported regressions is the homicide rate in each category. Unlike in the previous regression, we do not take the log of the homicide rate, since some states have zero homicides in a particular category in a particular year.[13] As can be seen, the introduction of MML at the Mexican border significantly reduces homicides related to narcotic drug laws, and juvenile gangs. In addition, there is a significant, but smaller, negative effect on juvenile gang killings in non-border states.

Table 5: The Effect of Medical Marijuana Laws on Different Types of Homicide: SHR

	(1) Drug Laws	(2) Juvenile Gang	(3) Gangland	(4) Under the Influence of... Alcohol	(5) Drugs
MML at Mexico border	-0.172***	-0.564**	0.020	0.014	0.015
	(0.057)	(0.265)	(0.018)	(0.026)	(0.024)
MML Rest	0.022	-0.047**	0.013	0.022	-0.010
	(0.091)	(0.021)	(0.029)	(0.017)	(0.026)
Constant	14.909	13.354	1.408	0.443	-3.694
	(19.259)	(17.062)	(2.319)	(3.344)	(3.861)
Observations	1,130	1,130	1,130	1,130	1,130
R-squared	0.760	0.962	0.436	0.750	0.781

Note: The dependent variable in each column is the homicide rate per 100,000 inhabitants of the type of homicide listed above in state s at time t. The MML variables are dummies which take value one from the moment MML are enacted. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalisation policy, unemployment rate, logged income per capita, the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34. The panel covers the period 1990-2012. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Results shown are the same as when having the raw dependent variable. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

Determining the magnitude is slightly more difficult, since the model is estimated in levels rather than logs, and the homicide rate in California is much larger than in the other two MML states at the Mexican border. To be more precise, if the juvenile gang homicide rate in New Mexico and Arizona would decrease by -0.564 as our central estimate suggests, the homicide rate in this category would turn negative for those states. Hence, we interpret the magnitude of our coefficients by dividing them by the overall average homicide rate in each category in California prior to introduction of MML. Using this interpretation, our central estimate suggests that MML have decreased drug-law related homicides in California by 48 percent, and the juvenile gang homicide rate by 33 percent.

[13]Regressions using the log of the homicide rate, or 1 plus the log of the homicide rate lead to qualitatively similar results.

Both homicides related to narcotic drug laws, and juvenile gang killings are offenses which are often linked to Mexican DTOs, and gangs affiliated to the DTOs. Hence, these results further corroborate our theory that MML have negatively impacted crime related to DTOs in Mexican border states. The magnitude of the estimate is surprisingly large, although we should take into account that the standard error is large as well.

Morris et al. (2014) suggest that the decrease in the homicide rate seen in the UCR data may have been caused by the fact that users in MML states have substituted marijuana for alcohol, which in turn decreased the amount of homicides under the influence of alcohol. We find no evidence for this hypothesis in the supplementary homicide data. Instead the decrease in homicides is the result of a drop in drug- and gang-related violence.

5.4 STRIDE Results

Table 6 reports the results of MML on drug seizures using the STRIDE data. The dependent variable in the first 4 columns is the log of the quantity seized by the police of, respectively, powdered cocaine, crack cocaine, methamphetamine and heroine. Columns 5-8 report the log of the count of seizures. At the Mexican border MML decrease the amount seized for powdered and crack cocaine, as well as the number of seizures. Seizures outside the Mexican-border states are unaffected by MML, except for the amount of heroin seized which also decreases. The central estimate indicates that the amount of powdered cocaine seized in states at the Mexican border have decreased by 85 percent as a result of MML, while the number of seizures decreased by 35 percent. The amount of crack cocaine seized decreased by 83 percent, while the number of seizures decreased by 64 percent.

The pattern that emerges from the seizure data of STRIDE appears to be consistent with our theory that MML have decreased the supply of other drugs, in states at the Mexican border. The fact that we only find a significant effect for cocaine could be due to the fact that cocaine is the largest drug market after the market for marijuana, and prior to 2009 it was actually the largest drug market (see Kilmer et al., 2014). As such, cocaine seizures are more common than seizures for other drugs, and hence, our estimates are more precise for this drug than for other drugs.

