The grass is always greener on the other side -

Prevalence of adolescent cannabis use and decriminalization

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Abstract:

Cannabis policy is a topic of constant discussion and changes worldwide. Various aspects of cannabis have been studied extensively in the US states and Australia, while research on European countries is mostly conducted, if they are in the process of decriminalizing cannabis for personal use. This paper tests the causality between cannabis policy (criminalized versus decriminalized) and prevalence of cannabis use. The target population is 15 to 16 year old adolescents in 24 European countries. A difference-in-differences model is fitted to estimate the effect of decriminalization of personal cannabis use/ possession towards the prevalence of cannabis use. The empirical results suggest that decriminalizing cannabis leads to a decrease of more than 6 % in consumption as compared to the control group that kept cannabis criminalized. When controlling for unemployment, alcohol use, GDP and polity, this reduction is about 12 %. This insight can be used for policy recommendations on the international unification of criminal law on cannabis since an effective policy will have to include all jurisdictions. The prohibitionist approach specified for cannabis in the UN Single Convention on Narcotic Drugs needs to be reconsidered.

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1. Introduction

Cannabis policy is diverse, ranging from a legal status of the drug to complete prohibition. Uruguay is the first country that legalized cannabis worldwide in December 2013 (The Time, 2013). Colorado is one of the US states that decriminalized cannabis in some of its counties during the years 2005 to 2009 (Alexandre, 2013) and then legalized it for recreational use starting January 2014 (Colorado Government, 2012). South Australia is the state in Australia that has decriminalized cannabis for the longest time, since 1987, while Western Australia prohibits cannabis use, possession or sale (Lenton, Humeniuk, Heale & Christie, 2000). Due to the free movement of people and the increasing opportunities to travel, pressure is rising to find a common approach on drugs.

The UN Single Convention on Narcotic Drugs, established in 1961, criminalizes all drugs worldwide. This includes cannabis in order to prevent deterioration of health. However, instead of global compliance, there are two main prevailing drug policies for the personal use and possession of small quantities of cannabis – criminalization and decriminalization (Pacula et al., 2005). On the one hand, criminalization is the existence of a criminal penalty for any drug-related offence. Using or possessing cannabis is a criminal act. On the other hand, decriminalization is the abolishment of such criminal penalties for personal use or possession of small quantities of cannabis. It can be seen as a reduction of the criminal penalty to an administrative offence. This should not be confused with legalization, since cannabis is still illegal under a decriminalized policy.

Among the contenders that decriminalization is beneficial for the individual and society it is believed to improve public health. This happens through the provision of hygienic conditions for drug use along with treatment opportunities and the reduction in costs of prosecution and law enforcement (Hughes & Stevens, 2010; MacCoun & Reuter, 2001; Single, Christie & Ali, 2000). If a criminal penalty is applied, convicted offenders report negative long-term effects, such as trouble with housing, employment or relationships along with higher conviction rates for other minor offences (Lenton, Humeniuk, Heale & Christie, 2000). All these consequences can be seen as a potential cost to the individual and society.

Research on cross-national cannabis polices and their consequence for adolescents is scarce (Vuolo, 2013). The contribution of this study is adding a European-wide overview of drug policies on personal cannabis use and possession and a difference-in-differences model is used to determine causality between cannabis policy and prevalence rates of cannabis use among adolescents. The use of cross-sectional data on 24 countries assures that not only the states that recently changed their drug policy with high media attention are researched, like Portugal in 2001 and Czech Republic in 2010 (Hughes & Stevens, 2010). The research question explores whether there is a causal effect running from decriminalization of cannabis for personal use and possession to the prevalence of cannabis use.

The empirical analysis, namely the difference-in-differences model, shows the significant difference between the criminalized and decriminalized countries. Two models are specified: A basic model without and an extended model with independent variables. In the basic model, countries that decriminalize cannabis experience a more than 6 % decrease of youth cannabis use after changing the law as compared to the group of criminalized countries. However, countries that decriminalize cannabis might do so, because their mean cannabis use is higher by around 8.5 percentage points. In the extended model, cannabis decriminalization leads to a reduction of cannabis use by 12 %, when controlling for four independent factors: Unemployment, alcohol use, GDP per capita and a polity score. The only significant independent variable is alcohol use.

In the following, Section 2 will outline the theory of drug policy and youth cannabis consumption. A line of reasoning derived from economics theory is introduced in Section 3. Section 4 presents the methodology of both models and Section 5 their empirical results. Finally, in Section 6, a conclusion is drawn and policy recommendations for the international community are given.

2. Theory

2.1 Prevalence of cannabis use and the policy approach

The effects of cannabis policy are still debated with advocates for three potential scenarios: (1) Decriminalization has a negative effect and a major consequence of decriminalization is the rise of usage rates. (2) Decriminalization is indifferent and has no effect on prevalence rates. (3)

Decriminalization does not lead to higher usage rates. Rather, it is effective in reducing the burden on the criminal system.

