# The Effect of Marijuana Decriminalization on Alcohol, Marijuana and Cocaine Consumption

by

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### Abstract

This work uses the 2009 National Household Survey on Drug Abuse to assess the impact of marijuana decriminalization policy on alcohol, marijuana and cocaine use prevalence in US. The results suggest that decriminalization is associated with an increase of both last month and last year marijuana prevalence rates. Moreover, marijuana decriminalization also increases the frequency of use among marijuana users. Marijuana decriminalization is also found to increase the probability of consuming alcohol last month which indicating that marijuana and alcohol are more likely to be complements than substitutes. The effect of marijuana decriminalization on cocaine consumption is found to be positive and significant but very small in magnitude.

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# 1. Introduction

Marijuana<sup>1</sup> is the most commonly used illicit drug in the world according to the United Nations Drug Report 2010. In the US, according to the 2009 National Survey on Drug Use and Health (NSDUH), about 104 million of people aged 12 or older have at least once tried marijuana, which represents 41.5% of the whole country population in that age group. About 28.5 million or 11.3% of the population used marijuana at least once in the past year and 16.7 million or 6.6% of the population used marijuana at least once in the past month.

Governments all over the globe are spending a significant part of their budgets trying to regulate its use. Generally marijuana policy should be directed to achieve two main goals. First, it should minimize social costs associated with marijuana consumption. Second, it should minimize the enforcement costs associated with control of marijuana consumption. These two goals could contradict one another. If the government weakens the enforcement it will save some budget money but it also could lead to increase of marijuana use among population. Conversely, strict enforcement would probably lower marijuana smoking rates but make social costs higher.

Decriminalization means elimination or substantial reduction of penalties for possession of a "small amount" of marijuana for personal use. Depending on the jurisdiction, criminal charges for possession might be abolished or replaced with civil fine, drug education or drug treatment. There are two important points to make. First, decriminalization reduces penalties only for possession; the manufacture; distribution or sale remains illegal and still is criminally prosecuted. Second,

<sup>&</sup>lt;sup>1</sup> Marijuana is a mixture of dried, shredded leaves, stems, seeds, and flowers of the hemp plant *Cannabis sativa*. It has psychoactive and physiological effects when consumed. Short-term effects include a subjective change in perception and mood, increased heart rate, lowered blood pressure, impairment of short-term and working memory, psychomotor coordination, and concentration.

United Nations Office on Drugs and Crime (2006). Cannabis: Why We Should Care.

Further in the thesis I will use the words "marijuana" and "cannabis" as synonyms.

decriminalization does not mean legalization. Possessing even small amount of marijuana for personal use is still illegal although the punishment is not severe.

Up to date, marijuana has been decriminalized at least to some degree in the Netherlands, Germany, Italy, Spain, Portugal, Argentina, Mexico, the Czech Republic and in some states of Australia. In the US the process has started in 1970s and by today 13 states have decriminalized the possession of small amount of marijuana for personal use. In 1973, Oregon became the first state to decriminalize cannabis possession. By 1978 Alaska, California, Colorado, Maine, Minnesota, Mississippi, New York, Nebraska, North Carolina, and Ohio had some form of marijuana decriminalization. Nevada made possession of any amount of cannabis for non-medical use by persons age 21 or older punishable by a \$600 fine or drug treatment in 2002. The most recent state that decriminalized possession is Massachusetts. Any person caught with less than an ounce of marijuana or smoking in public will be punished by a civil fine of \$100 since January 2009.

The degree of decriminalization is different in each state (*Appendix A*). In some states decriminalization policy works only for the first time offenders in others only if the amount of cannabis that person possess is less than certain "small amount". The definition of "small amount" varies from 15 to 100 gram across states. So, if someone get caught having in possession 50 gram of marijuana in Ohio that person will serve no jail time at all, but if the same situation happens in Minnesota he or she could go to jail for 5 years. The fines set for possessing cannabis are also quite different in every state. There is no fine for smoking marijuana inside one's residence or home in Alaska, for the rest of states the fines lay in the interval from \$100 to \$1000.

In January 2011, the bill that would decriminalize marijuana possession of two ounces or less to a petty offense with a penalty of no more than a \$100 fine was introduced in Arizona (now marijuana

possession classified as felony and possible jail sentence is from 6 month to 1.5 years), so the decriminalization process is still going on in US and it is a subject of huge debates.



Figure 1. Drugs shown for their physical harm to user and addictive potential

Source: Nutt et al. (2007). Development of a rational scale to assess the harm of drugs of potential misuse

The **advocates** of decriminalization argue that marijuana is harmless relatively to other drugs such as for example cocaine, heroin or amphetamines, and government should redirect resources for fighting with them instead. The study by Nutt *et al.* (2007) provides some support to that point. They tried to assess the harms of a range of illicit and legal drugs. Marijuana was ranked as one of the least harmful drugs considering its physical harm and addictive potential.

Another argument in favor of decriminalization often provided by its supporters is that marijuana is a substitute to alcohol and health hazards associated with marijuana are substantially less than those associated with the consumption of alcoholic beverages. Nutt *et al.* (2007) ranked alcohol as more dangerous than marijuana therefore providing support for the second part of the argument. As for the

first part, the conclusions of empirical studies about substitutability of marijuana and alcohol are mixed. For example, the results of DiNardo and Lemieux (1992) support the substitution theory, but Saffer and Chaloupka (1998); and Cameron and Williams (2001) found the evidence that alcohol and marijuana are complements.

The **opponents** of marijuana decriminalization usually point out its two main potential hazards. First, decriminalization can change marijuana perception in the society. Under decriminalization policy smoking cannabis might be viewed as less dangerous to health and generally more appropriate behavior. So, the users of marijuana can start consume even more and those who have not tried it yet might get more incentive to start. There is no single opinion about the impact of marijuana decriminalization on its consumption. Some studies report the positive effect (Saffer and Chaloupka (1998), Williams *et al.* (2004)); other report no effect at all (Single (1989), Thies and Register (1993)).

The second possible hazard is so-called gateway effect. The hypothesis of gateway effect is that the use cannabis may lead to a future risk of using more dangerous hard drugs such as, for example, cocaine and heroin (Lynskey *et al.* (2003)).

The main goal of the present work is to estimate the effect of marijuana decriminalization on marijuana, alcohol and cocaine consumption. The results of previous studies about impact of the decriminalization on marijuana use are quite mixed. Very few works have directly estimated the effect of marijuana decriminalization on alcohol and cocaine consumption before.

The work organized as follows. Section 2 provides review of related literature. Section 3 presents main hypotheses of this study. Section 4 provides description of the data used in the work. Section 5 presents the results. Finally, Section 6 concludes.

### 2. Literature Overview

If one starts thinking about marijuana decriminalization – the Netherlands is the first country that would probably comes to one's mind. Since 1976 the possession of a small quantity of "soft" drugs (including marijuana) for personal use in the Netherlands is a minor offence punishable by fine. But generally, the possession and smoking marijuana is tolerated by law enforcement (unless the person in question causing a public disturbance), particularly within the regulated system of coffee shops.

In their paper, MacCoun and Reuter (1997) compared trends in marijuana prevalence in the Netherlands with those in US and in some European countries where marijuana has not been decriminalized, such as, for example, Denmark and Norway. They concluded that increase in cannabis use rates was due not to decriminalization itself but rather due to commercial access through the coffee shops.

