# Essays on the regulation of cannabis -

# A law and economics approach

Kumulative Dissertation

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Vorgelegt von

Ines Reith

geboren am 25. Mai 1990 in Bochum.

Hamburg, 2016

Vorsitzender:	Prof. Dr. Maennig
Erstgutachter:	Prof. Dr. Straubhaar
Zweitgutacher:	Prof. Dr. Eger
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#### Preface and acknowledgments

This dissertation was written in the Graduate School of "The Economics of the Internationalization of the Law" in Hamburg, Germany. The three-year program is funded by the German Research Foundation (DFG) and offers the possibility to investigate a topic of personal choice. I would like to thank the German Research Foundation (DFG) for their generous financial support as well as for the provision of materials and offices. The thesis centers around cannabis regulation in the international context since it is of high interest for all actors involved and offers vast possibilities for analysis. This dissertation is interdisciplinary between law, economics, public health and political sciences and consists of five papers on cannabis policy.

I was blessed with helpful and motivating supervisors, namely Prof. Dr. Thomas Straubhaar and Prof. Dr. Thomas Eger. Both of them helped me through constant academic discussions, moral support and devotion of time to my research. I feel very grateful for the efforts of the team at the Hamburg Institute of Law and Economics and Janina Satzer's good organizational skills. I highly appreciate Jerg Gutmann's input and knowledge about econometrics. Furthermore, Prof. Dr. Stefan Voigt kept me on the right track to completion of the thesis through his comments.

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Finally yet importantly, I want to praise my mum for bearing with me all those years of studying and endless complaints about bureaucracy at university. I am grateful to have a loving family that always cheered me up. I send kisses to my brother, my grandparents Irene and Bruno and my dad.

"Now here's somebody who wants to smoke a marijuana cigarette. If he's caught, he goes to jail. Now is that moral? Is that proper? I think it's absolutely disgraceful that our government, supposed to be our government, should be in the position of converting people who are not harming others into criminals, of destroying their lives, putting them in jail. That's the issue to me."

> - Milton Friedman, Economist and Nobel Prize Winner (1991, Interview at America's Drug Forum)

"Marijuana is an addictive drug which produces in its users insanity, criminality, and death."

- Harry Anslinger, Commissioner of the US Bureau of Narcotics 1930-1962 (1937, Congressional Hearing on the Marijuana Tax Act)

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# Introduction

#### 1. The broader context

Public health is the responsibility of each nation state on its own, as visible from the minor competences granted on international or supranational level. Nevertheless, many health-related problems can be solved more efficiently in an international effort (WHO, 2006); for example the regulation of legal and illegal drugs (Commission of the European Communities, 2007). The Schengen and the North American Free Trade Agreement (NAFTA) opened the possibility of easy border crossing, which also unintentionally facilitates trade in substances that are considered illegal in one's home country. These include cannabis, hard drugs, but also certain types of spirits like absinth.

The pursuit of harmonization of laws as a mean to decrease substance-related problems has led to a series of manifestos throughout the 20<sup>th</sup> century (Zimmer, 1997). In 1961, the first hard law treaty on drugs came into force: The United Nations (UN) Single Convention on Narcotic Drugs (United Nations, 2013). This convention demanded complete criminalization of drugs and classified cannabis as a drug that needs to be put in the strictest control schedule, along with heroin and cocaine. In 1971 and 1988 two complementary treaties were adopted; the Convention on Psychotropic Substances and the UN Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances, respectively (United Nations, 2015). However, these two subsequent treaties did not change the status of cannabis as a highly controlled drug.

The Global Commission on Drug Policy (2014) published a report in September 2014. This manifesto called for change in drug policies because prohibition had failed to eradicate drug-related problems. Members of this commission include Kofi Annan, UN officials (Michel Kazatchkine, Thorvald Stoltenberg among others) and many (former) presidents, like Juan Manuel Santos (president of Colombia) and Ruth Dreifuss (former president of Switzerland). The Commission invited experiments with regulated legalization or at least cannabis decriminalization to protect individual users from criminal penalties.

The UN General Assembly Special Sessions (UNGASS) on drugs was due to be held in 2019 (International Drug Policy Consortium, 2014). However, due to requests by a multitude of countries, it has been moved forward to 2016. This meeting was last held in 1998 and 2008 and provides a huge opportunity to reconsider modern drug policy. The assembly is responsible for policy-making and all countries are represented equally. The Global

Commission on Drug Policy (2014) believes that the UN Single Convention on Narcotic Drugs from 1961 can be reformed towards a more liberal approach during this assembly. Room (2014) highlights that the ongoing modernization of cannabis policy needs to be reflected in UN legislation to protect public health interests world-wide.

It is important to realize that the UN Single Convention on Narcotic Drugs from 1961 has a binding character, which other institutions in the domain of health do not have. The WHO can only adopt non-compulsory measures to benefit or protect international public health (WHO, 2006). Statements and advice can be issued or best practice on policy can be identified through research. However, the 194 member states of the WHO do not have to adhere to the recommended actions and often choose to use their sovereignty to make their own decisions. In the European Union "*a high level of human health protection shall be ensured*" (European Union, 2008, Article 168,1) throughout all policies and decisions. However, the tasks and legal possibilities of the European Union are restricted in the domain of public health (Aluttis et al., 2013). The instruments available fall within the soft law category, for example by fostering cooperation or supplementing the efforts of the member states.

This dissertation centers around the treaty provisions of the United Nations on the topic of cannabis, which is regulated in articles 4, 33 and 36 of the Single Convention. The UN Single Convention on Narcotic Drugs is the most important document in this domain (United Nations, 2013). It is hard law as a result of which 184 countries have agreed to criminalize the use of cannabis for purposes other than research or medical use. A control mechanism for adherence is provided through the International Narcotics Control Board (International Narcotics Control Board, 2014). This International Narcotics Control Board reviews every country's compliance status on an annual basis. This includes drug policies as well as administrative and governmental provisions. In case of non-compliance, article 14 comes into force and this entails several stages of punishment from consultations to more severe measures. This is further explored in the article "live and let die".

Cannabis policy is not the binary choice between prohibition and full legalization as it is often assumed (Caulkins et al., 2015). Nowadays a number of more nuanced policies have emerged towards cannabis (Pudney, 2010). These range from prohibition with increased sanctions to commercializing cannabis sales. However, it is important to remember the

interconnectedness of countries. Cannabis deregulation in one jurisdiction will have effects on surrounding countries as well (Caulkins et al., 2015).

The driving forces behind these emergent legal approaches need to be analyzed. Why have these divergent approaches come into existence and what consequences does each entail? Figure 1 shows the scale of policy options for drugs along the x-axis, ranging from complete prohibition to an unregulated, free market. At this moment, the options considered for cannabis policy are prohibition, decriminalization or regulated legalization. The two extremes of criminalization and legalization are defined by whether or not there is a criminal penalty for the offender. This is absent in a legal drug market, but imposed under prohibition (Pacula et al., 2005). Decriminalization converts the criminal penalty into an administrative one, at least for personal use and possession, up to a certain threshold of grams of cannabis.



Figure 1: Degrees of drug regulation and market consequences.

Based on a graph presented by the Global Commission on Drug Policy (2014), but with minor changes in labeling.

Until now, only Uruguay has opted to legalize cannabis under a state monopoly (Room, 2014). Many other governments have decriminalized cannabis in order to reduce costs and other negative consequences of prohibition (Pudney, 2010; Pacula et al., 2005). This is shown on the y-axis: According to the Global Commission on Drug Policy (2014), the problems

related to cannabis policy are minimized, if a scheme of regulated legalization is adopted. Decriminalization performs better than prohibition in this regard, but it is not the optimal policy.

In Figure 2 a timeline is displayed. It starts in 1976, when the Netherlands decriminalized cannabis and became the first country to do so. Since then 44 countries more have adopted decriminalization as the approach of choice regarding cannabis. These countries are very diverse ranging from Brazil and Argentina in South America to Portugal and Czech Republic in Europe to Kazakhstan or even Bangladesh. Australia and the US have been excluded from this Figure because policies vary between states. Federally, prohibition remains in force in the US, but cannabis has been legalized in some US states, like Colorado or Washington (Room, 2014).



Figure 2: Timeline of cannabis decriminalization world-wide.

The quotes above, from Harry Anslinger and Milton Friedman, mirror the lack of consensus in international policy-making on cannabis. Only if all jurisdictions decriminalize cannabis simultaneously, the maximum benefits of this policy can be achieved (Adda, McConnell & Rashul, 2014). This would mean reallocation of law enforcement resources, enhanced welfare and diminished drug tourism, which the Netherlands defines as the major drawback of its

decriminalization policy because of the nuisance caused (Government of the Netherlands, 2014). Nevertheless, the number of supporters for a relaxation of cannabis policy is growing world-wide (Global Commission on Drug Policy, 2014).

#### 2. Connection between the cumulative dissertation papers

The dissertation consists of five papers that add up to my doctoral thesis in a cumulative way (see Figure 3). Each paper takes up the point of view of a different and salient stakeholder. The focal points are (Paper 1) the international community as reflected through UN policy, (Paper 2) the electorate and policy-makers, (Paper 3) the consumers, (Paper 4) the alcohol industry and (Paper 5) the cannabis producers. Furthermore, every piece of work will contribute to the understanding of cannabis policy and its consequences in a unique way. If they are read as an accumulation of insights, a thorough understanding of cannabis regulation world-wide will emerge.