The first case is the rise of cannabis usage rates after decriminalization. Pacula (2010) reviewed the economic literature and found that a more liberal approach, lower penalties, lower prices and less frequent conviction are positively related to higher consumption. Pacula, Chriqui & King (2003) and Model (1993) highlight the higher prevalence rates of cannabis use after decriminalization in different US states. According to studies from the US and Australia, especially younger people are sensitive to lower prices and experiment more, if the drug is available at a cheaper rate (Pacula, Grossman, Chaloupka, O´Malley, Johnston & Farrelly, 2001; van Ours & Williams, 2007). In the US, stricter police enforcement of penalties connects to lower rates of usage in the US states (Farrelly, Bray, Zarkin & Wendling, 2001). A policy experiment in which cannabis was decriminalized in parts of London in 2001 led to the increase of cannabis-related crimes, even after the experiment ended (Adda, McConnell & Rashul, 2014). Furthermore, housing prices decreased in that particular part of the city due to the active drug market and the following decrease in the inhabitant´s welfare.

The second case is possibility of cannabis policy being indifferent and irrelevant for prevalence rates of use. This has been demonstrated in different studies in the US (Reinarman, Cohen, & Kaal, 2004; Johnston, O'Malley & Bachman, 1981), Australia (Lenton, Humeniuk, Heale & Christie, 2000) and Europe (the Netherlands – Korf, 2002) as well as on WHO level (Degenhardt et al., 2008; Reinarman, Cohen, & Kaal, 2004). However, it is also mentioned that a criminal conviction has an adverse impact on the offender´s social status and integration and that other influences of society, like culture, need to be taken into account before designing and implementing policies (Reuband, 1995).

The third case is the best case scenario for a country: Cannabis decriminalization would lead to economic benefits in terms of the less crowded prison system and lower prosecution costs (Shanahan, 2011; Single, 1989). Meanwhile, prevalence of cannabis use would not rise. This effect is demonstrated on the example of Portugal’s drug decriminalization in 2001 (Hughes & Stevens, 2010). Portugal´s scheme appears to be a success for the country. Prevalence of drug use has not risen and resources were freed in the criminal system that had been overcrowded. Health benefits can be monitored through the drug-related harm, mortality and problematic drug use,

which have declined over the last decade. Lenton (2000) finds a similar effect for the decriminalized states in the US. A new, liberalized approach with high standards of regulation and health education – similar to the one taken on tobacco in the European Union – would benefit the United Kingdom in economic terms through reducing expenses in the law enforcement and the criminal system (Bryan, Del Bono & Pudney, 2013).

2.2 Adolescents and cannabis use

Cannabis use is on the rise world-wide and an increasing number of adolescents have tried the substance (Zimmer & Morgan, 1997). Apart from the need of a comprehensive European-wide review, it is quite important to look at adolescents, since they are often neglected in international research. However, the period of being an adolescent is critical for the use of (illicit) drugs, since it is unclear whether a higher frequency and a younger age of onset of cannabis use seems to be significantly related to a decriminalized approach.

Defendants of the criminalized approach highlight that decriminalization is responsible for earlier cannabis use among adolescents (Palali & van Ours, 2013). They are vulnerable, due to peer influences (Ennett, Flewelling, Lindrooth & Norton, 1997). More evenings out with friends are related to higher prevalence rates of use (Kokkevi, Arapaki, Richardson, Florescu, Kuzman, Stergar & Further, 2007) as well as failure in schooling (Fergusson, Horwood & Beautrais, 2003; Lynskey, Coffey, Degenhardt, Carlin & Patton, 2003). Pacula (2010) reviewed the literature regarding different types of drug use (initiation, regular, heavy and quitter) in 2010. For the young population four factors seemed to influence the initiation and usage behavior. These are decriminalization, penalties, price and conviction through the police force. A more liberal approach, lower penalties, lower prices and less frequent conviction are positively related to higher consumption. These four dimensions are all included in a decriminalized policy framework.

Proponents of decriminalization present evidence that cannabis use is not more frequent and that it does not happen at an earlier age, if the country has changed the law towards a decriminalized approach (Gorman & Huber, 2007; Williams, 2004; Miron, 2002). It is not detrimental to adolescents' health or behavior to decriminalize cannabis. Rather it is much easier to monitor health benefits under decriminalization (Degenhardt et al., 2008) and crimes rates decrease

(Erickson & Addiction Research Foundation of Ontario, 1980). Substitutes that adolescents could use for illegal cannabis are far more harmful than cannabis itself. On the one hand, this could be hard drugs and on the other hand, new drugs like spice, which are known to induce psychosis more frequently than cannabis (Johnson, Johnson & Alfonzo, 2011).

Cannabis is a soft drug and has moderate health effects, like tobacco or alcohol. However, it is debatable, if the adverse effects of cannabis are worse than those of legally available substances. On the one hand, cannabis seems to be especially detrimental to adolescents through dependency, accidents, cardiovascular as well as respiratory diseases, psychosis and depression (Hall & Degenhardt, 2009; Hall, 2008; Rey, Sawyer, Raphael, Patton & Lynskey, 2002). Furthermore, it slows development and is related to a lower educational level (Lynskey & Hall, 2002). On the other hand, Fried & O´Connell (1987) find no adverse effect of cannabis on the offspring, if it is used during pregnancy. Rather nicotine and alcohol damage the fetus.