Korf (2002) also conducted comparative analysis of trends in lifetime marijuana prevalence between Netherlands, US and variety of European countries with different marijuana policies. He found that trends in marijuana use went together with changes in cannabis policy, for example, rapid growth in the number of coffee shops was reflected by significant increase in prevalence rates. But Korf argues that "simultaneity of ups and downs in cannabis use with stages in decriminalization process in the Netherlands might be accidental" since cannabis consumption in other countries also exhibits wave-like patterns. He concludes that decriminalization causing increase in marijuana use being very unlikely. The results of two papers above seem doubtful since none of them provides sophisticated econometric analysis.

Empirical results from Australian experience confirm the hypothesis about marijuana decriminalization leading to increase of its consumption. Australia consists of eight jurisdictions, and

four of them have decriminalized a possession of a 'small amount' of marijuana – criminal charges were replaced with civil penalties such as fine or attending drug-education session. 'Small amount' varies from 25 to 100 grams depending on jurisdiction.

Cameron and Williams (2001) using pooled cross-section dataset from the Australian National **Drug Strategy Household Surveys** (NDSHS) for the 1988, 1991, 1993 and 1995, found evidence suggesting that decriminalization corresponds with higher marijuana use rates.

Damrongplasit, Hsiao and Zhao (2010) used NDSHS for 2001 to assess the impact of marijuana decriminalization policy on marijuana smoking prevalence using both parametric and non-parametric approaches. They concluded that decriminalization had a significant positive effect on marijuana smoking behavior and the result is robust to the model specification.

In the US, the results of empirical studies estimating the effect of marijuana decriminalization on its use show mixed results. One of the first works on the topic was by Johnston, O'Malley and Bachman (1981). They compared the mean difference of marijuana smoking prevalence in states which decriminalized cannabis and states which did not. Johnston at al. used **Monitoring the Future Survey** (MTF) data for 1975-1980 and according to their findings the increase of the marijuana use in states adopted decriminalization policy is insignificant. The work by Single (1989) does not employ any regression analysis and supports the findings of Johnston at al.

Subsequent studies mostly use individual-level data sets while conducting research. DiNardo and Lemieux (1992) used sample of high school seniors from 43 US states over the years 1980-1989. Thies and Register (1993) used **National Longitudinal Survey of Youth** (NLSY). Both studies concluded that decriminalization has no significant effect on marijuana consumption.

Saffer and Chaloupka (1998) studied demographic differentials in alcohol and illicit drug participation using pooled dataset from **National Household Surveys on Drug Abuse** (NHSDA) for 1988, 1990 and 1991. They included decriminalization variable into their marijuana prevalence regression and found a significant positive effect. Similar study by Williams at al. (2004) used the pooled sample of 1993, 1997 and 1999 Harvard School of Public Health's **College Alcohol Study** (CAS) and also concluded that living in a state which decriminalized marijuana is associated with higher prevalence of marijuana use.

In their work Pacula, Chriqui and King (2003) analyzed laws of decriminalized and nondecriminalized states highlighting key dimensions of these laws (such as, for example, statutorily imposed jail-time or maximum fine associated with possession of a small amount of marijuana); and including those dimensions in the analysis. Conducting the analysis they used a sample of high school students from the **National Educational Longitudinal Survey** (NELS). The result of this study is that decriminalization has a significant positive effect on marijuana use even after accounting for the legal dimensions of the states' policy.

Almost all researchers concentrated their attention on the drug prevalence – the decision of the individual to take or not to take a drug. A different approach was taken by Model (1992) who studied the effect of marijuana decriminalization on hospital emergency drug episodes. She used data from **Drug Abuse Warning Network** (DAWN) collected in 24 major metropolitan statistical areas from 1975 to 1978 and found out that after marijuana decriminalization the number of ER marijuana episodes significantly increased.

The results of empirical works studying the effect of marijuana decriminalization are quite mixed. Earlier papers (1981-1997) tend to find no impact of marijuana decriminalization on its consumption, whereas later papers (1998-2010) tend to give positive and significant impact of decriminalization policy (*Table 1*).

The majority of all studies only include youth and young adults as their samples, although young people not necessarily represent whole population. These studies the results are mixed. Only in the research of Model (1992), Saffer and Chaloupka (1998); Cameron and Williams (2001) and Damrongplasit, Hsiao, Zhao (2010) the general population is represented; and all papers show positive and significant impact of marijuana decriminalization on its use.

There are only three empirical works assessing the impact of marijuana decriminalization on alcohol consumption and each of them gives a different result. DiNardo and Lemieux (1992) found that marijuana decriminalization has a sufficient negative effect on alcohol consumption. Cameron and Williams (2001), on the contrary, concluded that the effect is positive. And finally, Thies and Register (1993) found no significant effect of marijuana decriminalization on alcohol use.

Only Thies and Register (1993) directly studied the effect of marijuana decriminalization on the cocaine consumption. They concluded that decriminalization has no significant effect on the cocaine use. The work of Model (1992) provided evidence that number of ER episodes involving cocaine decreased after marijuana decriminalization. This result suggests that marijuana decriminalization has negative effect on cocaine consumption.

To conclude, there are a couple of gaps in the existing literature. First, only Saffer and Chaloupka (1993) employed the sample from general population estimating the impact of marijuana decriminalization in US. The rest of US researchers worked with young or young adult datasets and obtained results might not hold for the whole population. Second, there are very few works directly

estimating the impact of marijuana decriminalization on alcohol and cocaine consumption. The present study is aimed to fill those gaps in literature.

Year	Authors	Country	The Influence of Marijuana Decriminalization on Marijuana Consumption	The Influence of Marijuana Decriminalization on Alcohol Consumption	The Influence of Marijuana Decriminalization on Cocaine Consumption
1981	Johnston, O'Malley, Bachman	US	No influence	-	-
1989	Single	US	No influence	-	-
1992	DiNardo, Lemieux	US	No influence	Negative	-
1992	Model	US	Positive	-	Negative
1993	Thies, Register	US	No influence	No effect	No effect
1997	MacCoun, Reuter	Netherlands	No or very little influence	-	-
1998	Saffer, Chaloupka	US	Positive	-	-
2001	Cameron, Williams	Australia	Positive	Positive	-
2002	Korf	Netherlands	No influence	-	-
2003	Pacula, Chriqui, King	US	Positive	-	-
2004	Williams, Pacula, Chaloupka, Wechsler	US	Positive	-	-
2010	Damrongplasit, Hsiao, Zhao	Australia	Positive	-	-

Table 1. The summary of related literature

### 3. The Consequences of Marijuana Decriminalization: The Hypotheses

### 3.1 Marijuana

There are many possible mechanisms through which marijuana decriminalization can affect marijuana use. In order to understand the problem, it is necessary to analyze factors influencing the consumption of this drug. Economic literature generally focused on examining the relative importance of changes in monetary price and income as determinants of the decision to use marijuana and on the length of using. A number of studies have found a negative relationship between monetary price of cannabis and its consumption (for example, Saffer and Chaloupka (1998), Williams *et al.* (2004)). As for income, the empirical studies give mixed results. DiNardo and Lemieux (1992) reported that marijuana is a normal good - its consumption increases as consumer's income rises. Saffer and Chaloupka (1998) found an insignificant effect of income on the probability of marijuana use. Thies and Register (1993) reported a significant negative income effects. The theoretical study about rational addiction by Becker and Murphy (1988) concluded that people who heavily discount future are more likely to become addicts. People with higher income usually value their future more (discount the future less) than people with lower income therefore, people with the high income are less likely to use drugs (including marijuana).