Moreover, DTOs are known to have replaced marijuana plants with poppy plants (Miroff, 2014; UNODC, 2014, e.g.). Hence, we do not expect the supply of this drug to decrease very much as a result of MML. Finally, methamphetamine has clear alternative supply chains, since it can also be produced within the US. As such, one would also expect lower complementarity between the supply of this drug and marijuana.

We caution in interpreting these results. In particular, as discussed in the data section, STRIDE data is noisy, and likely not representative of drug markets in the US. Indeed, the magnitude of the point estimates is in our opinion implausibly large and we find that the standard errors are also large, which creates some doubt on the value of the central estimate.

Note that the observed drop in seizures does not appear to be consistent with a theory where law enforcement agencies shift resources from marijuana to other drugs. In that case we would expect an increase in other drug seizures, whereas we actually observe a decrease. Thus, these results may be interpreted as statistical evidence that MML at the Mexican border has decreased drug trafficking of cocaine.

Table 7 reports the estimated effect of MML on the price of drugs as measured by the STRIDE data, at various distribution levels. As can be seen, MML at the Mexican border significantly increase the price of powdered cocaine at all distribution levels. Effects are again large, but also very noisy. For the other drugs no pattern arises that is consistent among the

Table 6: The Effect of MML on Drugs Seized

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Quantity				Count - Seizures			
	Powder Cocain	Crack Cocaine	Methamphetamine	Heroin	Powder Cocaine	Crack Cocaine	Methampehtamine	Heroin
MML Mexico Border	-1.865***	-1.548***	-0.140	0.042	-0.418***	-0.988***	-0.085	-0.084
	(0.317)	(0.495)	(0.549)	(0.426)	(0.110)	(0.218)	(0.297)	(0.221)
MML Rest	-0.154	0.338	-0.389	-1.300**	-0.337	-0.076	-0.149	-0.105
	(0.626)	(0.853)	(0.562)	(0.561)	(0.280)	(0.123)	(0.172)	(0.279)
Constant	122.807*	-3.098	-172.584	66.002	5.606	9.621	-98.065**	27.380
	(69.392)	(74.499)	(110.438)	(123.047)	(27.313)	(38.463)	(43.794)	(42.129)
Observations	886	851	780	809	886	851	780	809
R-squared	0.881	0.759	0.790	0.802	0.948	0.909	0.905	0.907

Note: The dependent variable in the first 4 columns is the logged quantity seized by the police of the drug reported in the column header, while the dependent variable in the last 4 columns is the logged count of seizures of these drugs in state s at time t as measured in the STRIDE data. The MML variables are dummies which take value one from the moment MML are enacted. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalisation policy, unemployment rate, logged income per capita, the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34. The panel covers the period 1990-2007. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Results shown are the same as when having the raw dependent variable. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 7: The Effect of MML on Prices of Drugs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Powder Cocaine				Crack Cocaine			Methamphetamine			Heroin		
MML at Mexico border	0.634*	0.742***	0.156*	0.317***	0.117	-0.436***	0.157	-0.123	0.195	0.668	0.020	0.486***	-0.015
	(0.326)	(0.194)	(0.083)	(0.079)	(0.202)	(0.116)	(0.148)	(0.309)	(0.154)	(0.423)	(0.407)	(0.179)	(0.160)
MML non border	-0.478**	0.231	0.072	0.138	0.347	-0.195	0.025	0.137	-0.106	0.099	-0.375	0.297	0.040
	(0.228)	(0.552)	(0.181)	(0.238)	(0.466)	(0.463)	(0.347)	(0.433)	(0.171)	(0.267)	(0.436)	(0.675)	(0.119)
Constant	30.834	16.610	17.756	-12.602	-27.797	26.238	-38.808	54.400	-42.013	-41.761	55.317	-81.923	-39.573
	(97.178)	(54.024)	(17.293)	(23.950)	(66.895)	(33.404)	(26.386)	(55.602)	(36.936)	(62.650)	(83.238)	(60.280)	(31.820)
Observations	600	683	789	746	603	724	717	535	573	422	537	576	592
R-squared	0.603	0.541	0.358	0.334	0.581	0.489	0.438	0.509	0.430	0.426	0.343	0.288	0.594
Street Level	x				x			x			x		
Low Distribution		x				x			x			x	
High Distribution			x										
Wholesale				x			x			x			x