3. Economic theory

3.1 Rational choice (pro-criminalization)

In the realm of rational choice theory, there are two potential lines of reasoning regarding the economic implications of cannabis use. Either sanctions for drug use or a metaphorical price for the drug is applied. A criminalized approach could be seen as a sanction since cannabis use is a criminal offence and a decriminalized approach could be regarded as a price due to the lower, administrative punishment. On the one hand, Cooter (1984) differentiates between prices and sanctions, with sanctions containing an extra element of deterrence. On the other hand, Becker (1974) equals prices and sanctions. He underscores that setting a sanction is the same as setting a higher price. Even though these two theories approach the topic from different angles, they still reach the same conclusion that a criminalized policy is more beneficial.

According to Cooter (1984), prices can be regarded as a payment for legal actions to internalize externalities, while sanctions are a consequence of an illegal act to deter wrongdoing. Sanctions are associated with a sudden jump in the sum of payment, when passing from the legal into the illegal zone. Prices do not have this rapid price increase, since they are not meant to deter behavior. Therefore, elasticity of behavior is much higher for price changes. This means that prevalence rates of cannabis use are likely to be higher under a decriminalized regime since

changing from a criminalized policy to a decriminalized approach on cannabis is parallel to transforming a sanction into a price. The price for the drug does not have the same deterring component that a sanction would have through imprisonment or a drug trial. A decrease of the price of cannabis would lead to more consumers under a decriminalized policy, but not under a criminalized regime, due to the behavioral elasticity.

According to Becker (1974), punishment for crimes, through criminal sanctions, is supposed to deter it (theory of deterrence). The individual has to weigh the gains of a criminal act versus the cost of receiving a criminal sanction, which also depends on the probability of being apprehended during the criminal act. Lower or non-existent sanctions are like lowering the price of the drug. It can be seen as a metaphorical price that is the combined price of the actual monetary payment and expected costs incurred by a criminal that is arrested. Therefore, the demand for the drug will rise, if the expected cost of being arrested is reduced from a criminal to an administrative offence.

Both, Cooter´s (1984) and Becker´s theory (1974), lead to the same conclusion that criminalization is likely to benefit society. A shift from a criminalized to a decriminalized approach on drugs can be analyzed from a microeconomic perspective with a criminalized state keeping the price of cannabis above the equilibrium level. Markowitz & Tauras (2009) suggest a relation between substance use and a bigger budget. Decriminalization is expected to lead to a drop in the price, which affects the price-sensitive adolescent population most (Williams, 2004). The demand for cannabis increases with the decrease in price, which is due to the budget constraint that adolescents have under the higher price of the criminalized regime (Bretteville-Jensen, 2006).

For cannabis, sanctions are preferable, since the desirable behavior for society can be identified (no consumption) and deviations from the socially desirable actions are hard to assess (Cooter, 1984). The sanction does not have to be calculated based on the harm caused (on the individual's health, in nuisance or drug related crimes, loss of workforce or accidents). This value would be impossible to calculate. However, the sanction has to be as large as to induce the socially efficient behavior by minimizing one´s private cost at the socially desirable level. In a decriminalized state the sanction is reduced to an administrative offence and the precaution taken is not at the socially efficient level. Rather it is at a point below the legal standard that minimizes the actor´s private costs, since the precaution taken is more elastic for prices than for sanctions.

Officials are the best observer of the social costs and the social benefits. Following Cooter (1984), sanctions in case of violation of a predefined legal standard are the best response.

3.2 Behavioral economics (pro-decriminalization)

Rational choice suggests that decriminalization increases cannabis use. However, reasoning in the light of behavioral economics suggests otherwise. Real-life examples of decriminalization do not support the inferences drawn from rational choice and deterrence theory either. States often decriminalize cannabis use because their usage rates are high and they need to solve the drug-related problems (Harper, Strumpf & Kaufman, 2012). If cannabis is treated like other soft drugs that have been legalized, prevalence of cannabis use would likely decrease. Adolescents like to experiment with forbidden products and legalization makes them boring (MacCoun, 2011).

Kahneman & Tversky (1984) established that the effect of the sanction can be grouped into two categories. (1) The effect at zero probability of being sanctioned and (2) the effect at non-zero probability of being sanctioned. In both, criminalized and decriminalized regimes, the effect lies within the non-zero effect of the sanction. Rational choice suggests a moderate deterrence effect for sanctions, but also highlights that the severity of sanctions does not matter (MacCoun & Reuter, 2001). A shift from criminalization to decriminalization does not remove the sanction and therefore, the deterrence effect should not be affected. Rather decriminalization reduces the criminal penalty into an administrative offence. This is a severity measure, which should not affect the deterring properties of the law for cannabis use.

Legal sanctions are not necessarily the right tool to reduce cannabis use in all population groups (MacCoun, Pacula, Reuter, Chriqui & Harris, 2009). The influence of sanction on adolescents is limited (Cameron & Williams, 2001). This could be due to risk-taking behavior, over- or underestimations of risks and benefits of a situation, impulsivity, biased judgment and the lack of good decision-making skills (Rheyda & Farley, 2006). Under both policies, criminalization and decriminalization, the individuals are subject to anchoring and other biases (Kahneman, 2003).

Decriminalization does not lead to higher prevalence rates of cannabis use as the examples of the Netherlands and Portugal show. The cannabis market in the Netherlands can be called a success (Spapens, 2011). The population that uses cannabis is lower than in other EU countries or the US and in comparison to other countries, Dutch citizens stop experimenting with cannabis faster

(McVay, 1991). Portugal´s rates of drug use decreased after legalization, especially for high-risk use (Hughes & Stevens, 2010). It seems that decriminalization can be used as a tool to reduce cannabis use (Laker, 2003). There is no need for criminal or administrative sanctions to achieve that goal.