Figure 3: Dissertation paper and their inter-relatedness.

(Regarding 1) International pressure due to the UN Single Convention on Narcotic Drugs from 1961 has directed cannabis policy into criminalization on an international as well as national level (United Nations, 2013). However, countries increasingly deviate from this hard law treaty. (Regarding 2) Different US states have adopted varying degrees of cannabis deregulation (Gorelick, 2014). Assessing the determinants of cannabis legislation might help predict deregulation. (Regarding 3) The consumer base has substantially grown in the last decades and cannabis has become the most widely consumed illegal drug (United Nations Office on Drugs and Crime, 2013; Zimmer & Morgan, 1997). Cannabis policy could foster or diminish this trend. (Regarding 4) In order to explore national players with an interest in preventing a rapid and easy deregulation of cannabis, the role of the alcohol industry as a policy stakeholder is analyzed in more detail. (Regarding 5) Decriminalization might affect the behavior of cannabis producers and lead to an increased or decreased domestic production.

The questions tested by empirical means and solved by this dissertation are fivefold:

(1) What are the incentives for governments to deviate from the agreed upon criminalization in the UN hard law from 1961? This explores the economic incentives for cannabis decriminalization.

(2) Why do US states deregulate at different speeds and extents? This question explores the drivers of the electorate and policy-makers.

(3) What are the consequences in the consumer base, if this deregulation takes place? Posing this question explores the social incentives to decriminalize cannabis.

(4) Why do some stakeholder groups invest heavily in order to avoid a liberalization of cannabis policy? This question highlights the actors' incentives to (de)criminalize cannabis.(5) How are cannabis cultivators affected by the prevailing policy? Criminalization might deter individual growers, while organized crime thrives.

#### 3. Paper summaries and presentation opportunities

#### 1. Live and let die - Survival analysis of the UN Single Convention on Narcotic Drugs

#### Abstract

Almost all countries worldwide agreed to the UN Single Convention on Narcotic Drugs from 1961, which highly criminalizes cannabis in its strictest schedule. However, the Netherlands de facto legalized cannabis in 1976. Since then many more countries have decriminalized cannabis due to a learning effect. This paper explores the economic incentives for the deviation from the UN legislation through survival analysis. A Cox Proportional Hazard Model is fitted with eight independent variables of which two stand out as significant predictors for decriminalization. First, a higher democratic freedom score and second, the existence of a landborder with a country that already decriminalized cannabis, which provides prove for the learning effect. International cannabis legislation needs to be revised and cannabis rescheduled in order to shift resources away from the individual user to large-scale criminals in cannabis trade.

#### **Presented at:**

- Idea presentation at the Reading Seminar of the Graduate School (July 2014)
- EALE in Aix-en-Provence (September 2014)
- Graduate School Mid-Term Meeting (December 2014)

#### 2. The determinants of drug policy

#### with Marek Endrich

#### Abstract

An increasing diversity in cannabis policy can be observed despite the world-wide prohibition of recreational cannabis use by the UN Single Convention on Narcotic Drugs from 1961. In the US, cannabis deregulation differs in speed and depth between states; in the medical as well as the recreational domain. In this paper we use the US as an example to identify the determinants of cannabis policy. The outcome measure is a novel cannabis policy index, which combines medical and recreational cannabis policies within 10 categories. In the observation period from 1990 to 2014, 47 policy changes occurred. We find that changes in cannabis policy were influenced by the electorate's ideology and by the drug policy of other US states rather than government partisanship. Furthermore, the fraction of elderly in a state,

race, access to the coast and the Great Lakes, the budget deficit and real state growth affect the choice of cannabis regimes. It appears that cannabis policy changes are induced by political considerations rather than any apparent necessity.

#### **Presented at:**

- Professor Voigt's jour fixe (November 2014)
- Extensive written comments from Rosalie Pacula (RAND Drug Policy Research Center) (January 2015). Skype meetings to further clarify econometric issues (February 2015)
- Suggestions from Peter Reuter (University of Maryland) (February 2015)
- Professor Voigt's jour fixe (August 2015)

# 3. The grass is always greener on the other side - Prevalence of adolescent cannabis use and decriminalization

#### 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, polity, corruption and interactions between the independent variables, this reduction is about 13 %. 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.

#### **Presented at:**

✤ Law and Economics Conference in Ankara (April 2014)

- ❖ Doctoral seminar for Labor- and Social-Economics with Prof. Thomas Siedler (May 2014 → followed by substantive changes
- Italian Economics Association in Trento (October 2014)
- Graduate School Mid-Term Meeting (December 2014)

#### 4. Who gets high(er)? - Stakeholders in cannabis policy

#### Abstract

Cannabis policy is shaped by a multitude of stakeholders ranging from international to local players. This paper employs stakeholder theory to position them in the realm of cannabis policy-making and explains their opposition or support of decriminalization. Moreover, a difference-in-differences analysis is utilized to show the substitution effect of cannabis for alcoholic drinks with a sample of 114 countries. Accordingly, not only the UN, but also the alcohol industry, has an interest to uphold the criminalization of cannabis agreed upon in the UN Single Convention from 1961. In the observation period from 1961 to 2010, 41 countries decriminalized cannabis. The trend of increasing alcohol consumption is slowed down by cannabis decriminalization, even after controlling for unemployment, GDP per capita, democratic freedom and the share of Muslims. Decriminalized countries experience about 15% less annual increment in alcohol consumption as compared to criminalized countries. Consequently, policy-makers need to consider stakeholder interests, when choosing a policy. However, they need to be careful to not succumb to the most power- or resourceful player.

#### **Presented at:**

- CYSAR (Center for Youth Substance Abuse Research) in Brisbane (February 2015)
- ✤ Law and Economics Conference in Ankara (May 2015)
- Annual Meeting of the Austrian Economic Association in Klagenfurt (June 2015)

5. Two plants are better than one? – The effect of decriminalization on the eradication of cannabis

#### Abstract

Cannabis cultivation is a thriving business, whether for profit or personal use. The reasons for engaging in illegal drug growing and the effects of drug policy on it are mostly unexplored.

This paper tries to shed some light on the impact of cannabis policy on this phenomenon through two models that predict first, the kilograms of marijuana herbs seized as an outcome variable and second, the number of cannabis plants eradicated. We found a significant policy effect on the number of cannabis plants eradicated while controlling for favorable outdoor (temperature) and indoor (electricity consumption) growing conditions, exports, land area, the rural population, corruption and neighboring countries that have previously decriminalized cannabis. However, the effect on the amount of marijuana herbs seized was merely weakly significant and only in a reduced sample of developed countries.

#### **Presented at:**

- Proofread by Professor Wayne Hall (March 2015)
- Paper Development Workshop with Prof. Dr. Busch at the WiSo Faculty (June 2015)

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## Paper I

# Live and let die -

#### Survival analysis of the UN Single Convention on Narcotic Drugs

#### Abstract:

Almost all countries worldwide agreed to the UN Single Convention on Narcotic Drugs from 1961, which highly criminalizes cannabis in its strictest schedule. However, the Netherlands de facto legalized cannabis in 1976. Since then many more countries have decriminalized cannabis due to a learning effect. This paper explores the economic incentives for the deviation from the UN legislation through survival analysis. A Cox Proportional Hazard Model is fitted with eight independent variables of which two stand out as significant predictors for decriminalization. First, a higher democratic freedom score and second, the existence of a landborder with a country that already decriminalized cannabis, which provides prove for the learning effect. International cannabis legislation needs to be revised and cannabis rescheduled in order to shift resources away from the individual user to large-scale criminals in cannabis trade.

#### JEL classification: C41, F53, K14

**Keywords:** Survival Analysis, Cox Proportional Hazard Model, UN Single Convention on Narcotic Drugs, Decriminalization, Cannabis, Learning Effect

#### **1. Introduction**

The market for cannabis is the biggest within the domain of illicit drugs (United Nations Office on Drugs and Crime, 2013). The World Drug Report concludes that the entire value of the cannabis retail market is 126 billion Euros per year (United Nations Office on Drugs and Crime, 2005). Caulkins, Kilmer & Graf (2013) estimate the EU market for cannabis between 15 - 35 billion Euros annually, while the US is responsible for half of the world's market. Cannabis is used by about 200 million consumers each year (United Nations Office on Drugs and Crime, 2013). This means that up to four percent of the world's population uses cannabis for recreational purposes.

It has been recognized by a multitude of governments that an alternative cannabis policy needs to be found for the individual user, while continuing to punish large-scale trade (Pudney, 2010). The solution adopted by an increasing number of countries is called decriminalization. The small-scale user's punishment is reduced from a criminal to an administrative offence and law enforcement resources are pooled to prevent large-scale trafficking and high-profit trade (Pacula et al., 2005). However, the only policy that is permitted by the UN Single Convention on Narcotic Drugs is complete criminalization.