Note: The dependent variable is the logged price of the drugs purchased, each supercolumn is disaggregated into several distribution levels as outlined in table 2. The distribution level of each column is marked at the bottom. The MML variables are dummies which take value one from the moment MML are enacted. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalization policy, unemployment rate, logged income per capita, and the share of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2007. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

distribution levels. Prices in states that are not at the Mexican border are unaffected.

The result on powdered cocaine is in line with our hypothesis that MML have decreased the supply of all illicit drugs in Mexican border states. Such a decrease in supply should lead to a decrease in quantity traded as well as an increase in the price as we have shown in table 6 and table 7.

We do not obtain equally supportive evidence for our theory from the other drugs. This could be the result of the quality of the STRIDE data which may be too noisy to pick up these effects.

5.5 Dynamic Effects

Table 8 shows the dynamic effects of the introduction of MML on crime using UCR data. In addition to the standard specification table 8 include lags of the treatment dummy. This, to some extent, allows us to determine how long it takes for MML to reduce the crime rate in Mexican border states. It is important to note that we only include up to two years of lags, since the final treatment at the Mexican border takes place in Arizona in 2010, 2 years before the end of our data.

As can be seen from the results in column 2 and 3, MML at the Mexican border does not significantly reduce violent crime right after introduction. The negative effect of MML on crime only becomes significant two years after introduction. This lag in the treatment effect can be easily explained through our theory. If MML reduced the activity of the Mexican DTOs, it is unlikely that this happened right after the introduction of the law. It takes some time to set up American marijuana production facilities, such that in the first years after the introduction of MML, most of the marijuana supplied in Mexican-border MML states still came from Mexico. Moreover, even after US facilities for marijuana production were created it is unlikely that this led to an immediate retreat of the Mexican DTOs from the American marijuana market. Finally, in accordance with the literature we coded laws that have been legalized in the month of December of a given year as occurring in that year, even though it would be more plausible that their effect is rather referred to the next year. A lag in the treatment effect is therefore to be expected.

On the other hand, the reduction in property crime appears to happen right after the introduction of MML in Mexican border states as can be seen in columns 4-6. The lagged treatment effect is only significant at the ten percent level. This sharp immediate effect of MML is perhaps more difficult to explain than the lagged effect in violent crime, since it is unlikely that the drug market changed significantly in at least the first few months after the introduction of MML. However, as was already emphasized before, our placebo test shown in the next section places some doubts on the results for property crime, since we cannot determine whether the estimated treatment coefficient is biased by a violation of the common-trend assumption.

6 Robustness Analysis

In our robustness analysis we focus on two issues. First, we test whether our results are correctly measuring the treatment effect of MML, or whether they are biased by differences in trends in the outcome variable between treatment and control states. Second, we test whether the heterogeneity in the treatment effect between Mexican-border states and inland states may be driven by differences in the characteristics of the MML, rather than proximity to Mexican DTOs.

Table 8: Dynamic Effects of MML

	(1)	(2)	(3)	(4)	(5)	(6)
	Violent Crime			Property Crime		
MML Mexico Border	-0.059***	-0.021	-0.028	-0.134***	-0.095***	-0.101***
	(0.020)	(0.024)	(0.021)	(0.027)	(0.022)	(0.020)
1 year after MML Mexico Border		-0.057**	-0.017		-0.062*	-0.025
		(0.028)	(0.018)		(0.035)	(0.020)
2 years after MML Mexico Border			-0.054**			-0.054*
			(0.024)			(0.027)
MML Rest	0.010	0.016	0.011	0.050**	0.036*	0.031*
	(0.033)	(0.025)	(0.025)	(0.023)	(0.018)	(0.017)
1 year after MML Rest		-0.016	-0.008		0.021	0.022
		(0.032)	(0.023)		(0.017)	(0.017)
2 years after MML Rest			-0.013			0.007
			(0.030)			(0.021)
Constant	9.516*	9.419	8.910	10.413***	11.798***	12.524***
	(5.308)	(5.650)	(6.034)	(3.733)	(4.007)	(4.124)
Observations	1,173	1,122	1,071	1,173	1,122	1,071
R-squared	0.980	0.980	0.980	0.974	0.975	0.977