4. Methodology

4.1 The difference-in-differences approach

The research is based on macro data for a sample of 24 European countries. The study estimates the difference between prevalence rates of adolescent cannabis use under different policy regimes. Prevalence rates of cannabis use are taken from the United Nations Office on Drugs and Crime (2013), which ensures reliability of data by combining national sources with the European School Survey Project on Alcohol and other Drugs (ESPAD). Each country´s drug policy was retrieved from the European Union´s database (European Monitoring Center for Drugs and Drug Addiction, 2013). The goal is to estimate whether there is a causal effect running from decriminalization of personal cannabis use and possession to prevalence rates.

The analysis is carried out for 24 countries: They can be divided into three categories: (1) European Union member states[2], potential European Union member states[3] and other European Region countries with high quality or synchronized data collection and reporting in common databases[4].

As explained in section 2.2, adolescents (15 to 16 year olds) were chosen, since the data is comparable for many European countries. Furthermore, people below the age of 18 are subject to the national laws of their birth-state. They are unable to take important life decisions on their own, since they are not of age yet. Another factor considered is that travelling and mobility are reduced for adolescents as well as stays abroad in countries that decriminalized cannabis and entry to coffee shops in the Netherlands are not easily done/ impossible for teenagers. This means

[2] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, France, Hungary, Ireland, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, and the United Kingdom

[3] Iceland and Serbia.

[4] Liechtenstein, Moldova, Switzerland and Ukraine.

that they will be heavily influenced in their drug use through national law. The access to (soft) drugs will depend on the conservativeness of the law and the enforcement.

As many data points as possible were collected per country. However, the availability of data is limited and only for the countries included in the sample more than one observation was found. On average there are 2.6 observations per country. The intention was to find one estimate of cannabis use from pre-decriminalization and another one from post-decriminalization period. The countries that did not change their legislation serve as a control group. The number of observations per country was not equal over time and analysis was carried out as an unbalanced panel. However, there was no right-side bias due to drop outs, but rather improvements in data collection and an increase in available observations and this does not affect the validity of the data and findings (Baltagi, 2013). Anonymous questionnaires were employed to collect prevalence rates of cannabis use in adolescents in order to avoid answers biased by a social desirability effect.

A total of 92 observations could be extracted from the United Nations database in May 2014. However, only the countries that changed their legislation from criminalization to decriminalization of personal use and possession during the time period was compared with the group of countries that kept a criminalized approach. 62 observations were left for analysis after eliminating the countries that changed towards a decriminalized approach before data was available. The observations were yearly estimates of lifetime prevalence of cannabis use in order distinguish the effect from other changes in the same years.

The empirical approach used is a difference-in-difference model. 24 European countries are assessed regarding their prevalence of adolescent cannabis use as an outcome measure and their policy on cannabis. 14 countries decriminalized cannabis for personal use and possession during the period of observation from 1990 to 2012 and 10 countries kept a criminalized approach on cannabis. The difference in prevalence of cannabis consumption was compared between the treated countries, which decriminalized cannabis, and the non-treated countries, which stayed with a criminalized policy. The countries that did not decriminalize cannabis are used as counterfactual (Angrist & Pischke, 2008). They are the control and show the trend that states would have had, if they would not have decriminalized cannabis.

The parallel trend assumption cannot be verified empirically since the number of data points before treatment is not sufficient; however, the assumption is thought to hold. In absence of decriminalization the trend in cannabis use would be equal for all countries (Mora & Reggio, 2012). Meyer (1995) states that an empirical verification is a useful addition, but that it is not necessary, if the development of trends should be the same. Since this paper includes 24 European countries with similar historical backgrounds and parameters, cannabis use should follow the same pattern. The European Monitoring Center for Drugs and Drug Addiction (2008) underscores the similarity of developments in the cannabis markets in Europe. Therefore, an underlying common trend is a reasonable assumption

A fixed effects regression was employed to check the within-country differences over time and to prevent omitted variable bias. The observations were treated as panel data. However, they were pooled cross-sections of the adolescent population in different countries at the varying points of time. On average 2.6 observations of prevalence of cannabis use were available for each country in the database of the United Nations Office on Drugs and Crime (2013). The countries varied widely in their starting and end level of cannabis consumption. Nevertheless, this approach considers the heterogeneity between the countries and unobservable factors, like culture or manners, are not an issue.

Meyer (1995) researched difference-in-differences approaches and concluded that they are apt for the estimation of causality when laws are changed. The effect decriminalization has is visible in the within-country changes in cannabis use pre- and post-decriminalization by comparing countries that decriminalized (changed the law) versus those that did not. The analysis was carried out with Stata (version 13.1) and clustering of standard errors was done at country level for the difference-in-differences model (Bertrand, Duflo & Mullainathan, 2004). A common trend for both, treated and non-treated countries, was assumed.