Previous researchers established that if the price of marijuana decreases its consumption is likely to go up. But the question is: will decriminalization make marijuana prices lower? The peculiar thing about decriminalization (as oppose to legalization) is that it applies only to demand side. The supply of marijuana and cultivation of cannabis, which is the plant marijuana is produced from, are subject to severe criminal charges. So, the dealers would still demand a black market premium for bearing such risk, therefore it is not very likely for marijuana price to significantly decrease. But is the price of marijuana entirely defines the decision of an individual whether to consume the drug or not? It is not exactly true. While making decision a person, along with price of the drug, takes into account legal risks, perceived health risks associated with using, and also the social norms regarding how appropriate is to use marijuana in the society that person lives. So, the total cost of consuming marijuana should be defined as:

#### Total Cost = Price + Expected Legal Costs + Expected Health Costs + Expected Social Cost(1)

In decriminalized states expected legal costs of possessing marijuana are sufficiently lower than in non-decriminalized ones. First of all, there is no jail time in decriminalized states. Imprisonment usually means losing a current job and not being able to get any source of sufficient income for the whole sentence. Second, fines for possession of marijuana in decriminalized states are almost ten times smaller than those in non-decriminalized states.

And third, only in four decriminalized states – Minnesota, Mississippi, Nevada and North Carolina - possession of a small amount of marijuana for personal use is classified as misdemeanor; and in the rest nine states it is a non-criminal offence (*Appendix A*). Non-criminal offence means that if an offender gets caught it will not affect his or her criminal record. But being caught even in those four states mentioned above does not automatically mean getting a criminal record. These states provide expungements of the offence. The expungement means removing the incident of one's criminal record provided that some conditions are met (for example, community service or probation). For a person, having a criminal record associated with sufficient costs – the employment opportunities might be constrained and the expected salary might be lower. The conclusion is classifying marijuana possession as non-criminal offence and providing expungement policies means a significant reduction in costs for marijuana possession in decriminalized states.

Decriminalization can affect general perception in society of potential health risks of marijuana smoking. People might start to consider it more harmless and their expected health costs of smoking it will decrease. After decriminalization expected social costs of using marijuana also become lower. With the removal of criminal status of possession offence, marijuana itself is likely to become more socially tolerable.

Considering the total cost of consuming marijuana defined by equation (1) the conclusion can be made that after decriminalization monetary part of the cost would likely remain on the same level; but non-monetary part consisting of expected by a person legal, health and social costs would significantly decrease. That means that the total cost defined by equation (1) will go down after decriminalization and it seems logical to assume a positive influence of decriminalization on marijuana consumption. So, one of the goals of this work is to test whether people living is states which decriminalized marijuana possession indeed an average consume more. The first hypothesis can be formulated in the following way:

Hypothesis 1. Decriminalization of marijuana leads to increase in marijuana consumption.

The increase in consumption can mean two things. First, the number of people using marijuana can rise. If more people decide to start consuming marijuana after decriminalization then prevalence rates in decriminalized states increases.

*Hypothesis 1a*. In decriminalized states rates of marijuana use prevalence are higher than in nondecriminalized ones.

Second, people who have already used can start to use more.

*Hypothesis 1b*. In decriminalized states users on average consume more marijuana than in nondecriminalized ones. To test the *hypothesis 1a* about the positive effect of marijuana decriminalization on marijuana prevalence rates I use a binary probit model:

$$P(y=1|d,X) = G(\alpha + \gamma d + \beta' X), \tag{2}$$

where 
$$G(z) = \int_{-\infty}^{z} \varphi(v) dv$$
 and  $\varphi(z) = (2\pi)^{-1/2} \exp(-z^2/2)$ .

In the equation y denotes the marijuana use prevalence rate; d is decriminalization dummy variable; X is the vector of socio-economic and demographic variables influencing the decision of individual whether to consume marijuana or not.

According to the *hypothesis 1a*, the coefficient on decriminalization variable d is expected to be positive. From the coefficients obtained by estimating a probit model only the direction of the effect and its significance can be observed. To assess quantitative effect of decriminalization on the probability of marijuana consumption I calculate marginal effect of decriminalization, which is equal to the value of standard normal c.d.f. G evaluated when d = 1 and all other variables are equal to their mean values minus the value of G evaluated when d = 0 and all other variables are equal to their mean values:

$$ME(d) = G(\alpha + \gamma d + \boldsymbol{\beta}' \boldsymbol{X})\Big|_{d=1,\overline{X}} - G(\alpha + \gamma d + \boldsymbol{\beta}' \boldsymbol{X})\Big|_{d=0,\overline{X}}.$$
(3)

To test the *hypothesis 1b* I use standard OLS model:

$$z = \alpha + \gamma d + \beta' X$$

(4)where z denotes how many days per last year an individual used marijuana; d is decriminalization dummy variable; X is the vector of socio-economic and demographic variables influencing the consumption of marijuana.

#### 3.2 Alcohol

The proponents of marijuana decriminalization argue that although the reasons behind alcohol and marijuana consumptions are quite similar for the most of people – to relax and get distracted from everyday stressful life, marijuana is less harmful than alcohol.

The variety of studies seems to support their opinion. Gable (2006) compared the ratio of effective dose to lethal dose of two substances in question. The effective dose is the dose allowing a person to archive a desirable relaxed state. The lethal dose is the dose which if taken at once could lead to the lethal reaction. For example, the effective dose of alcohol for healthy 70-kilogram adult is approximately 33 grams of ethyl alcohol (two 350-ml beers, two 150-ml glasses of wine or two 45-ml shots of vodka) and the lethal dose is approximately 330 grams (20 shots of vodka). So, the ratio of effective dose to lethal dose for alcohol is 10. The same ratio for marijuana is exceeding 1000 which means that alcohol is far more toxic than marijuana. According to US Center for Disease Control, there are hundreds of alcohol overdose deaths in US each year, yet there has never been a marijuana overdose death in history.

Nutt, King and Phillips (2010) used multicriteria decision analysis in assessment of the harms that can be caused by drug abuse. During the interactive workshop the members of the Independent Scientific committee on Drugs scored 14 drugs on 16 criteria. Some criteria were related to the damage that drug produces to individual and others to the damage to other people (*Appendix B*). All drugs were scored out of 100 points. The findings suggests that alcohol is the fourth most harmful drug to the individual (scored 26 points) after crack cocaine (37 points), heroin (34 points) and amphetamines (32 points); and it is the most harmful drug to others (scored 46 points), heroin and crack cocaine are on

the second and third places (21 and 17 points respectively). Also, alcohol was defined as the most harmful drug overall.



Figure 2. Drugs ordered by their overall harm scores, showing the separate contributions to the overall scores of harms to users and harm to others

Source: Nutt, D., L. King and L. Phillips (2010). Drug harms in the UK: a multicriteria decision analysis

Suppose that a person is making a decision which drug to consume – alcohol or marijuana. In order to make such decision he or she should compare the difference of potential gains with potential loses for both substances. In this case, a person considers reaching relaxing state after taking a drug as a gain and the cost of a drug which consists of monetary, legal, health and social components as loss. Assume that desirable relaxing state could be achieved either from consuming two bottles of beer or from smoking 1 gram of marijuana. Monetary costs are in favor of alcohol: beer would on average cost

about 3\$ and marijuana about \$10 (according to the Drug Science website). After decriminalization legal cost and the perception of health and social costs of cannabis consumption would definitely decline. So, there is a possibility for some people to switch from alcohol to marijuana which could be beneficial for an individual consuming the substance and the whole society (Nutt *et al.* (2010)), therefore I test the following hypothesis.