Note: The dependent variable in columns 1-3 is the log of the violent crime rate per 100,000 inhabitants of the crime listed above in state s at time t. The dependent variable in columns 4-6 is the log of the property crime rate, similarly defined. The MML variables are dummies which take value one from the moment MML are enacted. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalization policy, the unemployment rate, logged income per capita, and the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2012. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

Apart from these issues, we have performed several robustness checks for our main results in table 3, which are reported in the appendix. First, we ran the main regressions with unweighted, instead of population-weighted OLS. This could potentially influence the results at the Mexican border, since the population in California is more than twice as large as the combined population of the other two MML states at the Mexican border.

Second, we ran the regressions allowing for a differential treatment effect for each state that introduced MML at the Mexican Border. This allows us to determine whether the effect of MML at the Mexican border is driven by a California-specific effect.

Third, in accordance with the literature, our MML dummy variable takes value 1 for a given year if MML was introduced in that year. This likely attenuates our estimated treatment effect, since when MML are introduced in, for example, December 2010, it is unlikely that it has a significant effect on anything during 2010. Therefore in a robustness check we round the date of the MML instead, such that MML introduced in January-June lead to a change in the MML dummy variable in the same year, while changes in the period July-December lead to a change in the variable in the next year.

Fourth, we looked into the effect of Mexican law enforcement on crime in the US. In particular, the election victory of officials from the Mexican conservative party PAN (National Action Party) resulted in an increase in law enforcements efforts on prosecuting DTOs (see e.g. Dell, 2014). If DTO violence in the US has decreased due to the election victory of PAN, this could bias our estimated treatment effect in Mexican border states downwards. Therefore, we ran our regressions with a dummy variable for the PAN electoral victory in 2006 interacted with the Mexican-border dummy.

Fifth, we ran regressions with a separate treatment effect for the Canadian-border region and a dummy for an announcement at the interior states. Finally, we controlled for spillovers from neighbor states. In all these exercises, except the differential treatment effect of Arizona, MML at the Mexican border had a significant negative effect on violent crime and our results remained virtually unchanged. In the regression with differential treatment effects per state the indicator for Arizona was of negative sign, but not significant, perhaps because Arizona introduced MML 2 years before the end of the sample period such that there are too few observations for this state.

6.1 Placebo Test

To perform a difference-in-differences analysis one must assume that the outcome variable follows the same trend in treatment and control states, absent of treatment. We test whether this common-trend assumption is satisfied by creating a placebo test where we include the lead of the MML dummy in our regression. The test works under the following premise. The announcement effect of MML at the Mexican border are likely negligible. All MML in Mexican border states were enacted immediately after a public vote, which for each of the three Mexican border states with MML was a close call. Moreover, even if criminals anticipated the enactment of MML, it is not clear what kind of different behavior they would exhibit during the announcement period. Therefore, the lead of MML cannot causally decrease the crime rate. Hence, the lead of the MML variable, in a specification which only contains this lead, should be attenuated with respect to the coefficient in our base regression. Additionally, we expect that the coefficient on the lead is non-significant and close to zero if we include both the lead and the actual treatment variable.

However, if our results are driven by the fact that the outcome variable follows a different trend in treatment than in control states, the coefficient on the lead of MML are likely of similar magnitude to the coefficient on the actual treatment variable. Additionally, in a specification that contains both the lead and the actual treatment variable, the treatment coefficient should be much closer to zero in comparison to the base regression, and the lead coefficient should be of approximately equal magnitude to the coefficient on the actual treatment variable. We perform this placebo test with two leads of the MML treatment dummy. Table 10 reports the results.