The UN Single Convention from 1961 specifies remedies for non-compliance under article 14 (United Nations, 2013). A number of responses are available, if the criminalization of drugs and the goal of eradication of drug production, cultivation and trafficking are endangered. The International Narcotics Control Board can react with recommendations or consultations or even induce a full investigation and punishment on the international level (International Narcotics Control Board, 2014). These sanctions are a credible threat for the parties of the Convention since they have been employed in a number of cases.

The literature on the UN Single Convention leaves one obvious gap: Why do countries<sup>1</sup> agree to the UN legislation, but then disregard its provisions shortly after? What is the extent of the problem? This paper addresses this gap through exploring which economic incentives lead to deviation from the UN legislation on cannabis. Survival analysis is used as a tool to identify the significant parameters. Out of 120 countries that were included in the analysis, 38

<sup>&</sup>lt;sup>1</sup> One has to employ the term "country" with careful consideration since international as well as national drug policies are shaped by a large number of actors within a country (Falcon, 2011). This complex setting will be explored in an upcoming paper. Here, for reasons of simplicity, a country will be defined as a unitary actor on international level.

decriminalized cannabis in the period of observation (1990-2012). Two explanatory variables, namely the score of democratic freedom and the dummy for having a landborder with a country that previously decriminalized cannabis, were significant in the Cox Proportional Hazard Model. Health expenditure, corruption control, being landlocked, annual GDP per capita growth, an EU dummy and a legal system dummy have failed to be significant predictors for decriminalization.

In Section 2 the theoretical background is given. This includes a brief historical overview of international cannabis legislation and the economic theory of learning effects. Section 3 describes the research question and hypotheses and section 4 explains the details of the methodology, the Cox Proportional Hazard Model. Section 5 displays the results of the survival analysis and they are discussed in section 6. A conclusion on the economic incentives for treaty deviation is laid out in section 7.

#### 2. Theoretical background

#### 2.1 Historical overview

Cannabis policy has been highly influenced by the US from the beginning (Zimmer, 1997). In 1925 the US government succeeded, after extensive lobbyism, to include cannabis in the Geneva Convention and to establish a highly criminalized cannabis control. In 1937, the director of the American Federal Bureau of Narcotics, Harry Anslinger, managed to criminalize cannabis in the US through lobbying targeted at politicians. Cannabis was perceived as dangerous in two ways: First, it was said to be responsible for the negative effects that subgroups of the population caused. These effects included crime and violence. Second, it was seen as a gateway drug to promiscuity, addiction and insanity. This was especially considered so for adolescents. Nevertheless, it is important to recall that this was rather a social belief than a scientifically proven fact.

Before 1961, there was already a strong lobby for and against cannabis criminalization (Scheerer, 1997). Besides the US four countries had a special interest in the international war against drugs due to domestic problems and use of cannabis by violent subgroups of the population. Italy asked to include cannabis before the conference in The Hague (1912), but only the need for research was recognized during the meeting. South Africa wanted it to be considered in the Geneva conference (1925). Both, Egypt and Turkey, expressed the same notion since they considered cannabis a drug of the lower socio-economic stratum of society

(Scheerer, 1997). Nevertheless, after a study in 1884, Britain concluded that cannabis prohibition would be an unjustifiable, paternalistic act (Indian Hemp Drugs Commission, 1884). They wanted to protect public health values and held that position until 1961.

The different stakeholders that can be identified within the countries attending the conference that produced the UN Single Convention on Narcotic Drugs in 1961 can be separated in five groups (Parliament of Canada, 2002). (1) States that produced the raw material for drugs, like South Africa or South Asia for cannabis. (2) Countries that used cannabis for the manufacturing of pharmaceuticals and scientific purposes. This group included industrialized countries like the US or the Netherlands. The nations that were not economically implicated by the control of drugs were lobbyists for (3) strict or (4) weak control. France and Brazil can be named as examples for the strict control advocates and the Soviet Union as an example for a weaker control system. (5) The last group was neutral and consisted of Luxembourg and many African nations.

Since 1961 it has been acknowledged that illicit drug trade and use can only be eliminated, if all countries join an international effort to deter it (McAllister, 1992). However, not all countries were willing to give up part of their national sovereignty or fight drug-related crime at all (Parliament of Canada, 2002). On the one hand, raw material producers saw a high burden placed on them and wanted compensation while neutral states did not care about the outcome of the conference. On the other hand, industrial nations wanted to retain their rights to the scientific use of drugs and eliminate domestic drug abuse at the same time. The strict and the weak control group were implicated by domestic drug abuse too, but did not have economic interests otherwise. The manufacturing and the strict control group were the strongest supporters of a supranational authority.

Initially, the UN Single Convention on Narcotic Drugs was meant as a document that would combine all the existing treaties on drugs (Zimmer, 1997). However, the scope of the regulation went well beyond this and put severe restraints on national sovereignty with regards to drugs. Cannabis was placed under the strictest control possible: schedule I and IV. All activities related to cannabis trafficking, cultivation, use and possession had to be eliminated and all cannabis-related offences had to be punished severely, according to these schedules (United Nations, 2013). By 1970 cannabis criminalization was implemented almost everywhere and a total of 184 countries joined the Convention, which means that the opinion that cannabis should be criminalized was held world-wide (United Nations, 2014).

Articles 4, 33 and 36 of the UN Single Convention on Narcotic Drugs specifically refer to cannabis criminalization and condemnation (United Nations, 2013). An exception is only established for highly regulated scientific purposes. The UN Single Convention was an attempt to reach a so-called "*drug-free world*" (United Nations Drug Control, 2014), which seemed desirable to all participants. Punishment was seen as a necessity for both, the individual user and the large-scale criminal.

Despite all the efforts to criminalize cannabis, prevalence of use was on the rise (Zimmer & Morgan, 1997). This created the need for alternative policies. By 1990 many countries were in the process of shifting away from criminalization or had already shifted (Zimmer, 1997). The Netherlands was the first country to deviate. In 1976, only 15 years after signing the UN Single Convention, they adopted a policy of normalization of cannabis use. This drastic change was criticized by the US. Moreover, its neighboring countries saw their policy of criminalization endangered with the Netherlands distributing cannabis in a de facto legal way.

The shift towards alternative cannabis policies is a pragmatic one (Nadelmann, 1997). Morals are not the most important factor anymore and many countries are starting to acknowledge that prohibition never worked and that drugs will prevail in society. The market cannot be eliminated. However, cannabis is not associated with major harms (Zimmer & Morgan, 1997). This has been established by governmental committees including the Indian Hemp Drugs Commission (1884), the British Wootten Report (1969), Canadian LeDain report (1970), the Dutch Baan Commission (1972) and an Australian Commission (1977). The countries deviating from criminalization found that decriminalization of the individual user and focusing on the professional dealers is the easiest and most inexpensive way for law enforcement (Nadelmann, 1997).

In December 1987, the US requested the Expert Committee on Drug Dependence to reschedule the active ingredient in cannabis. They wanted delta-9-tetrahydrocannabinol to be removed from the strict schedule I and to be included in schedule II in order to relax the measures against this substance (WHO, 1989). However, the Committee concluded that not enough evidence was available. Similar notions were raised on three subsequent occasions until today (WHO, 1991; WHO, 2003 and WHO, 2006). They all failed and cannabis remains in the strictest schedule.

#### 2.2 Economic theory

Even nowadays cannabis is criminalized and placed under the strictest control schedules of the UN Single Convention on Narcotic Drugs from 1961. However, a number of countries have deviated from the international treaty and adopted an alternative policy approach. Economic theory is able to explain this phenomenon through game theory, the learning effect and a shift in preferences. International law is a perfect example for coordination games in which two or more players commonly desire a certain outcome (McAdams, 2008). The UN Single Convention on Narcotic Drugs governs international law regarding cannabis. This hard law treaty was written in order to give in to the lobbyism of a few countries led by the US (Zimmer, 1997). For an economic analysis, cannabis policy can be seen as a coordination game. In 1961, two prominent options for cannabis policy were considered: Criminalization and legalization (see Table 1).

#### Country 2

		Criminalize	Legalize
Country 1	Criminalize	10,10	0,0
	Legalize	0,0	5,5

Table 1: Coordination game of cannabis policy in 1961.

Cannabis policy in 1961 can be modeled as a coordination game in which two Nash equilibria exist; one if all players criminalize cannabis and one if all players legalize cannabis (Mehta, Starmer & Sugden, 1994). Criminalization of cannabis was seen as the most beneficial policy since it would guarantee a drug-free world (United Nations Drug Control, 2014). Furthermore, it was expected to solve the problems with violence and crime in cannabis-using subpopulations of society (Zimmer, 1997). Cooperation towards legalization would have been the next best option and a Nash equilibrium, but it was not seen as a solution to the drug-related problems worldwide. Therefore, the payoffs for legalization are lower (5,5). Nevertheless, cooperation and coordination are always more highly rewarded than uncoordinated, unilateral actions (Parisi & Ghei, 2003).