*Hypothesis* 2. In decriminalized states prevalence rate of alcohol consumption is lower than in non-decriminalized ones.

In order to do that I use binary probit model same in structure as model (2) but the dependent variable y now denotes last month alcohol use prevalence. Negative and significant coefficient on the decriminalization dummy is necessary to accept the *hypothesis* 2. I also calculate marginal effect (3) of marijuana decriminalization on alcohol use prevalence rate.

### 3.3 Cocaine

One of the central topics of decriminalization debates is gateway hypothesis. It suggests that the use of less deleterious drugs such as marijuana may lead to a future risk of using more dangerous hard drugs, for example cocaine<sup>2</sup>.

If the gateway theory is true decriminalization of marijuana might lead to the increase of the cocaine use rates. There is no single opinion about gateway theory in literature. Some studies find evidence to support the gateway theory others do not and third cannot give any conclusive answer.

 $<sup>^{2}</sup>$  Cocaine is a drug obtained from the leaves of the coca plant. It is a stimulant of the central nervous system, an appetite suppressant, and a topical anesthetic. Its possession, cultivation, and distribution are illegal for non-medicinal and non-government sanctioned purposes in US. Occasional cocaine use does not typically lead to severe or even minor physical or social problems, but with excessive or prolonged use, the drug can cause itching, tachycardia, hallucinations, and paranoid delusions. Overdoses cause tachyarrhythmia and a marked elevation of blood pressure, which can be life-threatening and even fatal.

World Health Organization (2004). Neuroscience of psychoactive substance use and dependence.

In order to test the gateway hypothesis Fergusson and Nordwood (2002) analyzed the data from 21 year longitudinal study of 1265 New Zealand children. They found out that cannabis is strongly related to the onset of other forms of illicit drug use even after controlling for covariate factors, including childhood factors, family factors and adolescent life-style factors. Fergusson and Nordwood concluded that marijuana may act as a gateway drug that encourages other forms of illicit drug use, but the possibility remains that the association is non-causal and reflects factors that were not adequately controlled in the analysis.

Lynskey *et al.* (2003) and Lynskey, Vink and Boomsma (2005) used co-twin control design to test whether early onset cannabis use leads to elevated risks of other illicit drug use. In both studies the authors used data from survey of twin pairs in Australia and the Netherlands respectively. They wanted to check whether people who started using marijuana before 18 years is more likely to use hard drugs later in the life than people who have not started to use cannabis before 18. Co-twin design allows controlling for common family risk factors which could be either genetic or environmental. The results of both studies showed that rates of lifetime use of hard drugs are significantly higher for individuals with early onset cannabis use relative to their co-twins who had not tried marijuana before 18. These findings provide evidence to support a gateway theory.

In their work, Reinarman, Cohen and Kaal (2004) argued that consumption of cannabis itself does not lead to subsequent consumption of harder drugs. The authors believe that the real cause is exposure to the black market where harder drugs are available. They compared the samples of cannabis users in San Francisco to those in Amsterdam in order to test whether the differences in drug policy of these two cities can affect the drug use patterns. Although the possession of small amount of cannabis is decriminalized in San Francisco the sale is still an illegal activity which means that marijuana can be bought in the black market, sometimes even from the same dealers who sell hard drugs. In Amsterdam an individual over 18 can buy cannabis "almost legally" in specially licensed "coffee shops". The results showed that cannabis use patterns in two cities were very similar but San Francisco cannabis users were significantly more likely to use cocaine, crack, amphetamines, ecstasy, and opiates compares to their counterparts in Amsterdam. The authors concluded that black market itself acts as a gateway to harder drugs, as opposed to the effects of cannabis per se.

Assuming that at least one of the two theories is justified (gateway theory or black market exposure), it is logical to expect that after marijuana decriminalization more people will start to use marijuana which in its turn will lead to increase in cocaine use prevalence rate.

*Hypothesis 3*. In decriminalized states prevalence rate of cocaine consumption is higher than in non-decriminalized ones.

To test this hypothesis I estimate coefficients of the probit model (2) with last year cocaine use prevalence rate as dependent variable. In the line with hypothesis 3 positive and significant coefficient on decriminalization dummy variable is expected.

# 4. Description of Variables and Data

### 4.1 The Dataset

The data were taken from 2009 National Household Survey on Drug Abuse (NHSDA). The survey provides information about use of illicit drugs and alcohol among members of the non-institutionalized U.S. civilian population aged 12 and older. Non-institutionalized population means that people in military service and people in prisons, treatment centers, nursing homes, hospitals are excluded from the sample. Less than 2% of population is excluded and it is quite possible that this 2% of population contains more regular users than the included in the sample 98%. It could be the case that NHSDA is more likely to represent an occasional user than a regular one.

I have chosen NHSDA data set for the research because it has an important advantage over National Longitudinal Survey of Youth and Monitoring the Future surveys which are widely used in literature. It represents the whole population as opposed to NLSY and MTF (described earlier in the Section 2) which are limited by youth. But NHSDA has a drawback - the survey is cross-sectional rather than longitudinal. The participants were interviewed only once and the survey provides an insight on drug use patterns only at specific point in time rather than a view on how the patterns change over time for specific individuals. A total of 55,772 observations were available in 2009 survey. After observations with missed data were deleted, the resulting sample comprised 39,505 observations.

### 4.2 Explanatory variables

The main goal of the present work is to estimate the effect of marijuana decriminalization on use patterns of alcohol, marijuana and cocaine, such as prevalence rates of use, the age of marijuana initiation and the number of days per year when an individual consuming cannabis.

So, the independent variable of main interest - *decrim* is supposed to reflect the marijuana policy of state in which a respondent resides. Due to confidentiality reasons the available data set does not provide direct information about the state each individual lives in. Instead it contains information about maximum legal penalty for the first offence possession of an ounce or less of marijuana for personal use. The penalty could be: mandatory prison sentence, possible prison sentence, fine, community service or no penalty at all. I constructed a binary variable *decrim* the following way: it takes value 1 if the state did not employ any legal punishment for marijuana possession or the maximum penalty was either fine or community service which basically means decriminalization; and it takes value 0 if maximum punishment was possible prison sentence or mandatory prison sentence.

The demand function for a drug depends on price consisting of the monetary, legal, health and social parts, income, as well as some standard socioeconomic and demographic factors that capture heterogeneity in demand which are broadly used in literature (e.g. Thies and Register (1993), Saffer and Chaloupka(1998),). Those factors include age, sex, race, employment status, education, marital status, religious beliefs and some characteristics of the county where a person resides.

All control variables are binary. The reason for that is the way the questions formulated in the demographic part of NHSDA questionnaire. When respondents were asked, for example, about their age they were supposed to choose from several age groups instead of putting their age in years. That is why, to control for an age of an individual, I used binary variables *age\_1217*, *age\_1820*, *age\_2129*,

*age\_3034*, *age\_3549*, *age\_5064*, *age\_65*. For example, *age\_1217* takes value 1 if individual's age is in interval from 12 to 17 years and 0 otherwise and so on; *age\_65* takes value 1 if the respondent is 65 years old or older. According to the O'Donoghue and Rabin (1999), person's desire to consume addictive products usually decreases as he or she gets older. So, I expect that all else held constant, drug consumption rates will be smaller at early age, then they will grow and peak somewhere at early twentieth, and then will start to decrease.