Column 1 presents the baseline estimate for the effect of MML on violent crime. As can be seen, in column 2 and 3 the one- and two-year leads of MML at the Mexican border do not have a significant effect on violent crime when considered in isolation. As expected, the coefficient in column 2 is closer to zero than the one in column 1, while the coefficient in column 3 is almost zero. Column 4 shows a specification that contains both leads of MML and the MML variable itself. In this specification, the value of the MML coefficient is virtually unaffected with respect to the base estimate, while the coefficients on the leads of MML at the Mexican border are close to zero. This provides strong evidence that our result on violent crime is driven by a treatment effect, rather than by differences in crime trends between the treatment and the control states.

The results for property crime are less clear cut. In a specification with only the one-year lead of MML at the Mexican border the coefficient for the lead is significant at the 1 percent level, as can be seen in column 6. In addition, in the specification with both leads and the actual treatment the coefficient on the one year lead is significant, while the actual treatment effect is smaller than in our base estimates, as can be seen in column 8. This indicates that any result we derive for the property crime rate must be interpreted with care, since we cannot exclude the possibility that (part of) our estimate for the treatment coefficient for property crime is driven by a violation of the common trend assumption.

6.2 Characteristics

We also assess the robustness of our result with respect to the characteristics of different MML. In particular, Alford (2014) shows that MML which allow for dispensaries increase the violent and property crime rate, while MML which only allow for home cultivation have a non-significant impact on crime. If the differences in MML correlate with proximity to the Mexican border, our estimated treatment effect may be biased by the difference in MML between inland states and Mexican border states.

To test whether this is the case we create three new dummy variables. The first takes value 1 when MML are introduced. The second takes value 1 the moment a state allows for home cultivation. The final treatment dummy takes value 1 either when a state legalizes dispensaries or when dispensaries start operating. The treatment effect is again split between states at the Mexican border, and other states, with the exception of the MML dummy, since all MML states at the Mexican border immediately allowed for home cultivation. The overall treatment effect of a state at the Mexican border which allows for both home cultivation and dispensaries is therefore the sum of the coefficient for home cultivation and dispensaries at the Mexican border. The overall treatment effect at a state in the interior of the US which allows for home cultivation and dispensaries is the sum of the coefficients for the respective dummies for characteristics and the dummy for MML at the interior.

Table 9 presents our results. Column 1 and 3 show the results for each major crime category when we use the date at which dispensaries were legally allowed at the state level. This variable was used previously in Pacula et al. (forthcoming) and Alford (2014). With this dummy we replicate the results by Alford (2014) in the sense that allowing for dispensaries is

Table 9: The Effect of MML on Crime by MML Characteristics

	(1)	(2)	(3)	(4)
	Violent Crime		Property Crime	
Dispensary Legalization Mexico Border	-0.024		0.070***	
	(0.021)		(0.016)	
Dispensary Legalization Rest	0.070*		0.022	
	(0.037)		(0.042)	
Dispensary Operating Mexico Border		-0.084***		-0.080**
		(0.021)		(0.032)
Dispensary Operating Rest		0.031		-0.020
		(0.028)		(0.016)
Home Cultivation Mexico Border	-0.061***	-0.016	-0.133***	-0.092***
	(0.023)	(0.020)	(0.022)	(0.019)
Home Cultivation Rest	-0.025	-0.095**	-0.009	-0.038
	(0.043)	(0.047)	(0.049)	(0.038)
MML Rest	0.014	0.077	0.049	0.077**
	(0.049)	(0.047)	(0.053)	(0.038)
Constant	8.932	9.916*	11.380***	11.282***
	(5.347)	(5.222)	(3.644)	(3.946)
Observations	1,173	1,173	1,173	1,173
R-squared	0.980	0.980	0.975	0.974