With increasing prevalence of cannabis use, some countries were looking for alternative options (Zimmer & Morgan, 1997). The Netherlands was the first country to deviate. In 1976, only 15 years after signing the UN Single Convention, they adopted a policy of normalization of cannabis use (Zimmer, 1997). The three policy options for cannabis are displayed in Table 2, where the Netherlands shifted from strategy I (criminalization) to strategy II (decriminalization). The matrix is inspired by the divergent preference game from Parisi & Ghei (2003) and Keohane's commitment theory (1986). For simplicity, only two players are used, but the game holds for multiple countries too, since they face the same payoff decisions with regards to the criminalization of cannabis (Snyder, 1971).

#### Country 2

		Criminalize	Decriminalize	Legalize
		(Strategy I)	(Strategy II)	(Strategy II)
	Criminalize			
	(Strategy I)	10, 9	5, <u>10</u>	0, 7
	Decriminalize			
Country 1	(Strategy II)	8, 5	9, 10	5, 8
	Legalize			
	(Strategy III)	7, 0	8, 5	9, 9

Table 2: Coordination game of cannabis policy with a learning effect.

The payoffs for each cell are not random; rather they are an abstract display of real-life payoffs. If country 2 criminalizes cannabis, the best option for country 1 is to also criminalize it and reap the benefits of a coordinated war on drugs (payoff: 10). Country 1 still has a payoff of 8 or 7, if it decriminalizes or legalizes cannabis because it does not incur the costs of criminalization anymore (Shanahan, 2011; Single, 1989). However, criminalization is preferred due to a possible reputational loss connected to deviation from the UN Single Convention (Room, 2014) and the fear of increasing drug-related costs when deviating from criminalization (Koh, 1997).

If country 2 decriminalizes cannabis, the best option for country 1 is to follow this shift and to decriminalize cannabis (payoff: 9). Country I would prefer mutual criminalization, but

regards coordinated decriminalization as the next best option. If country 1 would be the sole criminalizing party, their payoff would decrease to 5 because a large share of the criminal law enforcement cost would be borne by them (Shanahan, 2011). Legalization of cannabis would again lead to a reputational problem and possible retaliation by the other party in this or other coordination games on treaties (McAdams, 2008; Keohane, 1986). Due to this the payoff of legalization (8) would be lower, even though tax revenue could be collected on legalized cannabis.

If country 2 legalizes cannabis, the preferred option is mutual legalization and taxing cannabis sales (payoff: 9). However, this is not yet common practice. If country 1 decides to criminalize cannabis, while the other party legalizes it, the payoff is 0. This is due to the high criminal law enforcement cost for criminalization (Single, 1989), if cannabis is legally produced in another country. Should country 1 opt for decriminalization the payoff is higher (5), because law enforcement is only needed for large-scale traffickers (Shanahan, 2011).

In rational, infinitely repeated games learning effects can occur (Fudenberg, 1998). In the realm of rational choice the rule of Bayesian updating was coined for games with uncertain payoffs since the actors can only decide with bounded rationality (Holt & Anderson, 1996). Based on previous experiences, the probability of events can be adjusted and taken into account in the next stage of the game. This is displayed in Table 2, where country 1 prefers the first Nash equilibrium and country 2 prefers the second equilibrium, regardless of the other player's action due to a higher payoff. This means that the countries have divergent preferences (Parisi & Ghei, 2003).

In Table 2 it is shown that country 2 has an incentive to deviate from the strategy of criminalization due to a higher payoff of decriminalization (10, if country 1 plays criminalization or decriminalization). Unlike the first game in Table 1, this is not a symmetric anymore. Country 1 will not deviate due to the continued high payoff of criminalization (10). As countries deviate from criminalization, it will be increasingly more difficult to uphold criminalization. The payoff of 10 for country 1 slowly starts to decrease with every further decriminalization in any country world-wide. The rate of decriminalization becomes self-sustaining, parallel to Rogers' (2003) diffusion of innovation theory from 1962.

Being a party to the UN Single Convention on Narcotic Drugs left all countries in the criminalized equilibrium. However, once the first country deviated, the others could observe the positive consequences of decriminalization and many more countries followed the Dutch

example since then. This learning effect has been formalized by Bandura (1971) in his social learning theory. He acknowledges the importance of reinforcement after all actions and its influence on future decision. However, he highlights that observation of other actors is an indispensable source of information for decisions. Hall (1993) adds a social learning perspective on policy-making. Policies change based on (1) experiences and knowledge gained from previous policies, (2) key figures' opinions (e.g. experts) and (3) societal participation through parties, lobby groups or the like. A shift from criminalization to decriminalization is seen as a third order change due to switching all three components of a policy: The goal, the instrument and the level of the instruments.

Preferences for policy can be ranked and are subject to potential shifts (Samuelson, 2001). In 1961 almost all countries agreed that criminalization of cannabis was the most beneficial policy; however, during the following decades preferences changed. The example of the Netherlands and its surrounding countries, which switched to decriminalization subsequently, shows the pressure to reach one of the Nash equilibria. Countries observe and learn from the positive experiences with decriminalization, for example in the Netherlands (MacCoun & Reuter, 1997) or Portugal (Hughes & Stevens, 2010). In the following stage of the game, when cannabis policy is discussed nationally, the decision is made based on previous experiences and the observations collected. The different stakeholders in these countries then prefer decriminalization over criminalization. This process should lead to optimal policies in the long run (Hall, 1993).

The learning effect theory can be applied directly to cannabis policy. Governments try to get rid of drug trafficking and consumption in their country. At first, they tried to adopt stricter criminalization laws in order to uphold the first equilibrium of criminalization. France is an example for this practice (European Monitoring Center for Drugs and Drug Addiction, 2008). The next step was decriminalization: A country that implements an alternative cannabis policy provides cheaper and more efficient laws. All resources can be shifted away from the small-scale users and towards fighting organized crime. This increases the pressure on neighboring countries to also decriminalize, if they do not want to bear the costs alone. This induces a shift to the Nash equilibrium of decriminalization. Monitoring other countries' experience regarding decriminalization can than lead to an easier adoption of a similar policy.

Each jurisdiction has to take into account that neighboring jurisdictions have a high influence on their policy outcomes, which is a negative externality (Revesz, 1992). This was the reason

for the complaints from Belgium and Germany about the de facto legalization of cannabis in the Netherlands in 1976. Both countries highlighted that retaining criminalization would be much harder, if the Netherlands changed policy. On the one hand, this is due to the citizens being discontent with the paternalism and desiring the free choice Dutch citizens have. On the other hand, the governments feared that more cannabis would be shipped to the Netherlands to satisfy the potentially higher demand and that prevalence of cannabis use and possession would also rise in the neighboring states. Both countries soon followed the Dutch example and decriminalized cannabis in 2003 and 1994, respectively (European Monitoring Center for Drugs and Drug Addiction, 2008).

According to Greif & Laitin (2004), equilibria can be reinforced or dissolved through positive/ negative reinforcement. In the repeated game of cannabis policy, countries can use decriminalization as a mean to diminish drug-related problems. If this approach works, other countries can learn from the example and the rate of decriminalization increases. Greif & Laitin's theory states that payoffs for the old strategy decrease with every round and at a critical point all participants will abandon the old position.

#### Country 2

		Criminalize	Decriminalize	Legalize
		(Strategy I)	(Strategy II)	(Strategy II)
	Criminalize			
	(Strategy I)	<u>7,9</u> , 9	5, 10	0, 7
	Decriminalize			
Country 1	(Strategy II)	8, 5	9, 10	5, 8
	Legalize			
	(Strategy III)	7, 0	8, 5	9,9

Table 3: Coordination game of cannabis policy and the shifted equilibrium.

There are two Nash equilibria along the diagonal axis, for which coordination is a necessary condition. However, the countries have to decide on one form of cooperation (McAdams, 2008). The cooperation can be called embedded, since countries chose their strategy from the 4 cells on the upper left (Garrett & Weingast, 1993); both cooperative cells are Pareto-

optimal. Legalization has not yet established itself as a viable alternative since only Uruguay has legalized cannabis on federal level so far. In this infinitely repeated game, cooperation can be upheld according to the folk theorem (Friedman, 1971). Cooperation in international law arises best from voluntary obedience with internal commitment in order to preserve one's reputation in the repeated interactions (Koh, 1997). This is mirrored in the UN Single Convention since there is no direct legal punishment for deviation from the treaty provisions.

In Table 2, country 1 preferred criminalization due to the higher payoff (10). Country 1 will continue to play strategy I until the payoff of criminalization falls below the aforementioned critical threshold a tipping point, which can be described as payoff strategy I < payoff strategy II (Greif & Laitin, 2004). Then the new Nash equilibrium of both countries decriminalizing cannabis will be reached, as visible in Table 3. The theory of a tipping point has been coined by Schelling (1971). The minority of countries that decriminalized cannabis developed into a sufficient mass to shift the behavior of criminalized countries. The critical mass phenomenon has been applied to international law by Worster (2012). Equilibria shift, if the quantity of countries that has changed their laws is sufficient to lead to a qualitative change in the equilibrium of laws. Then all countries agree on a new international norm.

Each party can chose a strategy, but the outcome is determined by the combined actions of the parties (Parisi & Ghei, 2003). Better cooperation equals better payoffs. Strategy I is in line with the UN Single Convention on Narcotic Drugs, while strategy II and strategy III are not. However, strategy II will still be regarded as an alternative form of cooperative behavior since criminalization is continued and large-scale drug traffickers are prosecuted. Strategy III is regarded as an outright deviation from the agreed upon treaty since legalization means discarding the UN's provisions completely.