I used the variable *male* to control for the sex of respondent. It takes value 1 if the respondent is male ant takes value 0 if the female. All previous research showed that ceteris paribus men's drug use rates are higher than women's. It is very likely that single people are more likely to drink alcohol and consume illicit drugs than people with families. They might consume less addictive substances because of pressure of spouses. Also, levels of drug consumption might higher for divorced and widowed people who might start using in order to cope with stress. I tried to capture these effects with binary variables *married*, *divorced* and *widowed*.

The level of person's education and employment status might be correlated with his or her decision to take a drug. Well educated and currently employed people might be less likely to get involved with addictive substances. To control for these effects I used binary variables *job* (takes value 1 if the respondent has a job at the moment and 0 otherwise); *educ\_college* (takes value 1 if the respondent graduated college and 0 otherwise) and *educ\_school* (takes value 1 if the respondent graduated college and 0 otherwise).

Religious belief of a person might also play an important role in his or her decision about using addictive substances. I constructed a variable *religion* which takes value 1 if the person strongly agrees or agrees with a statement that religious belief plays important role in his or her life and takes value 0 if the respondent disagrees or strongly disagrees with the statement.

The family income is likely to affect an individual's decision regarding drug consumption. In survey, the whole sample is divided into four groups: with total family income less than \$20,000; with family income in the interval from \$20,000 to \$49,999; from \$50,000 to \$74,000; and finally with family income more than \$75,000. The corresponding variables are: *low\_inc*, *low\_mid\_inc*, *up\_mid\_inc* and *up\_inc*.

Variable	All data N=39,505		Decriminalized N=23,317		Non-decriminalized N=16,188	
	Mean	SD	Mean	SD	Mean	SD
MJ_PREV_MONTH	0.123	0.329	0.145	0.352	0.091	0.288
MJ_PREV_YEAR	0.080	0.272	0.090	0.286	0.067	0.250
ALC_PREV_MONTH	0.459	0.498	0.479	0.500	0.430	0.495
CC_PREV_LYEAR	0.031	0.173	0.033	0.180	0.027	0.162
AGE_1217	0.328	0.469	0.310	0.463	0.353	0.478
AGE_1820	0.150	0.357	0.153	0.360	0.147	0.354
AGE_2129	0.270	0.444	0.275	0.446	0.262	0.440
AGE_3034	0.049	0.215	0.048	0.213	0.051	0.219
AGE_5064	0.052	0.222	0.057	0.233	0.044	0.205
AGE_3549	0.127	0.333	0.127	0.333	0.127	0.333
AGE_65	0.025	0.155	0.030	0.170	0.017	0.128
SEX_MALE	0.510	0.500	0.515	0.500	0.502	0.500
RACE_WHITE	0.606	0.489	0.608	0.488	0.604	0.489
RACE_BLACK	0.138	0.344	0.144	0.351	0.129	0.335
RACE_HISP	0.166	0.372	0.163	0.369	0.171	0.376
RACE_OTHER	0.090	0.286	0.085	0.279	0.096	0.295
EDUC_COLLEGE	0.336	0.472	0.329	0.470	0.346	0.476
EDUC_SCHOOL	0.548	0.498	0.546	0.498	0.551	0.497
JOB	0.050	0.217	0.052	0.223	0.046	0.209
DIVORCED	0.055	0.228	0.058	0.233	0.051	0.220
WIDOWED	0.010	0.125	0.011	0.106	0.008	0.091
MARRIED	0.215	0.411	0.216	0.412	0.215	0.411
LARGE_METRO	0.447	0.497	0.440	0.496	0.458	0.498
SMALL_METRO	0.344	0.475	0.349	0.477	0.337	0.473
LOW_INC	0.231	0.422	0.242	0.428	0.216	0.411
LOW_MID_INC	0.339	0.474	0.345	0.475	0.331	0.471
UP_MID_INC	0.168	0.374	0.164	0.371	0.174	0.379
RELIGION	0.460	0.498	0.463	0.499	0.457	0.498
DEPRESSION	0.098	0.298	0.098	0.298	0.098	0.298

 Table 1. Summary statistics for dependent and independent variables for the whole sample

I also controlled for a type of county where the respondent resides using variables: *large\_metro*, *small\_metro*, *non\_metro*. For example, drugs might be much more easily obtained by a person who

lives in large metropolitan area compared to small metropolitan and non-metropolitan areas. In nonmetropolitan areas a drug users might experience a higher degree of social disapproval.

Apart from the socioeconomic and demographic variables discussed above which are "usual suspects" almost in every study, I controlled for the depression level of a respondent. A lot of researchers report a positive association between depression and use of drugs, for example Way *et al.* (1994) and Kelder *et al.* (2001). Another interesting piece of evidence was provided by Vlahov *et al.* (2004). They analyzed the pattern of cigarette, alcohol, and marijuana use rates in New York City after September 11 terrorist attacks which apparently were the reason for major stress and depression among the population. The rates showed sufficient and persistent increase indicating the positive influence of stressful events on marijuana and alcohol consumption.

A special module was included into NHSDA questionnaire designed to measure whether or not the respondent experienced a major depressive episode (MDE) in the past year. The variable *depression* takes value 1 if the responded experienced MDE during previous year and takes 0 otherwise.

### 4.3 Dependent variables

In order to test *hypothesis 1a* I took last month prevalence and last year prevalence rates of marijuana use and constructed two binary variables *mj\_prev\_month* and *mj\_prev\_year*. The variable *mj\_prev\_month* takes value 1 if an individual used cannabis in the last month and 0 otherwise. I used previous month prevalence rate as an approximation regular "hard" users" and for people who only started to use. The variable *mj\_prev\_year* takes value 1 if a person used marijuana during last year but not in the last month and takes value 0 if the person never used the drug during last year. It could be an

approximation for non-frequent "light" users and quitters. As it can be seen from *Table 1*, both last month and last year prevalence rates are higher in decriminalized states.

Variable	All data N=8,077		Decrim N=4	inalized ,526	Non-decriminalized N=3,551	
	Mean	SD	Mean	SD	Mean	SD
MJ_YRTOT	113.047	127.198	117.620	128.4419	103.139	123.911
AGE_1217	0.246	0.431	0.257	0.437	0.219	0.414
AGE_1820	0.257	0.437	0.247	0.431	0.279	0.448
AGE_2129	0.366	0.481	0.359	0.479	0.378	0.485
AGE_3034	0.039	0.194	0.039	0.194	0.038	0.192
AGE_5064	0.071	0.257	0.074	0.261	0.065	0.247
AGE_3549	0.019	0.137	0.020	0.140	0.017	0.130
AGE_65	0.001	0.036	0.001	0.040	0.001	0.027
SEX_MALE	0.575	0.494	0.587	0.492	0.551	0.497
RACE_WHITE	0.646	0.478	0.641	0.479	0.657	0.474
RACE_BLACK	0.127	0.334	0.133	0.340	0.115	0.319
RACE_HISP	0.138	0.345	0.141	0.348	0.133	0.339
RACE_OTHER	0.087	0.282	0.083	0.277	0.094	0.291
EDUC_COLLEGE	0.357	0.479	0.328	0.469	0.420	0.493
EDUC_SCHOOL	0.501	0.500	0.519	0.499	0.460	0.498
JOB	0.062	0.241	0.064	0.246	0.056	0.230
DIVORCED	0.044	0.206	0.044	0.205	0.045	0.209
WIDOWED	0.002	0.047	0.001	0.042	0.003	0.055
MARRIED	0.097	0.296	0.097	0.297	0.097	0.296
LARGE_METRO	0.463	0.498	0.458	0.498	0.474	0.499
SMALL_METRO	0.347	0.476	0.351	0.477	0.338	0.473
LOW_INC	0.290	0.453	0.291	0.454	0.286	0.452
LOW_MID_INC	0.342	0.474	0.352	0.477	0.319	0.466
UP_MID_INC	0.141	0.348	0.141	0.348	0.141	0.349
DEPRESSION	0.149	0.357	0.137	0.344	0.177	0.381