The model is formally specified as

$$Y_{ct} = \beta_0 + \beta_1 Year_t + \beta_2 Policy_c + \beta_3 Treated/Post_{ct} + \alpha_c + \varepsilon_{ct}$$

Y_{ct} is the outcome measure, namely prevalence of young people that ever used cannabis in country $_c$ in year $_t$. β_0 is the intercept that shows the basic effect for countries that were not treated in the initial observation period before treatment. Since data on adolescent cannabis use is scarce,

no pre- and post-legislation point where specified. Rather the trend is monitored between the years 1990 and 2012 with about 2.6 observations per country. Therefore, Year indicates the year the observation was made. Policy is the treatment dummy. It distinguishes whether a country has (1) or has not been treated (0). This dummy is needed for the first estimation model without fixed effects; later it is omitted. Treated/Post shows whether a country has been treated by decriminalizing cannabis and whether the observation stems from the pre- or post-legislation change period. Treated/Post is a dummy that only shows the value 1, if a country has been treated and is in the post-legislation change period. This term replaces the interaction usually seen in difference-in-difference models.

Instead of merely dividing between treated and non-treated countries a fixed effect and a cluster were included. Each country with its observations was specified as a separate cluster - there were 24 of them. This was done to account for the intra-group correlation, while the clusters (countries) themselves should be independent from each other. The fixed effect, α_c, allows the intercept to differ from country to country. Nevertheless, the slopes were still assumed to be the same. It was assumed that the countries are not systematically different. Through the fixed effect model we can connect observation sets and countries and identify the within country variation. The exogenous bias, like cultural background, is eliminated and control variables are not necessary. ε_{ct} is the country- and year-specific error term.

Drawbacks of the data that have to be mentioned are the scarcity, the missing t_0 and t_1, the differing definitions of adolescents and the methodological design. Only very limited data was available for adolescent cannabis use; however, adolescents are the relevant consumer group and another approach would not seem as promising. The differences in prevalence of cannabis use were not compared between two specific points in time (t_0 and t_1), but rather observed as a general trend in time. This was due to the availability of data in very specific years for each country. Adolescents were defined as 15-16 year olds. Nevertheless, for some observations the definition differs and ranges from 12 to 24 years. Harper, Strumpf & Kaufman (2012) suggest that difference-in-differences models have one fallacy, namely the strong assumption that there are no immeasurable changes in behavior or policy that could affect cannabis use in the treated versus non-treated states. Nevertheless, all these drawbacks have been carefully considered and are not thought to change the main result of the analysis.

4.2 Extended model

The plain difference-in-differences model needs to be supplemented with further explanatory variables, which can be identified from the literature. However, prevalence of cannabis use is predicted by a multitude of factors and only the most important ones on population level are used in this model (European Monitoring Center for Drugs and Drug Addiction, 2008). These variables include unemployment, alcohol use, GDP per capita and a polity score. The extended formal specification of the model, with the four additional independent variables and their coefficients, is:

$$Y_{ct} = \beta_0 + \beta_1 Year_t + \beta_2 Policy_c + \beta_3 Treated/Post_{ct} + \beta_4 Unemployment + \beta_5 Alcohol + \beta_6 GDP + \beta_7 Polity + \alpha_c + \varepsilon_{ct}$$

Unemployment as an explanatory variable is taken from the European Health for All Database (World Health Organization, 2014). It is estimated as the percentage of the population that is registered as unemployed. The European Monitoring Center for Drugs and Drug Addiction (2008) defines unemployment and the closely connected notion of boredom as the main contextual risk factor for cannabis use. Moreover, peer pressure effects are stronger in groups of unemployed adolescents: They are more likely to (1) have had trouble in the school system, (2) be in contact with delinquents and (3) copy the example of their substance using peers (van den Bree & Pickworth, 2005). Unemployed adolescents use cannabis more often (Morrell, Taylor & Kerr, 1998). Consequently, if a higher percentage of the population is unemployed, prevalence of cannabis use should be higher.

Alcohol use is measured in liters per capita and the variable can be found in the European Health for All Database (World Health Organization, 2014). More alcohol use is significantly related to higher prevalence of cannabis use according to Hofler et al. (2002). Guxens, Nebot, Ariza & Ochoa (2007) support this finding in a systematic literature review of risk factors for cannabis use. This is especially important since von Sydow et al. (2002) estimate the effect for adolescents and also find previous experiences with alcohol to be a significant predictor for cannabis use. The European Monitoring Center for Drugs and Drug Addiction (2008) highlights the difficulty of refusing drugs when intoxicated with alcohol. Therefore, higher alcohol use in the population should lead to higher cannabis use.

GDP per capita (in constant 2005 US$ for all years) is extracted from the World Bank´s World Development Indicators (World Bank, 2014). The financial dimension is critical for the decision on whether to use or not to use cannabis (European Monitoring Center for Drugs and Drug Addiction, 2008). Adolescents are subject to a budget constraint and Markowitz & Tauras (2009) find that a bigger budget predicts higher substance use. The cannabis market is booming in wealthier countries (Little, Weaver, King, Liu & Chassin, 2008) and prevalence of cannabis use is higher since their citizens can afford it more easily (ter Bogt et al., 2014). Therefore, a higher GDP per capita should indicate more cannabis use.