Note: The dependent variable in the first two columns is the log of the violent crime rate per 100,000 inhabitants of the crime listed above in state s at time t. The dependent variable in the last two columns is the log of the property crime rate, similarly defined. The variables are defined as follows: Dispensary Legalization is a dummy that takes a value one when dispensaries are legalized in state s at time t, separately for states at the Mexican Border and all the other states. Dispensary Operating is a dummy that takes a value one when licensed dispensaries are operating regardless of the legal framework in state s at time t, similarly separated for states at the Mexican border and all the rest. Home Cultivation is a dummy that takes a value one when home cultivation has been legalized in state s at time t, for Mexico border states and the rest. MML Rest variable is a dummy which takes value one from the moment MML are enacted in states not at the Mexican border. An MML variable for Mexican border states is not included because it is collinear to Home Cultivation at Mexico Border. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalization policy, the unemployment rate, logged income per capita, and the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2012. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 10: Placebo Test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Violent Crime				Property Crime			
MML at Mexico border	-0.059***			-0.055**	-0.134***			-0.112***
	(0.020)			(0.023)	(0.027)			(0.039)
1 year before MML Mexico border		-0.041		-0.005		-0.115***		-0.041***
		(0.029)		(0.023)		(0.029)		(0.013)
2 years before MML Mexico border			-0.023	0.002			-0.075	-0.004
			(0.042)	(0.032)			(0.051)	(0.048)
MML Rest	0.010			0.001	0.050**			0.027
	(0.033)			(0.029)	(0.023)			(0.017)
1 year before MML Rest		0.010		-0.006		0.051**		0.004
		(0.024)		(0.017)		(0.020)		(0.014)
2 years before MML Rest			0.008	0.012			0.051***	0.039**
			(0.020)	(0.026)			(0.019)	(0.017)
Constant	9.516*	11.279**	12.188**	12.998**	10.413***	12.114***	11.219***	12.827***
	(5.308)	(5.334)	(5.397)	(5.341)	(3.733)	(3.446)	(3.235)	(3.618)
Observations	1,173	1,122	1,071	1,071	1,173	1,122	1,071	1,071
R-squared	0.980	0.981	0.983	0.983	0.974	0.974	0.974	0.975

Note: The dependent variable in columns 1-4 is the log of the violent crime rate per 100,000 inhabitants of the crime listed above in state s at time t. The dependent variable in columns 5-8 is the log of the property crime rate, similarly defined. The MML variables are dummies which take value one from the moment MML are enacted. The variables "1 year before MML" are dummies which take a value one a year before the introduction of MML. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalization policy, the unemployment rate, logged income per capita, and the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2012. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

positively correlated to violent crime in non-border states, and to property crime in Mexican border states. Nonetheless, our main result, which shows that MML decrease overall violent crime in the Mexican border states, remains unaffected. To see this note that the overall treatment effect of MML, the sum of the coefficient of home cultivation and for dispensaries, is negative at the Mexican border.

When we include the first opening of a licensed dispensary, instead of the state-wide allowance of dispensaries, this result disappears. Dispensaries at the Mexican border have a negative effect on both violent and property crime, and dispensaries in inland states do not affect the crime rate at all. Additionally, the effect of home cultivation at the Mexican border on crime becomes smaller, and in the case of violent crime even insignificant.

This latter result could be seen as giving some indirect evidence for our theory. In particular, the opening of dispensaries will likely give a far stronger boost to US production of marijuana than the allowance of home cultivation. As such, Mexican DTOs and their affiliated gangs are likely negatively affected by the opening of licensed dispensaries. Hence, we see a reduction in crime, in particular, once Mexican border states allow for dispensaries. However, we should note that identification on the effect of dispensaries is rather weak. In particular, for the three states at the Mexican border, California's first licensed dispensary opened one year after the adoption of MML. For New Mexico and Arizona this occurred two years after MML were adopted. If we take into account that MML may have a delayed impact on crime, we cannot be certain whether the estimated coefficient for dispensaries is related to the dispensaries, or to a delayed effect of the adoption of the MML itself.