Table 2. Summary statistics of the sample restricted by individuals who used marijuana last year

To check whether marijuana users consume more in the decriminalized states compared to nondecriminalized (*hypothesis 1b*) I took variable  $mj_yrtot$  which reflects how many days during last year the respondent used the marijuana. The sample was restricted to people who reported marijuana consumption during last year. In decriminalized states on average users consumed marijuana for 117 days last year, in non-decriminalized – for 103. To test the *hypothesis 2* regarding the influence of marijuana decriminalization on the alcohol consumption, I took only last month alcohol prevalence rate since it is more likely to capture people who consume alcohol on regular basis. Most of the people drink some form of alcohol at least once per year, so last year prevalence does not seem to be very informative. Prevalence rate in decriminalized states (0,48) is higher than in non-decriminalized ones (0,43).

For testing *hypothesis 3* about the impact of marijuana decriminalization on cocaine consumption, I constructed a variable *cc\_prev\_wyear* which takes value 1 if a person ever used cocaine during the whole last year and value 0 otherwise.

#### 4.4 Data limitations

The NHSDA data are self-reports of drug use and their value depends on respondent's truthfulness and memory, so some over-reporting and underreporting might take place. For example, one can argue that people living in non-decriminalized states might have an incentive to underreport their marijuana consumption. The NHSDA was designed in a way to minimize such possibilities. The respondents were guaranteed a high degree of anonymity. The survey included control questions in order to identify truthfulness of respondents. For sensitive questions, such as individual drug consumption, the respondent's answers were kept confidential from the interviewer. All describe measures might have not eliminated underreporting and over-reporting problem completely but the NHSDA data is the best approximation of real drug situation for US general population that could be obtained at the moment.

### 5. Results

Because of binary nature of dependent variables, I employ probit model to estimate the coefficients for alcohol, marijuana, cocaine use prevalence rates equations. Table 4 reports the results for marijuana use prevalence equations (last month and last year) and for the intensity of marijuana use equation. For the last equation I use standard OLS method. Table 5 provides estimated coefficients and marginal effects for alcohol and cocaine use prevalence equations.

### 5.1 Marijuana

In accordance with *hypothesis 1a* the results show that decriminalization has positive and significant impact on marijuana smoking behavior. Marginal effect is 4.4% for last month prevalence model and 2.1% for last year prevalence model.

Further, due to the specifics of probit model, for other control variables affecting drug consumption only direction of the effect and level of significance will be discussed. Age is an important factor affecting marijuana smoking behavior. The probability of smoking marijuana peaks at age 18-20 years and then declines monotonically thereafter for both last month and last year prevalence. The coefficient on gender dummy variable is positive and significant – holding everything else constant, males are more likely to consume than females.

Married individuals are less likely to use marijuana than their never married, divorced and widowed counterparts. The reasonable explanation is that married people, who never used marijuana but willing to try it, are likely to experience discouragement from spouse's side; and the married people who use marijuana are likely to experience pressure to quit their marijuana smoking habit. The

people whose religious beliefs are important to them are less likely to use marijuana because of religion disapproval of substance abuse.

	(1) Marijuana last month prevalence		(2) Marijuana last year prevalence		(3)How many days	
Variable					marijuana	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
DECRIM	0.257***	0.018	0.273***	0.016	10.9***	2.982
AGE_1217	0.756***	0.141	0.997***	0.124	-47.1	37.822
AGE_1820	1.229***	0.140	1.499***	0.123	-7.1	37.615
AGE_2129	1.158***	0.139	1.361***	0.122	11.1	37.504
AGE_3034	1.012***	0.142	1.145***	0.125	6.7	37.96
AGE_3549	0.861***	0.139	0.977***	0.122	-8.1	37.649
AGE_5064	0.718***	0.145	0.772***	0.127	-8.7	38.582
EDUC_COLLEGE	-0.086***	0.029	-0.004	0.026	-45.9***	4.509
EDUC_SCHOOL	-0.067**	0.029	-0.018	0.027	-13.6***	4.582
JOB	0.066*	0.037	0.054	0.033	5.8	5.715
LARGE_METRO	0.167***	0.024	0.148***	0.021	0.9	3.906
LOW_INC	0.177***	0.026	0.150***	0.023	15.5***	4.052
LOW_MID_INC	0.114***	0.024	0.086***	0.021	14.2***	3.855
MARITAL_DIV	0.731***	0.059	0.760***	0.051	32.3***	10.754
MARITAL_NEVER	0.835***	0.040	0.885***	0.032	28.2***	7.763
MARITAL_WID	0.378***	0.050	0.393***	0.041	26.9***	9.405
RACE_WHITE	0.100***	0.027	0.162***	0.024	7.2	4.449
RACE_HISP	-0.128***	0.032	-0.069**	0.028	-5.9	4.189
RACE_OTHER	0.075**	0.037	0.084**	0.033	-1.7	5.011
SEX_MALE	0.258***	0.018	0.205***	0.016	29.6***	2.855
SMALL_METRO	0.139***	0.025	0.099***	0.022	5.9	3.958
UP_MID_INC	0.005	0.029	-0.006	0.025	7.9*	4.694
RELIGION	-0.357***	0.021	-0.344***	0.019	-17.2***	3.251
DEPRESSION	0.235***	0.027	0.305***	0.024	-1.7	4.052
С	-3.187***	0.152	3.122***	0.133	74.9*	38.7
Marginal Effect of Decriminalization	0.04	44	0.021		-	-

and OLS coefficient estimates intensity of marijuana use equations

Table 4. Probit coefficient estimates for marijuana use prevalence rates (last month and last year)

NOTE: \*\*\* significant at 1% level; \*\* significant at 5% level; \* significant at 10% level.

The coefficients on low and low middle income dummies are positive and significant which means that marijuana has negative income effect. Education and employment status also have negative impact on marijuana consumption for last month prevalence. These are the evidence to support rational addiction theory presented by Becker and Murphy (1988). Educated; employed people and people with

higher income value their future more and therefore are less likely to become addictive to marijuana. It is worth to note that for last year marijuana use prevalence the coefficients on education and employment variables are insignificant. There is no contradiction with rational addiction theory since last year prevalence rate approximates occasional users who tried marijuana but have not become addicted to it.

People living in large and small metropolitan areas are more likely to consume marijuana than people living in non-metropolitan areas. Among other factors, this can be explained by greater availability of the drug in metropolitan areas – it is much easier, for example, to find a dealer in a large city compared to the small town. People living in metropolitan areas are probably less dependent on social opinion and in particular on social disapproval of marijuana smoking. And finally, as it was expected, depression has positive significant effect on marijuana consumption.