The polity score can be found in the online resources of the Center for Systemic Peace (2014). It is a combined score for the level of autocracy and level of democracy, with the first subtracted from the latter. It is measured on a scale from -10 to 10. A higher polity score indicates a more democratic environment in which cannabis is subject to lobbyism since green parties often include cannabis decriminalization in their party´s electoral program. A few examples are Belgium (Gelders & Van Mierlo, 2004), New Zealand (Edwards & Lomax, 2012) and the United Kingdom (Green Party, 2006). The European Monitoring Center for Drugs and Drug Addiction (2008) specifies that trying to fit in and peer pressure make individuals prone to cannabis use. Attitudes towards cannabis are slowly changing and law enforcement world-wide is reduced (Duncan, 2008). A more democratic environment with an array of parties and opinions should then be an indicator for higher prevalence of cannabis use.

5. Empirical analysis

5.1 The difference-in-differences approach

Decriminalization is the main factor analyzed. Countries with a decriminalized approach on personal use and possession of (small quantities of) cannabis are compared to the countries with a criminalized approach. The idea is to look at the absence of criminal penalties and the data are extracted from the legal documents and laws on drugs for each country. The dependent variable is the prevalence of cannabis use among adolescents, due to the fact that most research so far has assessed the measure of decriminalization through its effect on the prevalence rates (Hughes & Stevens, 2010).

	Pre-treatment period (1^{st} point of observation for non-treated countries)	**Post**-treatment period (2^{nd} point of observation for non-treated countries)
Non-treated countries # of observations	10.03 % 10	18.64 % 16
Treated countries # of observations	18.52 % 16	19.43 % 20

Table 1: Mean prevalence of adolescents´ cannabis use in %. Two-by-two table for criminalized (non-treated) versus decriminalized (treated) countries before and after treatment.

As visible in table 1, the mean prevalence of cannabis use among adolescents is split in a two-by-two table between criminalized and decriminalized countries. The mean prevalence of the pre- and post-treatment periods is observed for these two groups. Non-treated countries, which did not change their laws regarding the personal use and possession of cannabis and kept it criminalized, have a mean prevalence of adolescent cannabis use of 10 percent at the pre-treatment point. Their prevalence rose to about 18.5 percent at the later point of time (post-treatment). This is an increase of 8.6 percent. The treated group started with a mean prevalence of 18.5 percent and it increased to 19.5 percent for the post-treatment measurement. This is an increase of 0.9 percent.

The increase in mean prevalence of adolescent cannabis use during the period of observation from 1990 to 2012 was higher for the group of criminalized countries. Their increase was 8.6 percent versus the 0.9 percent increase of mean prevalence for the countries that decriminalized cannabis. However, the starting points for the two groups were substantially different. The countries with a criminalized policy started with a mean prevalence of 10 percent at pre-treatment measurement level, while the countries that would be treated later had a mean prevalence of 18.5 percent. This constitutes a difference of 8.5 percentage points.

Following the basic difference-in-differences approach, the treatment effect can be calculated. The theoretical formula can be described as (Post-treatment mean $_{\text{Treated Countries}}$ − Pre-treatment mean $_{\text{Treated Countries}}$) – (Post-treatment mean $_{\text{Non-treated Countries}}$ − Pre-treatment mean $_{\text{Non -treated Countries}}$).

Using the percentages from table 1: (19.43 % - 18.52 %) – (18.64 % - 10.03 %). The treatment effect of cannabis decriminalization is -7.7 % on the mean prevalence of cannabis use. Treated countries experience a 7.7 % lower increase in cannabis use as compared to the criminalized countries.

Variable	**# of observations**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Prevalence of adolescent cannabis use (%)	62	17.47	10.62	3.5	45.1
Year of the observation	62	Not applicable	Not applicable	1990	2012
Decriminalization (0=no; 1=yes)	62	0.58	Not applicable	0	1
Treated + Post-legislation change (0=no; 1=yes)	62	0.32	Not applicable	0	1

Table 2: Summary statistics for the variables used in the difference-in-differences model.

In table 2 summary statistics for the variables used are presented. The data is included in the appendix. Cannabis prevalence ranges from 3.5 to 45.1 % during the years 1990 to 2012 in the 24 countries. 62 observations were made during that time period. Year shows the time trend that replaces a t_0 and t_1 point of time. Decriminalization is the treatment dummy and merely shows whether has been treated or not (0 = no; 1 = yes). Treated + Post-legislation change summarizes whether a country has been treated and prevalence of cannabis use is recorded for the post-treatment period (Dummy = 1).

Variable	**Coefficients without fixed effects (p-value)**	**Coefficients with fixed effects (p-value)**
Constant	-1006.12 (0.006)*	-1279.92 (0.003)*
Treatment Dummy	5.44 (0.184)	omitted
Year	0.51 (0.005)*	0.65 (0.003)*
Interaction (Treatment and Time-period)	-4.66 (0.144)	-6.33 (0.047)*

*significant at the 5 % level

Table 3: Result of the difference-in-differences analysis.

The crude analysis without fixed effects shows no significant difference for the interaction term. This means that there is no difference between treated and non-treated countries with regards to their mean prevalence of adolescents` cannabis use. The confidence interval of the interaction terms goes from -10.93 to 1.60. For each year the mean prevalence of cannabis consumption increases by 0.5 percent. The next step is to eliminate the country-specific characteristics, which is done in the following model with fixed effects.