7 Conclusion

In this paper we provide indirect evidence for the theory that Medical Marijuana Laws (MML) decrease crimes committed by Mexican Drug Trafficking Organizations (DTOs) in the US. We exploit a quasi-experimental variation of MML, which were gradually introduced in several states at different points in time. We explore the effect of MML on crime at the Mexican Border states through the lenses of three different datasets. First, we use the Uniform Crime Reports to find the overall effect of MML introduction on crime. We find that MML have significantly reduced violent crimes in Mexican border states, most prominent among them, robberies and homicides. Second, we explore the circumstances under which homicides were committed through the Supplementary Homicides Reports data. We find that the drop in homicides is driven by a drop in drug law and juvenile gang related homicides, lending support to the hypothesis that the drop in crime is related to activity in drug markets. Third, we look at the effect on MML on drug seizures and prices as recorded by the STRIDE dataset. We observe a drop in the number of seizures as well as the quantity seized for both crack cocaine and powdered cocaine after MML are introduced in Mexican border states. Moreover, we observe an increase in the price of powdered cocaine. This provides evidence for a negative supply shock in illicit drug markets after introduction of MML in Mexican border states. All these results are consistent with the theory that MML are negatively affecting the large Mexican DTOs.

The magnitude of each of the identified effects is surprisingly large. In particular, the gap in violent crime rates between inland states and border states prior to MML is 20 percent. Our estimates suggests the introduction of an MML closes this gap by 30 percent, even though MML only open the door for small-scale production of marijuana. This is consistent with the idea that marijuana is the "bread and butter" of Mexican DTOs. Although there is some evidence that DTOs are switching activity to crimes unrelated to drugs such as human trafficking, none of these activities exhibit the same scale and profit commonly associated with the trafficking of marijuana. Extrapolating from our results, we consider it likely that the full legalization of marijuana in Colorado and Washington will have an even stronger impact on the DTOs as large-scale marijuana production facilities are erected in these states.

The case of MML provides an important lesson for policy makers. Drug markets are well-known for their violence. However, in the case of marijuana when the supply chain of the drug is legalized, or at least decriminalized, a lot of the violence disappears and the business of organized crime structures is hurt. In this light, the war on drugs seems counterproductive in the sense that it has little effect on the availability of marijuana, but large negative effects on violent crime related to the drug.

An important caveat of this study and other studies on crime is the focus on the property and violent crime categories reported in UCR, and to drug crimes reported in STRIDE. To our knowledge, a similar database on crimes such as extortion, human trafficking and fraud is not available. Therefore, our study cannot assert whether these crimes, which are sometimes associated to activity of Mexican DTOs, are affected by MML. Collecting these crimes in a nationwide database would provide researchers in (the economics of) crime with an opportunity to study them in more detail.

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A Robustness Checks

Table A.1: Alternative Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Violent Crime					Property Crime		
MML Mexico Border	-0.059***	-0.076***	-0.224*	-0.210**		-0.134***	-0.101**	-0.182***	-0.154***	
	(0.020)	(0.020)	(0.119)	(0.094)		(0.027)	(0.049)	(0.060)	(0.056)	
MML Rest	0.010	-0.036	0.071	0.057	0.010	0.050**	0.041*	-0.025	-0.036	0.049**
	(0.033)	(0.041)	(0.053)	(0.069)	(0.033)	(0.023)	(0.021)	(0.033)	(0.024)	(0.023)
MML Arizona					-0.027					-0.094***
					(0.027)					(0.022)
MML California					-0.066**					-0.159***
					(0.030)					(0.031)
MML New Mexico					-0.079***					0.002
					(0.029)					(0.020)
Constant	9.516*	8.660	6.495***	6.143***	9.590*	10.413***	9.734***	8.520***	8.432***	11.208***
	(5.308)	(6.040)	(0.086)	(0.086)	(5.379)	(3.733)	(3.056)	(0.043)	(0.033)	(3.612)
Observations	1,173	1,173	1,173	1,173	1,173	1,173	1,173	1,173	1,173	1,173
R-squared	0.980	0.981	0.924	0.924	0.980	0.974	0.968	0.912	0.916	0.974
Control variables	x	x	-	-	x	x	x	-	-	x
State specific trends	x	x	-	-	x	x	x	-	-	x
Weighting	x	-	x	-	x	x	-	x	-	x
Standard Errors	Clustered	Clustered	Bootstrap	Bootstrap	Clustered	Clustered	Clustered	Bootstrap	Bootstrap	Clustered