#### **3.** Research question and hypotheses

A variety of factors shape national cannabis policies; these include characteristics of the state, public health considerations and morality amongst others (Pacula, MacCoun, Reuter, Chriqui, Kilmer, Paoli & Schäfer, 2005). However, the most important influence can be attributed to the costs associated with cannabis. The research question explores which economic incentives lead to decriminalization and therefore, a deviation from the agreed upon criminalization of cannabis in the UN Convention. Potential explanatory variables can be found in the literature. The ones with the strongest theoretical foundation are health

expenditure, criminal law enforcement expenditure, the impact of ideology, being landlocked, the annual growth of the per capita GDP, being a member of the EU, the legal system (civil or common law) and the learning effect (landborder to a country that has decriminalized cannabis). However, the theoretical explanation is often not one-sided and for some variables competing theories are presented.

Hypothesis 1: Countries are more likely to die, the higher the public health expenditure. Health expenditure is the most important factor in the decision for a cannabis policy. This includes demand reduction, drug dependence and treatment as well as secondary illnesses, like mental health disorders (Hall, 2009). In 1961, proponents of criminalization argued that health expenditure should be lower under a criminalized regime since cannabis use is supposed to be completely prevented and there should be no addicts to the drug (MacCoun & Reuter, 2001). They reasoned that under decriminalization the state would have to acknowledge the negative health effects of cannabis and treat them (Shanahan, Gerard & Ritter, 2014). However, this view is outdated since health expenditure as well as prevalence of cannabis use have been on the rise world-wide regardless of the cannabis policy exercised (Wall, Poh, Cerdá, Keyes, Galea & Hasin, 2011). When health expenditure increases, even though drugs are criminalized, many governments opt for decriminalization of cannabis in order to reduce costs and make more efficient use of the budget for healthcare (Harper, Strumpf & Kaufman, 2012). In this paper, health expenditure is measured as a percentage of the GDP spent on healthcare. Only the public, not the private expenditure is considered, since the state will base its decision on the amount of government spending. It is used as a proxy for drug-related health expenditure, for an application see Saffer, Chaloupka & Dave (2001).

*Hypothesis 2: Countries are more likely to die, if they face more corruption.* The second cost related to cannabis is the criminal law enforcement expenditure. However, this cannot be directly measured due to the lack of internationally collected time-series data; a proxy has to be employed. In a recent book by Gray (2010), the connection between corruption and drug-related law enforcement is highlighted and said to be the determinant of all law enforcement efforts. The International Narcotics Control Board (2011) underscores the importance of corruption in criminal law enforcement further: The financial background of the cannabis traffickers allows them to (1) corrupt, (2) intimidate or (3) assassinate officials that cannot be corrupted. Efforts to control drugs have failed due to this phenomenon, especially if criminal law enforcement personnel, police or judges are bribed (Buckley, Nadelmann & Sweet, 1996). If corruption takes place only once, all law enforcement is doomed to fail thereafter.

The goal of the traffickers is to reduce criminal law enforcement for cannabis, which makes it harder for a government to uphold criminalization, if the level of corruption is high. The proxy used is the corruption level in each country, measured on a scale from -2.59 to 2.59.

Hypothesis 3: Countries are more likely to die, if they have a more democratic system. National ideology and the level of freedom are important indicators for the willingness to political change. In autocracies, a small group can impose their agenda without constraints (Bättig & Bernauer, 2009). Democracies perform better in indicators of well-being (Siegle, Weinstein & Halperin, 2004). They are based on elections and public choice. Moreover, lobbyist or interest groups try to influence political outcomes. Green parties often include cannabis decriminalization in their party's electoral program. A few examples are New Zealand (Edwards & Lomax, 2012), the United Kingdom (Green Party, 2006) and Belgium (Gelders & Van Mierlo, 2004). They are more likely to experience the aforementioned learning effect for cannabis policy. A combined democratic freedom score was used as a proxy (scale from -10 to 10). In this variable countries received scores for level of autocracy and level of democracy; the first was then subtracted from the latter. A higher democratic freedom score indicates a more likely, if the level of democratic freedom is higher.

Landlocked countries are a special case with regards to drugs. *Hypothesis 4a: Countries are more likely to die, if they are NOT landlocked.* On the one hand, cannabis-trafficking is usually done via shipments to the Western regions (European Parliament, 1996). Therefore, the countries that have direct access to the sea are the first ones to receive illicit drugs (United Nations Office on Drugs and Crime, 2014a). Landlocked countries are the last ones to receive a share of cannabis in the smuggling chain. Especially under prohibition it is harder for illegal goods to transit through different countries. *Hypothesis 4b: Countries are more likely to die, if they are landlocked.* On the other hand, landlocked countries are the main producers of cannabis. Especially Lesotho and Kosovo have to be mentioned (Anastasijevic, 2008; Chouvy & Laniel, 2007). A dummy for landlocked countries is entered into the equation to test the validity of these divergent theories (dummy: 0= not landlocked; 1= landlocked).

*Hypothesis 5: Countries are more likely to die, if the economy grows more.* Considering the sample of decriminalized countries at hand, it needs to be ruled out that decriminalization is a phenomenon purely related to economically developed countries (Single, Christie & Ali, 2000). According to Room & Reuter (2012), developed countries tackle drug policy more

often and more effectively since higher economic growth might be related to more leeway and opportunity to decriminalize. Therefore, economic development needs to be controlled for in order to distill the effect of the other variables. The annual growth of the GDP is measured per capita and as a percentage to make the changes more comparable between countries.

*Hypothesis 6: Countries are more likely to die, if they are a member of the European Union.* In 1951, the predecessor of the European Union as it is known today was founded. This started a process of removal of trade barriers over the years (European Union, 2015b). When the Netherlands decriminalized cannabis in  $1976^2$ , a spillover effect was thought to be a matter of time (French, 2005). Especially Germany and Belgium were afraid of the potential implications for their national policy since free trade as well as higher levels of trade increase the influx of drugs (Russo, 2014). A similar concern was raised for the formation of the NAFTA (French, 2005). However, this trade Union does not include as many countries as the EU, which reduces the threat of political spillovers. Therefore, an EU dummy is included (0= not an EU member state; 1= EU member state).

*Hypothesis 7: Countries are more likely to die, if they are a civil law country.* In a civil law system legislation is formed by the government or custom, while common law relies heavily on precedents of earlier court rulings (Central Intelligence Agency, 2015). Potentially, one of the two predominant legal systems could be more prone to decriminalization. To test this relationship a dummy for civil law (0) and common law (1) is included in the survival analysis. Nevertheless, the hypothesis states that civil law might be an indicator for cannabis decriminalization due to two incidents. (1) The only country in which cannabis decriminalization bills have failed repeatedly, in 2002 and 2004, is Canada (Parliament of Canada, 2004), a common law country. (2) In the US, a defense of medical necessity of cannabis was rejected in 2001 stating that cannabis has no medical use whatsoever (United States v. Oakland Cannabis Buyer's Cooperative, 2001).

Hypothesis 8: Countries are more likely to die, if they have a landborder with a country that has already decriminalized cannabis. Countries could be more likely to decriminalize, if they see the positive effects of decriminalization in a neighboring country (French, 2005). In section 2.2 this was introduced as a so-called learning effect. Governments are not

<sup>&</sup>lt;sup>2</sup> See section 2.1 for information and sources.

independent from each other in their cannabis policy decision, especially if they share a common border<sup>3</sup>.

A number of variables were excluded from analysis due to their insignificance. First, the six WHO world regions were employed, but did not predict a significant change. Second, the four World Bank economy grouping dummies were tested without significant results. Third, a measure of the share of countries that already decriminalized cannabis. This percentage was calculated on a yearly basis with the cumulative number of countries that had decriminalized cannabis and the total number of countries included. This was done to see whether the pressure to decriminalize and to shift to the second equilibrium rises over the years. By the end of the period of analysis 32 percent of the 120 countries had adopted a decriminalized approach to cannabis. Again, this independent predictor failed to be significant and was excluded due to its similarity to the landborder dummy presented above.

#### 4. Methodology

The data for the analysis was taken from multiple different sources. First, the United Nation Treaty Database was used (United Nations, 2014). Information regarding the cannabis-related Conventions, including the parties to the UN Single Convention on Narcotic Drugs and the year of their accession, is available online at the United Nation website. Second, the European Union's database (European Monitoring Center for Drugs and Drug Addiction, 2013) and the British Government's database (National Centre of Expertise on Drugs and Drugs Law, 2014) hold information on the status of cannabis decriminalization world-wide. Third, the World Bank's World Development Indicators (World Bank, 2014) present percentages of public health expenditure as well as the annual growth of the per capita GDP (%). Fourth, the World Bank's World Governance Indicators (World Bank, 2013) include the corruption control score. Fifth, the democratic freedom score was extracted from the website of the Center for Systemic Peace (2014). Sixth, the United Nation Conference on Trade and Development (2013) provides a list of landlocked countries. Seventh, the EU member countries can be found at the EU's official webpage (European Union, 2015a). Eighth, the classification of legal system is accessible from the American Central Intelligence Agency in their World Factbook (Central Intelligence Agency, 2015). The share of decriminalized countries and the landborders were calculated manually.