The result of the difference-in-differences analysis with fixed effects is significant with a p-value of 0.047. Decriminalizing cannabis leads to an average reduction of cannabis use by 6.33 %. The difference-in-differences estimator (β_3) shows the decline in cannabis use due to the policy change (treatment). This means that countries that decriminalized personal cannabis use and possession experienced a significant decrease in cannabis use in comparison to the countries that

did not decriminalize cannabis. The confidence interval is -12.55 to -0.10 at the 95 % level. The treatment dummy is omitted, since the countries are clustered and each country is considered as an individual group. The dummy does not change over time for a country; only the treated + post-legislation change dummy changes from pre (0) to post (1).

The R^2 within countries is 25.59 %. This means that 25.6 % of the variance within each country can be explained by the change in legislation. Even though the overall R^2 accounts only for 0,29 %, the policy effect on people´s behavior can be estimated through this difference-in-differences approach. In treated countries the use of cannabis, which previously was at a higher level compared to the non-treated countries, decreases.

5.2 Extended model

Variable	# of observations	Mean	Standard Deviation	Minimum	Maximum
Unemployment (% of population)	55	8.36	4.37	0.5	23.6
Alcohol use (liters per capita)	49	10.86	2.06	6.05	14.74
GDP per capita (in constant 2005 US$)	61	24952.09	21789.42	974.1	105306.8
Polity (from -10 = autocracy to 10 = democracy)	55	9.11	2.18	-5	10

Table 4: Summary statistics for the independent variables used in the difference-in-differences model.

In table 4 the descriptive for the control variables are summarized. As visible, the data for the independent variables was incomplete, especially for smaller countries, such as Liechtenstein. However, there is variation in all of the covariates and they are well-suited for analysis. The

theoretical background for each of them was laid out in section 4 and a positive coefficient is expected for all of them in the difference-in-differences model.

Variable	**Coefficients without fixed effects (p-value)**	**Coefficients with fixed effects (p-value)**
Constant	-1340.55 (0.010)*	-2058.91 (0.009)*
Treatment Dummy	5.08 (0.214)	omitted
Year	0.66 (0.011)*	1.02 (0.010)*
Interaction (Treatment and Time-period)	-8.60 (0.051)	-12.26 (0.038)*
Unemployment	0.69 (0.107)	1.17 (0.109)
Alcohol	1.77 (0.043)*	2.28 (0.049)*
GDP	0.00 (0.201)	0.00 (0.852)
Polity	0.68 (0.300)	0.29 (0.559)

*significant at the 5 % level

Table 5: Result of the difference-in-differences analysis with independent variables.

In table 5 two models are specified analogous to table 3: First, a model without fixed effects and second, a model with fixed effects. The first model without fixed effect is not significant for the interaction term: There is no difference between treated and non-treated countries with regards to their mean prevalence of adolescents` cannabis use just as table 3 shows for the basic model. However, in this model, the p-value of 0.051 is on the verge of significance, even without fixed effects and the confidence interval of the interaction terms goes from -17.25 to 0.05. For each year the mean prevalence of cannabis consumption increases by 0.7 percent.

In the second model with fixed effects the country-specific characteristics are eliminated. The result of the difference-in-differences analysis with fixed effects is significant with a p-value of 0.038. This is a higher significance level than in the basic model without independent variables. Decriminalizing cannabis leads to an average reduction of cannabis use by 12.26 % when controlling for unemployment, alcohol use, GDP and polity. The difference-in-differences estimator (β_3) shows the decline in cannabis use due to the policy change (treatment), while controlling for the four independent variables. This means that countries that decriminalized personal cannabis use and possession experienced a significant decrease in cannabis use in comparison to the countries that did not decriminalize cannabis. The confidence interval is -23.76 to -0.77 at the 95 % level.

The only significant independent variable is alcohol use. The indicator has a positive coefficient, which means that higher alcohol use is related to more cannabis use. Controlling for alcohol use per capita increases the visible effect of cannabis decriminalization. When holding alcohol use constant across countries, the true effect size of cannabis decriminalization can be seen. Unemployment, GDP and the polity score are non-significant predictors in this model, but their coefficients point towards the expected direction.

The R^2 within countries is 44.27 %. This means that 44.3 % of the variance within each country can be explained by the change in legislation when controlling for and eliminating the effect of the explanatory variables. The overall R^2 accounts for much more of the variance in the model with control variables: 15.7 %. In treated countries the use of cannabis, which previously was at a higher level compared to the non-treated countries, decreases. This mirrors the results of the basic model without additional explanatory variables, but controlling for independent covariates strengthens the validity of the difference-in-differences model.

6. Conclusion

States that passed a new law regarding personal cannabis use and possession generally had higher average of prevalence rates of cannabis use. According to the reasoning of Wall, Poh, Cerdá, Keyes, Galea & Hasin (2011) and Harper, Strumpf & Kaufman (2012) this was due to countries trying to control the external effects of cannabis use by decriminalizing. However, decriminalization did not only free capacities in the law enforcement, made harm reduction measures possible and had a positive effect for the offenders. It also decreased cannabis consumption in the countries that decriminalized cannabis by more than 6 % in the basic model as compared to the trend that the group of control countries followed. In the extended model this effect was even higher, with a decrease of 12 % when controlling for unemployment, alcohol use, GDP and polity (of which only alcohol use is a significant predictor). Therefore, decriminalization has a positive effect for society.