So far it has been established that people living in decriminalized states are more likely to use marijuana than people living in non-decriminalized ones. Now it is time to answer the question of *hypothesis 1b* whether people living in decriminalized states indeed consume more marijuana than people living in non-decriminalized ones. In order to do that I use a dependent variable reflecting how many days per year an individual consumes marijuana and regress it on decriminalization dummy and set of control variables. The results of OLS coefficient estimates are presented in the column 3 of Table 4.

In decriminalized states users consume marijuana on average 11 days per year more than their counterparts living in non-decriminalized states. The result can be interpreted, for example, the following way: white never married males from 30 to 34 years old, with school education, employed; with household income from \$50,000 to \$75,000, non-religious and who did not experience a major depressive episode in the past year consume marijuana on average 140 days per year in non-

decriminalized states. The people living in decriminalized states and matching the same criteria consume marijuana 8% less intense (in terms of days per year). This finding provides enough evidence to accept *hypothesis 1b* although the effect is not as drastic as it could be expected.

	(1) Alcohol	last month	(2) Cocaine last year		
Variable	preva	lence	prevalence		
	Coefficient	Std. error	Coefficient	Std. error	
DECRIM	0.102***	0.014	0.071**	0.028	
AGE_1217	-0.788***	0.052	0.493	0.319	
AGE_1820	0.113**	0.049	1.006***	0.317	
AGE_2129	0.572***	0.047	1.169***	0.316	
AGE_3034	0.496***	0.053	1.062***	0.320	
AGE_3549	0.418***	0.047	0.955***	0.316	
AGE_5064	0.252***	0.052	0.801**	0.323	
EDUC_COLLEGE	0.547***	0.023	-0.129***	0.041	
EDUC_SCHOOL	0.250***	0.024	-0.121***	0.043	
JOB	-0.017	0.031	0.073	0.056	
LARGE_METRO	0.092***	0.019	0.120***	0.039	
LOW_INC	-0.152***	0.022	0.086**	0.040	
LOW_MID_INC	-0.121***	0.019	0.059	0.038	
MARITAL_DIV	0.646***	0.043	0.718***	0.106	
MARITAL_NEVER	0.779***	0.029	0.678***	0.089	
MARITAL_WID	0.529***	0.035	0.004	0.103	
RACE_WHITE	0.335***	0.022	0.557***	0.056	
RACE_HISP	0.070***	0.026	0.428***	0.062	
RACE_OTHER	0.043	0.031	0.447***	0.070	
SEX_MALE	0.181***	0.014	0.194***	0.028	
SMALL_METRO	0.047**	0.019	0.120***	0.039	
UP_MID_INC	-0.096***	0.022	-0.038	0.047	
RELIGION	-0.247***	0.018	-0.228***	0.030	
DEPRESSION	0.080***	0.023	0.248***	0.038	
Marginal Effect	0.042		0.003		

Table 5. Coefficient estimates for alcohol and cocaine use prevalence rate equations

NOTE: \*\*\* significant at 1% level; \*\* significant at 5% level; \* significant at 10% level.

It could be the case that after decriminalization more people would be willing to try marijuana once or twice – just looking for some new experience. This will lead to the higher percentage of occasional users in decriminalized states sample which could be the cause of small effect of decriminalization on the intensity of marijuana consumption. To test this potential problem the sample

was further restricted by excluding from it occasional users – people who use less than 10 days per year. The result has not significantly changed.

The results also show that holding everything else constant males consume marijuana roughly 30 days per year more than females. Income has a negative impact on the intensity of consumption. Married people consume significantly less marijuana (in terms of days per year) than never married, divorced and widowed. School education lowers marijuana consumption by 13 days per year, college education – by 46 days.

### 5.2 Alcohol

Contrary to the expectations, decriminalization has positive significant impact on the alcohol consumption. People living in states which have decriminalized marijuana are 4.2% more likely to consume alcohol last month than people living in non-decriminalized ones. This result provides enough evidence to reject *hypothesis 2*.

Age, sex, education, income and marital status are important factors influencing alcohol consumption behavior. Considering age and holding other factors constant, the smallest probability of consuming alcohol last month have the people under 21 years old who are not yet eligible to drink, and then probability reaches its maximum at twenties and monotonically decreases after that. Males are more likely to drink last month than females and married people are less likely to drink than their never married, divorced and widowed counterparts.

School and college education have positive significant effect on alcohol consumption. Alcohol, as opposed to marijuana, has a positive income effect – the probability of drinking last month is higher for people with higher household income. That not necessarily contradicts rational addiction theory.

Maybe people, while making a decision about alcohol consumption, do not consider it as addictive good.

Similar to marijuana consumption and in the line with expectations, the probability of consuming alcohol last month is lower for people considering their religious beliefs important and higher for people who had experienced a major depressive episode in the past year.

### 5.3 Cocaine

The estimated coefficients in the cocaine use prevalence rate equation are presented in the column 2 of Table 5. The coefficient on marijuana decriminalization variable although significant at 5% level is very small. The marginal effect of marijuana decriminalization is about 0.3%. This is a weak evidence for support of the *hypothesis 3* and, therefore the gateway theory.

Considering age, sex and marital status the probability of using cocaine exhibits the same patterns as probabilities for marijuana and alcohol – it peaks at twenties and declines afterward; it is higher for men and lower for married individuals.

Education and religious beliefs have negative impact on cocaine use prevalence rates. The coefficients on the income variables are insignificant, so we cannot make a conclusion about the income effect. People living in metropolitan areas are more likely to use cocaine probably, as in marijuana case, due to higher availability of black markets and lower social disapproval. Depression also has positive and significant impact on cocaine consumption.

### 6. Conclusion

This work used the 2009 National Household Survey on Drug Abuse to assess the impact of marijuana decriminalization on marijuana, alcohol and cocaine consumption in the US. The results show that marijuana decriminalization **positively** affects both the probability of using marijuana and the intensity of using it (in terms of days per year); also marijuana decriminalization has **positive** significant impact on alcohol consumption. The last finding is evidence against the theory about alcohol and marijuana being substitutes. Unfortunately, it is impossible to draw any conclusions about extent of complementarity of these two substances from the NHSDA data. The effect of decriminalization on cocaine use is **positive** and **significant** but very **small** in magnitude.

Policy makers always pay attention to the effect of marijuana decriminalization on marijuana consumption. The findings of this work should encourage them to pay closer attention to the impact of marijuana decriminalization on alcohol consumption instead. According to the study of Nutt *et al.* (2010) alcohol is the most harmful drug to the individual and to the society overall, so social costs of decriminalization could be underestimated.

The drug use patterns for alcohol, marijuana and cocaine have the same age structure – use rates reach maximum for people from 20 to 29 years old. The recommendation that could be made to drug education program designers is to consider people in their twenties as their target group.

Another interesting conclusion could be drawn. The population of the US is ageing. According to the Administration on Aging (AoA), the older population – persons 65 years and older – is expected to represent 19% of the whole US population by the 2030, in 2009 they represented 12.9%. The age patterns of alcohol, marijuana and cocaine consumption, obtained in this work, suggest that *ceteris paribus* the consumption rates of these drugs will decrease by 2030.

Another possible suggestion for policy makers is to try to keep children interested in education and expand possibilities for unprivileged children to receive education because education has strong negative effect on marijuana and cocaine consumption. Programs which target is to increase education level in the country might help to solve the drug problem.