<sup>&</sup>lt;sup>3</sup> See section 2.2 for information and sources.
Out of the 184 countries that are party to the UN Single Convention on Narcotic Drugs 56 had to be excluded due to missing data on the status of cannabis legislation or a discrepancy between federal and territorial legislation (for example Australia or the US)<sup>4</sup>. Another 4 nations could not be considered, because they entered the UN Convention and decriminalized cannabis use and possession before the period of data collection<sup>5</sup>. 3 countries were not included, because decriminalization of personal cannabis use already took place before the treaty was signed<sup>6</sup>. Bolivia is a special case, because it is the only country to leave and then re-enter the UN Single Convention on Narcotic Drugs with altered conditions on coca leaf chewing and decriminalized cannabis (United Nations Office on Drugs and Crime, 2014).

The method used is from the domain of survival analysis, which explores the time span from the onset of a "risk" to "death" (Walters, 2009). The onset of the risk is joining the UN Single Convention on Narcotic Drugs from 1961 while death means the decriminalization of cannabis. The year of decriminalization has been chosen to represent death because a de facto change in attitude and behavior of the population can be observed from that point onwards, even though the de jure decriminalization happens a few weeks later. Decriminalizing cannabis for personal use and possession is not justifiable, if one has agreed to criminalize all cannabis-related activities in the UN Convention. The Cox Proportional Hazard Model (CPHM) is employed to include explanatory variables and the effect of these variables on survival is estimated (Cox, 1972). It is semi-parametric and makes no assumption about the shape of the baseline hazard function since it is more important to analyze the parameters.

The decision to use the CPHM is based on its widespread use and high applicability (Fox & Weisberg, 2011). In the Cox Model it is possible to include explanatory factors, as opposed to the basic Kaplan-Meier method (Cox, 1972). A simple, binary model could never capture the importance of the time-span until "death". In this analysis, countries can flexibly join and

<sup>&</sup>lt;sup>4</sup> Antigua and Barbuda, Australia, Bosnia and Herzegovina, Burkina Faso, Burundi, Cabo Verde, Cambodia, Central African Republic, Congo, Democratic Republic Congo, Eritrea, Fiji, Gabon, Guinea, Haiti, Holy See, India, Iran, Kenya, Kuwait, Lesotho, Liberia, Libya, Malawi, Mali, Marshall Island, Micronesia, Mozambique, Myanmar, Nepal, Niger, Nigeria, North Korea, Palau, Qatar, Rwanda, San Marino, San Tome and Principe, Seychelles, Solomon Islands, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Swaziland, Tajikistan, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Turkmenistan, Uganda, the USA, Zambia and Zimbabwe.

<sup>&</sup>lt;sup>5</sup> Bangladesh, Italy, the Netherlands and Paraguay.

<sup>&</sup>lt;sup>6</sup> Albania, Lithuania and Montenegro.

discard the UN Single Convention in any given year and it is analyzed at what point of time this happens.

$$S(t) = Probability(T > t)$$
<sup>(1)</sup>

$$S(t/X) = S_0(t) \exp(\beta n X n)$$
<sup>(2)</sup>

"Survival" of countries in terms of their ongoing criminalization of cannabis is measured through an underlying survival function. Survival over time is a function of the probability of lasting beyond time t. A country should not experience the event of decriminalization before this. T is the time span until "death". This function is does not increase over time and is assumed to be monotone. Equation (1) shows the general survival function and equation (2) the survival function specified for this model. The survival function is dependent on the covariates X and there is a specified number (n) of them. All of them have a coefficient  $\beta_n$ . S<sub>0</sub> includes the baseline survivor function in the model.

$$h(t|X) = h_0(t) \exp(\beta_n X_n) \tag{3}$$

In equation (3) a general CPHM is given. h(t|X) is the hazard at any given time t after the onset of the risk with the independent variable(s) X. The term  $h_0(t)$  includes the baseline hazard function in the model. If all covariates are 0, only  $h_0(t)$  is left and therefore, it is called the baseline hazard. An exponential transformation of the coefficients follows in order to get the hazard ratios for all the parameters included in the parentheses. As an example a positive number (n) of covariates (X<sub>n</sub>) and their different coefficients ( $\beta_n$ ) are displayed after the exponential transformation. The CPHM does not need an error term,  $\varepsilon$ , because survival analysis implies randomness.

 $d(t/HE, CC, DF, D, LLD) = d_0(t) \exp(\beta_1 HE + \beta_2 CC + \beta_3 DF + \beta_4 LLD + \beta_5 GDP + \beta_6 EU + \beta_7 LEG + \beta_8 BORDER)$ (4)

The fitted model in equation (4) describes the hazard of decriminalization (d) at any given time t after signing the UN Single Convention on Narcotic Drugs, given eight covariates: Health expenditure (HE), Corruption control (CC), Democratic freedom (DF), a dummy for the country in question being landlocked or not (LLD), Growth of per capita GDP (GDP), an EU member dummy (EU), a dummy for the legal system (LEG) and a dummy for an existing landborder with a decriminalized country (BORDER). The baseline hazard function for decriminalization, if all other independent variables are 0 is given by  $d_0(t)$ . The coefficients of

the eight covariates (HE, CC, DF, LLD, GDP, EU, LEG, and BORDER) are multiplied with their coefficient and are exponentially transformed into hazard ratios.

The CPHM has a few limitations. It is not a device to generate theory, rather it uses existing data to prove hypotheses generated from the literature. Furthermore, large amounts of data have to be collected. The difficulty of this analysis was to find adequate time-series data. The percentage of public health expenditure was only available starting in 1995 and the corruption score is recorded from 1996 onwards. As visible in Table 4, there were some gaps in the data, as scores for entire countries were missing. Smaller gaps in the corruption score in 1997, 1999 and 2001 were not deemed important and could be fitted with data from previous years.

## 5. Results

Survival analysis is often called "time to event" analysis (Cleves, Gutierrez, Gould & Marchenko, 2010). The underlying dependent variable for a CPHM is the hazard rate. In order to include this unobservable variable in the model, the time and event occurrence is considered. In this case the countdown starts with a country's accession to the UN Single Convention on Narcotic Drugs and ends through an event (decriminalization of cannabis) or censoring. The observation period begins in 1990, due to the unavailability of data and the drastic political changes before that point. The data is censored on the right in the end of 2012, if no event could be observed. Every country has an individual entry and exit point to the analysis depending on the year of their treaty accession and whether they have to be censored or decriminalize cannabis. Each country's entry year is defined as their individual "year 0"; their onset of risk.

Variable	Summary Statistic	Result	Source		
Total	Observations	2140			
Outcome (Decriminalization yes/ no)	Observations of survival	2102	European Monitoring Center for Drugs and Drug Addiction (2013).		
	Observations of failure	38	National Centre of Expertise on Drugs and Drugs Law (2014).		
38 out of 120 countries decrimi	nalized cannabis.	This is equal to	31.7 %.		
Countries	Number	120			
Years of observation	Minimum	1990			
	Maximum	2012			
Public health expenditure (% of GDP)			World Development Indicators (World Bank, 2014)		
	Observations	1661			
	Mean	3.44			
	Standard Deviation	1.79			
	Minimum	0.01			
	Maximum	11.25			
Level of corruption (scale from high to low: -2.59 to 2.59)			World Governance Indicators (World Bank, 2013)		
	Observations	1584			
	Mean	0.01			
	Standard Deviation	0.95			
	Minimum	-1.92			
	Maximum	2.52			
Democratic freedom <sup>7</sup> (scale from full autocracy to full democracy: -10 to 10)			Center for Systemic Peace (2014)		

<sup>&</sup>lt;sup>7</sup> The polity score of the Center for Systemic Peace (2014) was chosen as the most adequate measure, since it provides a continuous variable of democracy. For this survival analysis a continuous measure yields better results of the likelihood to "die".