Due to decreased travelling costs and single markets (for example throughout the US or the Schengen area), consumers are flexible and free to obtain and consume cannabis in a state other than their home country (Grobe & Lüer, 2011). The consequence for international drug policy from this analysis is that the current tendencies to decriminalize or to legalize soft drugs might decrease usage rates among adolescents and improve country-specific conditions. However, a harmonized international criminal law on cannabis is needed, due to the vast possibilities of drug tourism (Kurzer, 2011; den Boer, 1997). If the legislator criminalizes cannabis, it is not within his interest that its citizens use drugs abroad. Adda, McConnell & Rashul (2014) point out that the importance should not be placed on the policy itself, but rather on the harmonization of all jurisdictions.

The UN Single Convention on Narcotic Drugs from 1961 demands global, unified compliance and enforcement with regards to substances labeled as drugs (United Nations, 1961). The Global Commission on Drug Policy has recognized that the war on drugs has failed and that a criminalized approach is not beneficial for public health (Global Commission on Drug Policy, 2011). Problems related to criminalization are stigmatization, unsafe and unhygienic conditions, drug-related crime and illegality of harm reduction measures. By recommending and suggesting that one approach to criminal law on cannabis is right, the international pressure to adopt this

strategy is constantly rising. Uruguay has already caved and legalized cannabis in 2013 (The Time, 2013) and some US states have followed in 2014 (Colorado Government, 2012).

So why is the grass always greener on the other side? Neither economic theory, nor empirical studies can conclude whether criminalization or decriminalization is more beneficial. States that have a conservative take on use and possession of small quantities of cannabis tend to look towards decriminalization as a mean to solve the problems associated with drug use. Nevertheless, criminalization prevents drug tourism and nuisance connected to it. There is a certain trade-off a state has to evaluate. On the one hand, decriminalization has to go along with a high level of regulation and control. This places a high burden on the legislator and the law enforcement. On the other hand, the reasons for the current policy changes are the overcrowding of the criminal system with minor offenders and the high costs of prosecution. Lenton (2000) highlights that the economic benefits outweigh the public health benefits and that it is in a state´s best interest to decriminalize cannabis.

Cannabis is widely consumed and will not bring about additional harm, if it is well-regulated, taxed and controlled under a decriminalized regime (Pudney, 2010). The UN Single Convention on Narcotic Drugs needs to be adjusted to the today´s challenges and personal use and possession of cannabis have to be decriminalized world-wide. Occasional cannabis use should be tolerated (Nadelmann, 1989). A future research topic will be to evaluate the data generated from Uruguay´s legalization of cannabis and the effort of some of the US states (like Colorado and Washington) to decriminalize, control and restrict cannabis dispensaries.

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Appendix – Pool cross-sectional data used for the empirical analysis

Country	Prevalence of adolescent cannabis use (%)	Year of the observation	Decriminalization (0=no; 1=yes)	Treated + Post-legislation change (0=no; 1=yes)
Austria	8.7	1994	1	0
Austria	18.0	2007	1	1
Belgium	18.9	1996	1	0
Belgium	24.0	2010	1	1
Belgium	21.5	2011	1	1
Bulgaria	15.0	1995	0	0
Bulgaria	26.0	2008	0	0
Bulgaria	25.6	2011	0	0
Croatia	9.0	1995	1	0
Croatia	18.3	2007	1	1
Croatia	13.4	2010	1	1
Cyprus	5.0	1995	0	0
Cyprus	5.0	2007	0	0
Cyprus	7.0	2011	0	0
Cyprus	10.9	2012	0	0
Czech Republic	21.5	1995	1	0
Czech Republic	45.1	2007	1	0
Czech Republic	42.3	2011	1	1
Denmark	28.0	1995	1	0
Denmark	25.5	2007	1	1
Denmark	18.1	2011	1	1
Estonia	7.5	1995	1	0
Estonia	26.2	2007	1	1
Estonia	24.2	2011	1	1
France	11.6	1993	0	0
France	31.0	2007	0	0
France	41.5	2011	0	0
Hungary	4.8	1995	0	0
Hungary	5.3	2007	0	0
Iceland	9.0	2007	0	0
Iceland	4.0	2011	0	0
Ireland	37.0	1995	1	0
Ireland	20.0	2007	1	1
Ireland	18.0	2011	1	1
Liechtenstein	16.2	2005	1	0
Liechtenstein	21.2	2011	1	1
Luxembourg	6.0	1995	1	0

Luxembourg	27.4	1999	1	0
Luxembourg	15.5	2010	1	1
Malta	8.5	1995	0	0
Malta	12.9	2007	0	0
Malta	9.8	2011	0	0
Moldova	4.8	2008	1	0
Moldova	4.9	2010	1	1
Poland	12.2	1995	0	0
Poland	36.0	2010	0	0
Poland	24.3	2012	0	0
Portugal	8.5	1995	1	0
Portugal	13.0	2007	1	1
Romania	3.5	2007	0	0
Romania	7.1	2011	0	0
Serbia	6.7	2008	1	0
Serbia	6.7	2011	1	1
Slovakia	15.7	1996	0	0
Slovakia	18.8	2010	0	0
Switzerland	15.0	1990	0	0
Switzerland	33.0	2007	0	0
UK	37.0	1995	1	0
UK	24.3	2010	1	1
UK	21.1	2011	1	1
Ukraine	14.0	2007	1	0
Ukraine	12.4	2011	1	1