# APPENDICIES

# Appendix A

1 oz of less in your residence of	
Alaska home no penalty none none	
1 oz to 4 oz misdemeanor 90 days \$1,00	0
More than 4 oz, or 25 or more	0.0
plants felony 5 years \$50,0	00
California     28.5 g or less     infraction     none     \$100	
More than 28.5 g misdemeanor 6 months \$500	
Colorado1 oz or lesspetty offensenone\$100	
1 oz or less - failure to appear misdemeanor 6 months \$500	
Display any in public mindamore additional	
Display of use in public misdemeanor additional none	¢5 000
1 to 8 oz misdemeanor 6 - 18 montins \$300	- \$5,000 N
More than 8 oz felony 1-3 years \$100	000
Usable amount with proof of	000
Maine physician's recommendation none none none	
Usable Amount (under <2.5 oz) civil violation none \$350	- \$600
1 lb or less misdemeanor 1 year \$2,00	0
1 lb - 20 lbs felony 5 years \$5,00	0
20 lbs or more felony 10 years \$20,0	00
Massachus	
etts One ounce or less civil offense none \$100	
More than one ounce (first	
offense) misdemeanor 6 months \$500	
offense) misdemeanor 6 months \$500	
Minnesota Less than 42.5 g misdemeanor none \$200	
$\frac{1}{42.5 \text{ g to } 10 \text{ kg}}$	00
$\frac{10 \text{ to } 50 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ kg}}{10 \text{ to } 50 \text{ kg}} = \frac{10 \text{ to } 10 \text{ to } 1$	000
$\frac{100050 \text{ kg}}{50 \text{ to } 100 \text{ kg}} = \frac{1000 \text{ kg}}{50 \text{ to } 100 \text{ kg}} = \frac{1000 \text{ kg}}{500000000000000000000000000000000000$	000
$\frac{100 \text{ kg or more}}{100 \text{ kg or more}} = \frac{100 \text{ kg or more}$	0.000
Microscippi 30 g or less (first offense) misdemeanor none \$100	\$250
$\frac{30 \text{ to } 250 \text{ g}}{30 \text{ to } 250 \text{ g}}$	- #230 N
250  to  500  g felony $2 - 8  years$ $55,00$	00
500  g to  5  kg felony $6 - 24  years$ $$500,000$	000
$\frac{500 \text{ g to 5 \text{ kg}}}{5 \text{ kg or more}} = \frac{10 \text{ g to 5 \text{ kg}}}{10 \text{ g sol}} = \frac{10 \text{ g sol}}{10 \text{ g sol}} = \frac{10 \text{ g sol}}{10 \text{ g sol}}$	000
Nebraska     1 oz or less (first offense)     civil citation     none     \$200	0,000
1 oz or less (second offense) misdemeanor 5 days \$400	
1  oz or less (subsequent offense) misdemeanor 7 days $$500$	
1 oz to 1 lb misdemeanor 7 days \$500	
More than 1 lb felony 5 years \$10.0	00

# Marijuana Possession State Laws in States with Decriminalization Policy

State	Possession	Offence	Incarceration	Fine
Nevada	Less than 1 oz (first offense)	misdemeanor	rehabilitation	\$600
	Less than 1 oz (second offense)	misdemeanor	rehabilitation	\$1,000
	Less than 1 oz (third offense)	gross misdemeanor	1 year	\$2,000
	Less than 1 oz (fourth offense)	felony	1 - 4 years	\$5,000
New York	25 g or less (first offense)	civil citation	none	\$100
	25 g or less (second offense)	civil citation	none	\$200
	25 g or less (3rd offense)	misdemeanor	5 days	\$250
	25 g to 2 oz	misdemeanor	3 months	\$500
	2 to 8 oz	misdemeanor	1 year	\$1,000
	8 to 16 oz	felony	1-4 years	\$5,000
	16 oz to 10 lbs	felony	1 - 15 years	\$5,000
	More than 10 lbs	felony	1 - 15 years	\$5,000
North	1/2		20.1 *	<b>\$2</b> 00
Carolina	1/2 oz or less	misdemeanor	30 days*	\$200
	1/2 to 1 1/2 oz	misdemeanor	1 - 120 days	\$500
	More than 1 1/2 oz	felony	12 months	fine
Ohio	Less than 100 g	minor misdemeanor	none	\$150
	100 g to 200 g	misdemeanor	30 days	\$250
	201 g to 999 g	felony	30 days	\$2,500
	1000			\$5,000-
	1000 g to 4999 g	felony	1 - 5 years	\$10,000
	5000 g to 19,999 g	felony	1 - 5 years	\$10,000
	20,000 g or more	felony	8 years	\$7,500- \$15,000
Oregon	Less than 1 oz	civil violation	none	\$500 - \$1,000
	1 oz to 110 g	felony	10 years	\$100,000
	More than 110 g	felony	variable	variable

Marijuana Possession State Laws in States with Decriminalization Policy (continuation)

\*Suspended sentence mandatory.

Data source: National Organization for the Reform of Marihuana Laws



Evaluation criteria organized by harms to users and harms to others, and clustered under physical, psychological, and social effects

Source: Nutt, D., L. King and L. Phillips (2010). Drug harms in the UK: a multicriteria decision analysis.

### **Drug-specific mortality**

Intrinsic lethality of the drug expressed as ratio of lethal dose and standard dose (for adults)

### **Drug-related mortality**

The extent to which life is shortened by the use of the drug (excludes drug-specific mortality)—e.g., road traffic accidents, lung cancers, HIV, suicide

### Drug-specific damage

Drug-specific damage to physical health—e.g., cirrhosis, seizures, strokes, cardiomyopathy, stomach ulcers

# **Drug-related damage**

Drug-related damage to physical health, including consequences of, for example, sexual unwanted activities and self-harm, blood-borne viruses, emphysema, and damage from cutting agents

# Dependence

The extent to which a drug creates a propensity or urges to continue to use despite adverse consequences

# Drug-specific impairment of mental functioning

Drug-specific impairment of mental functioning—e.g., amphetamine-induced psychosis, ketamine intoxication

# Drug-related impairment of mental functioning

Drug-related impairment of mental functioning—e.g., mood disorders secondary to drug-user's lifestyle or drug use

# Loss of tangibles

Extent of loss of tangible things (e.g., income, housing, job, educational achievements, criminal record, imprisonment)

# Loss of relationships

Extent of loss of relationship with family and friends

# Injury

Extent to which the use of a drug increases the chance of injuries to others both directly and indirectly—e.g., violence (including domestic violence), traffic accident, fetal harm, drug waste, secondary transmission of blood-borne viruses

### Crime

Extent to which the use of a drug involves or leads to an increase in volume of acquisitive crime (beyond the use-of drug act) directly or indirectly (at the population level, not the individual level)

### **Environmental damage**

Extent to which the use and production of a drug causes environmental damage locally—e.g., toxic waste from amphetamine factories, discarded needles

### **Family adversities**

Extent to which the use of a drug causes family adversities— e.g., family breakdown, economic wellbeing, emotional wellbeing, future prospects of children, child neglect

### **International damage**

Extent to which the use of a drug in the UK contributes to damage internationally—e.g., deforestation, destabilization of countries, international crime, new markets

### **Economic cost**

Extent to which the use of a drug causes direct costs to the country (e.g., health care, police, prisons, social services, customs, insurance, crime) and indirect costs (e.g., loss of productivity, absenteeism)

# Community

Extent to which the use of a drug creates decline in social cohesion and decline in the reputation of the community

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