	Observations	1894	
	Mean	3.51	
	Standard Deviation	6.57	
	Minimum	-10	
	Maximum	10	
Landlocked (dummy: yes (1) and no (0))			United Nation Conference on Trade and Development (2013)
	Observations	2140	
	No	1812	
	Yes	328	
GDP per capita growth (annual in %)			World Development Indicators (World Bank, 2014)
	Observations	2084	
	Mean	2.28	
	Standard Deviation	5.18	
	Minimum	-65.0	
	Maximum	53.8	
EU member (dummy: yes (1) and no (0))			EU webpage (European Union, 2015)
EU member (dummy: yes (1) and no (0))	Observations	2140	EU webpage (European Union, 2015)
EU member (dummy: yes (1) and no (0))	Observations Yes	2140 195	EU webpage (European Union, 2015)
EU member (dummy: yes (1) and no (0))	Observations Yes No	2140 195 1945	EU webpage (European Union, 2015)
EU member (dummy: yes (1) and no (0))	Observations Yes No	2140 195 1945	EU webpage (European Union, 2015)
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0))	Observations Yes No	2140 195 1945	EU webpage (European Union, 2015) The World Factbook (Central Intelligence Agency, 2015)
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0))	Observations Yes No Observations	2140 195 1945 2140	EU webpage (European Union, 2015) The World Factbook (Central Intelligence Agency, 2015)
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0))	Observations Yes No Observations Common law	2140 195 1945 2140 543	EU webpage (European Union, 2015) The World Factbook (Central Intelligence Agency, 2015)
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0))	Observations         Yes         No         Observations         Observations         Common law         Civil law	2140 195 1945 2140 543 1597	EU webpage (European Union, 2015)
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0))	Observations         Yes         No         Observations         Common law         Civil law	2140 195 1945 2140 543 1597	EU webpage (European Union, 2015) The World Factbook (Central Intelligence Agency, 2015)
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0)) Landborder with a decriminalized country (dummy: no landborder (0) and existence of a landborder (1))	Observations         Yes         No         Observations         Common law         Civil law	2140 195 1945 2140 543 1597	EU webpage (European Union, 2015) The World Factbook (Central Intelligence Agency, 2015) Calculated manually
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0)) Landborder with a decriminalized country (dummy: no landborder (0) and existence of a landborder (1))	Observations         Yes         No         Observations         Common law         Civil law         Observations         Observations	2140 195 1945 2140 543 1597 2140	EU webpage (European Union, 2015) The World Factbook (Central Intelligence Agency, 2015) Calculated manually
EU member (dummy: yes (1) and no (0)) Legal system (dummy: common law (1) and civil law (0)) Landborder with a decriminalized country (dummy: no landborder (0) and existence of a landborder (1))	Observations         Yes         No         Observations         Common law         Civil law         Observations         Observations         Border	2140 195 1945 2140 543 1597 2140 2140 458	EU webpage (European Union, 2015) The World Factbook (Central Intelligence Agency, 2015) Calculated manually

Share of decriminalization			Calculated manually
(% of all countries)			
	Observations	2140	
	Mean	15.12	
	Standard	9.46	
	Deviation		
	Minimum	0	
	Maximum	31.67	

Table 4: Summary statistics for country-specific data on the variables used.

Table 4 displays the descriptive statistics for the collected data. All covariates are timevariant. However, health expenditure, level of corruption, democratic freedom, GDP per capita growth, the landborder count and the share of decriminalized countries are event variables that change every year, while being landlocked, being an EU member and the classification of the legal system are enduring variables (Cleves, Gutierrez, Gould & Marchenko, 2010). A total of 2140 observations are collected from 120 countries. 38 of them decriminalized cannabis in the observation period from 1990 to 2012. This means that 31.7 % of the countries analyzed "failed" and "died" during the analysis time.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Health	1.088		1.188	1.088	1.117	1.101	1.106
Expenditure	(0.51)		(1.28)	(0.51)	(0.69)	(0.61)	(0.61)
Corruption	1.351	1.491		1.341	1.249	1.364	1.231
	(0.89)	(1.45)		(0.90)	(0.67)	(0.93)	(0.67)
Democratic	1.125**	1.131**	1.134**	$1.126^{**}$	$1.116^{*}$	$1.126^{**}$	$1.128^{**}$
Freedom	(1.97)	(2.06)	(2.08)	(1.97)	(1.91)	(1.98)	(2.01)
Landlocked	0.958	0.961	1.012		0.888	0.944	1.058
Dummy	(-0.09)	(-0.08)	(0.02)		(-0.24)	(-0.12)	(0.12)
GDP growth	1.060	1.060	1.055	1.060		1.060	1.060
(per capita)	(1.44)	(1.39)	(1.44)	(1.45)		(1.44)	(1.46)
EU	1.167	1.252	1.115	1.173	1.038		1.152
Dummy	(0.29)	(0.43)	(0.20)	(0.30)	(0.07)		(0.26)
-							
Legal	0.602	0.576	0.741	0.611	0.590	0.605	
System	(-0.71)	(-0.78)	(-0.45)	(-0.71)	(-0.75)	(-0.70)	
-							
Landborder	3.059**	3.241**	$2.810^{**}$	3.035**	3.499**	3.175**	3.335**
Dummy	(2.19)	(2.36)	(2.09)	(2.21)	(2.47)	(2.35)	(2.41)
N	1376	1376	1456	1376	1390	1376	1376
pseudo $R^2$	0.182	0.181	0.169	0.182	0.177	0.182	0.179
Ll	-76.57	-76.70	-78.84	-76.57	-80.02	-76.61	-76.84

Exponentiated coefficients; *t* statistics in parentheses

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 5: Hazard ratios for decriminalizing cannabis in different model specifications.

Table 5 summarizes the results of the CPHM and gives the hazard ratios for each predictor<sup>8</sup>. Democratic freedom and the landborder dummy are significant at the 5 % level and have positive ratios. These results are robust across all model specifications, the level of significance and the hazard ratios do not change much, if variables are dropped from the model. Even though the remaining predictors for health expenditure, corruption, the landlocked dummy, GDP growth, the EU dummy and the legal system dummy were not significant, they were left in the model due to their importance in the literature. All possible

<sup>&</sup>lt;sup>8</sup> Confidence Intervals can be found in the Appendix.

combinations of interactions were tested and dropped from the model again, because none are significant.

The proportionality assumption was tested in two different models. First, a logarithmic function of time and the predictors were interacted to time-dependent covariates. They were non-significant. Second, Schoenfeld residuals were calculated (see appendix). None of them turned out to be significant. This leads to the conclusion that the hazards are assumed to be proportional. A linktest is recommended by Cleves, Gutierrez, Gould & Marchenko (2010) and verified that the squared linear predictor is also non-significant.



Figure 4: The baseline survival function.

Figure 4 plots the baseline survival functions. This is the survival function with each covariate set to 0. It is basically a Kaplan-Meier test, since it does not include any explanatory parameters. Remembering equation 4 (see section 4), only the baseline hazard remains and they parameters are discarded. The function displayed has steps, which are observed through the empirical analysis. The steps occur since not all "deaths" happen at the same time, but rather in a successive order. Every time a country "dies" from the analysis, the survivor function decreases by a step. Sometimes it can decrease more rapidly due to multiple

"deaths", which means than more than one country decriminalizes cannabis in a given year. If the function would be projected into the future, the decreasing trend would predict the death of many other countries.



Figure 5: Goodness of fit of the Cox Proportional Hazard Model.

Figure 5 highlights the goodness of fit for the CPHM. A Cox-Snell residual test is employed and the Nelson-Aalen cumulative hazard is plotted against a line of 45 degrees. The cumulative hazard follows the line very closely; however, there is some variation on the right-hand side. This is quite normal for right-censored data due to subjects exiting the analysis or experiencing an event already (Cleves, Gutierrez, Gould & Marchenko, 2010). The sample is then too reduced to guarantee a perfect fit. This means that due to cannabis decriminalization in 38 countries, they are dropped from analysis in the year they implement the new policy (right-censoring). The sample size is reduced by more than 30 percent through this process and the goodness of fit of the model reduced.

#### 6. Discussion

The hazard ratios, or relative risks, are significant for two predictors: Democratic freedom and the landborder dummy. Even though the other explanatory variables are not significant, their hazard ratios should be considered in order to verify the hypotheses stated in section 3. Higher health expenditure, more corruption, more economy growth and EU membership increase the chances of decriminalization. Being landlocked slightly decreases the vulnerability to "die", which supports the hypothesis 4a. A landlocked country will receive the drugs later due to the lack of direct sea access. Criminalization is then easier to uphold. Finally, civil law countries appear to be more vulnerable to die than common law countries in this analysis.

The two significant hazard ratios can be interpreted in the following manner: (1) The hazard ratio of the democratic freedom score is 1.13. All other variables held constant, a 1 unit increase in the freedom of democracy score is related to a 14 % increase in the tendency to decriminalize. As explained in section 3, democracies are more open to lobbyism and public choice. It seems to be easier to change cannabis policy in democratic regimes and to benefit from a learning effect (Hall, 1993). (2) The land border count has a hazard ratio of 3.06. Comparing countries that share a landborder with a country that already decriminalized cannabis with the group that does not share a landborder shows that the former has a 306% higher chance of decriminalization, given that all other explanatory variables are held constant. This means that countries are more likely to die, if they have a neighbor that decriminalized cannabis before them. Observing that decriminalization functions well as a policy regime leads to a learning effect and enables governments to shift as well.

The democratic freedom score has a gradual increase of the chances to decriminalize because it is a continuous variable. Each unit increase of the score is related to a higher chance to decriminalize. However, the landborder count is a dummy variable that has only two values (0 and 1). Therefore, the likelihood to die increases with such a high percentage (306%). When a country switches from one group (not sharing a landborder) to the other (sharing a landborder), their chance of "death" rapidly increases. This increase can only occur once since there are only two categories.

Polity remains significant under all model specifications and the results regarding this variable are robust. It seems that ideology is the prevailing determinant of a cannabis policy change. It was theorized in section 3 that cannabis decriminalization might be related to the

level of (economic) development. However, GDP per capita growth and EU membership were tested and did not yield significant results. Neither did the level of expenditure influence the tendency to decriminalize. Cannabis decriminalization is not an effect restricted to the developed countries or the ones with the highest health and law enforcement expenditure. It can rather happen in any country as long as the population supports the government's notion to decriminalize.