Notes: The dependent variable in columns 1-5 is the log of the violent crime rate per 100,000 inhabitants of the crime listed above in state s at time t. The dependent variable in columns 6-10 is the log of the property crime rate, similarly defined. The regressions underlying the presented results were all estimated with state fixed effects and year fixed effects. Control variables and state-specific linear time trends were used where denotes. The included control variables are an indicator for decriminalization policy, the unemployment rate, logged income per capita, and the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2012. Standard errors in parenthesis. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

Variables: The MML variables are dummies which take value one from the moment MML are enacted. The first and sixth columns present the preferred specification, where standard errors are clustered at the state level and regressions are populations weighted. The second and seventh columns present unweighted estimates, while the third, fourth, eighth and ninth column present estimates with bootstrapped standard errors. The fifth and tenth columns disentangle the effect of the MML on each state at the Mexican Border.

Table A.2: Other Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Violent Crime				Property Crime			
MML Mexico Border		-0.067***	-0.059***	-0.077***		-0.136***	-0.134***	-0.135***
		(0.020)	(0.020)	(0.028)		(0.029)	(0.027)	(0.034)
MML Rest		0.013		0.020		0.050**		0.061***
		(0.034)		(0.032)		(0.023)		(0.021)
PAN		-0.047				-0.011		
		(0.030)				(0.035)		
MML Mexico Border (round up)	-0.075***				-0.128***			
	(0.022)				(0.030)			
MML Rest (round up)	-0.008				0.041*			
	(0.037)				(0.023)			
MML Canada Border			-0.030				0.015	
			(0.032)				(0.024)	
MML Rest less Canada Border			0.046				0.081***	
			(0.043)				(0.024)	
Neighbour of MML Mexico Border				-0.037				-0.024
				(0.024)				(0.023)
Neighbour of MML Rest				0.023				0.027
				(0.028)				(0.020)
Constant	10.023*	8.422	9.749*	9.686*	10.391***	10.166**	10.616***	10.310***
	(5.275)	(5.390)	(5.346)	(5.151)	(3.880)	(4.064)	(3.707)	(3.494)
Observations	1,173	1,173	1,173	1,173	1,173	1,173	1,173	1,173
R-squared	0.980	0.980	0.980	0.980	0.974	0.974	0.974	0.974

Notes: The dependent variable in columns 1-4 is the log of the violent crime rate per 100,000 inhabitants of the crime listed above in state s at time t. The dependent variable in columns 5-8 is the log of the property crime rate, similarly defined. The regressions underlying the presented results were all estimated with state fixed effects, year fixed effects, control variables and state-specific linear time trends. The included control variables are an indicator for decriminalization policy, the unemployment rate, logged income per capita, and the shares of males, African-Americans, Hispanics, age 15-24, and age 25-34 in the population. The panel covers the period 1990-2012. Standard errors in parenthesis are clustered at the state level. Regressions are populations weighted. Asterisks denote: $***p < 0.01, **p < 0.05, *p < 0.1$.

Variables: The MML variables are dummies which take value one from the moment MML are enacted. The variable PAN takes value 1 for states at the Mexican border after 2006. MML variables with (round up) take a value 1 in the next year of MML if the MML was passed after 30th of June of the same year. MML Canada Border denotes states that pass an MML law and that are situated at the Canadian border, MML Rest less Canada Border denotes all the internal states that are not at any border. The variables Neighbour take a value 1 if the neighbour of state s passed MML, it takes a value of 2 when a second neighbour of state s passes a MML and so on. Neighbour takes a value 0 if state s itself passes a MML.