The survival analysis shows that an increasing number of countries "die" and decriminalize cannabis. In section 2 of this paper shifting preferences and the learning effect were explained. Pressure to discard cannabis criminalization is rising, because it helps to improve public health outcomes and to avoid costs. This is even more so since the burden of criminalization has to be split between less countries. Nadelmann (1997) argues against paternalistic criminalization since harm should not be punished, if it is self-inflicted. Hall & Pacula (2003) and Degenhardt, Lynskey & Hall (2000) highlight the adverse effects of cannabis; however, they are not more severe than harms related to other, legal soft drugs.

In this sample 38 countries decriminalized cannabis. 25 of them already had a land border with another decriminalized regime, when making the decision to decriminalize. 4 of them did and do not border a nation that decriminalized cannabis<sup>9</sup>. Another 9 countries were the ones to follow the example of the Netherlands without any further prove that decriminalization would be beneficial<sup>10</sup>. This shows the impact of the learning effect and that countries are more prone to decriminalize cannabis, if there are successful examples.

An interesting observation is that sharing a landborder with a country that previously decriminalized cannabis is a significant predictor, while the cumulative share of countries that decriminalized cannabis fails to be one. Governments experience the aforementioned learning effect, if a country in their proximity introduces a policy of decriminalization with positive effects. It does not affect a government's decision to decriminalize how many countries world-wide have already decriminalized

The drastic regime change in 1961 towards strict criminalization is nowadays viewed in a critical light from a public health and harm-reduction perspective (Bewley-Taylor & Jelsma, 2012). In the recent literature, cannabis is not connected to serious harms for health or job

<sup>&</sup>lt;sup>9</sup> Costa Rica, Jamaica, Mexico and Serbia.

<sup>&</sup>lt;sup>10</sup> Estonia, Ireland, Kyrgyzstan, Moldova, Norway, Spain, Turkey, Uruguay and Venezuela

performance, if consumed recreationally (Van Ours & Williams, 2014). The laws established in 1961 need to be revised, since most nations are not satisfied with a criminalized approach to cannabis anymore (Bewley-Taylor, 2013).

## 7. Conclusion

The title of this paper is "live and let die" since the alternative policies to cannabis criminalization cannot be compatible with the UN Single Convention on Narcotic Drugs that was signed by almost all countries world-wide (Zimmer, 1997). In terms of the survival analysis conducted, countries "live" if they uphold criminalization and they "die" if the use alternative policies, like decriminalization. The question is whether we should let countries die peacefully and acknowledge that they are better off if they deviate from international law.

Decriminalization is followed by a learning effect that pressures the remaining countries to abandon the criminalized approach as well. Currently two trends are visible in cannabis policy. On the one hand, stricter criminalization in order to uphold it with the costs shared between fewer countries, like in France or African Nations. On the other hand, more countries redirect criminal law enforcement efforts from the individual user to professional traffickers and sellers. This development of two extremes makes sense, when considering cannabis policy a coordination game as explained in section 2. Two opposite Nash equilibria exist and countries try to shift towards one of them.

The research question asked which economic incentives lead to decriminalization. The level of democratic freedom and the learning effect (landborder with a country that previously decriminalized cannabis) were significant and induce political change regarding cannabis policy. Criminalization is too big of a constraint of nations' sovereignty, especially because it is connected to inefficiency and higher costs (Room & Reuter, 2012). Countries should be free in their decision on cannabis policy and cannabis should be rescheduled in the UN Single Convention on Narcotic Drugs in order to accommodate this need. This policy change was visible in 38 of the 120 countries analyzed. The ongoing internationalization of decriminalization is very similar to the failed prohibition of alcohol and the subsequent legalization. This policy change was visible in 38 of the 120 countries analyzed.

The empirical analysis shows that countries decide to act contrary to the international treaty despite the credible threat of sanctions, if their ideology permits it and they see the positive

effects of decriminalization in neighboring states. This learning effect is present if a neighboring country reports a decline in (law enforcement) expenditure after decriminalization. A potential cost reduction is one of the incentives to decriminalize cannabis, even though this strategy will not lead to the drug-free world envisioned in 1961. The acknowledgment that the war on drugs has failed is an important one; resources can be shifted to harder drugs than cannabis or to more pressing subjects (Gray, 2010). It is reasonable to conclude that "death" from the UN Single Convention is a positive event for a country. Either cannabis needs to be rescheduled to a weaker control system under UN legislation or countries should be left to die and rest in peace.

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# Appendix

Predictor	Hazard Ratio	Confidence Interval (95 %)	$\chi^2$ for non-proportionality
Health expenditure	1.088	0.79 / 1.50	0.391
Corruption	1.351	0.70 / 2.62	0.862
Democratic freedom	1.125**	1.00 / 1.27	0.243
Landlocked dummy	0.958	0.36 / 2.53	0.345
GDP growth	1.060	0.98 / 1.15	0.064
EU member	1.167	0.40 / 3.36	0.533
Legal system	0.602	0.15 / 2.45	0.654
Landborder count	3.059**	1.12 / 8.32	0.338

\*\*\* *p* < 0.05

Table: Predictors and  $\chi^2$  values for non-proportionality.

# Paper II

# The determinants of cannabis deregulation in the US

### Marek Endrich & Ines Reith

## Abstract:

An increasing diversity in cannabis policy can be observed despite the world-wide prohibition of recreational cannabis use by the UN Single Convention on Narcotic Drugs from 1961. In the US, cannabis deregulation differs in speed and depth between states; in the medical as well as the recreational domain. In this paper we use the US as an example to identify the determinants of cannabis policy. The outcome measure is a novel cannabis policy index, which combines medical and recreational cannabis policies within 10 categories. In the observation period from 1990 to 2014, 47 policy changes occurred. We find that changes in cannabis policy were influenced by the electorate's ideology and by the drug policy of other US states rather than government partisanship. Furthermore, the fraction of elderly in a state, race, access to the coast and the Great Lakes, the budget deficit and real state growth affect the choice of cannabis regimes. It appears that cannabis policy changes are induced by political considerations rather than any apparent necessity.

#### JEL classification: C51, H77, K14

Keywords: Cannabis regulation, Criminal Law, Policy determinants, Federalism

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## **1. Introduction**

In 1961 almost all countries world-wide agreed to place cannabis under a strict control regime that prohibited recreational cannabis use, the UN Single Convention on Narcotic Drugs (United Nations, 2013). The topic was pushed by Egypt's delegation at the Second Opium Conference, even though it was not on the agenda (Kendell, 2003). Prohibition was facilitated by low prevalence rates of cannabis use and the creation of fears about its health effects through the director of the American Federal Bureau of Narcotics, Harry Anslinger (Anslinger, 1937)<sup>11</sup>. By 1970 cannabis was criminalized and prohibited in all member countries and the goal of creating a "*drug-free world*" prevailed (United Nations Drug Control, 2014). Nevertheless, around 50 countries worldwide have since adopted a de jure decriminalization and Uruguay legalized cannabis in 2013 (Room, 2014).

Independently of the federal policy of cannabis prohibition in the US, a general shift towards deregulation of medical as well as recreational cannabis formed across the US states in the 1990s<sup>12</sup>. Moreover, in 2013 and 2014, four US states legalized personal use and possession of cannabis (Caulkins et al., 2015c). This phenomenon is due to the decisions of US states to discard federal laws and implement a drug policy of their choice, which produces a state versus federal law conflict<sup>13</sup>. The heterogeneity in drug policies differs in depth and ranges from criminalization via decriminalization to legalization for recreational use of cannabis and to more or less centrally regulated medical cannabis use.

To explore the differences in cannabis regulation, we add to the literature on drug policy and its determinants. Recent studies began to elaborate on cost estimates of the regulation of illicit drugs and provide policy recommendations on whether and how governments should intervene (Adda, 2014; Kelly & Rasul, 2014; Becker, 2006). Hunt & Saloga (2013) argue that US state politics are an important factor in the realm of cannabis policy, with Republicans administrations being less likely to deregulate. However, there is an obvious gap on the actual behavior of governments and their incentives when deciding on drug regulation (Pardo, 2014). Do different policy outcomes mirror different party ideologies or is it merely a reflection of different voters' preferences? How do US states influence each other? Under

<sup>&</sup>lt;sup>11</sup> "Marijuana is an addictive drug which produces in its users insanity, criminality, and death." (Harry Anslinger, 1937, Congressional Hearing on the Marijuana Tax Act)

<sup>&</sup>lt;sup>12</sup> This includes only states that implemented a de jure policy change. Non-enforcement of cannabis prohibition and therefore, de facto policy changes, add even further variation across the US states

<sup>&</sup>lt;sup>13</sup> See Garvey and Yeh (2014) for an overview of the legal issue of state law versus federal law.

which circumstances is a move towards liberalization of cannabis more probable? Therefore, this paper addresses the research question: which factors affect cannabis policy across the US states. By addressing the specific cannabis policy question, we also make inferences about the prohibition of consumption goods in general.

The aforementioned variance in cannabis policy across US states and their homogeneous background provide an opportunity to explore the determinants of cannabis policy. The outcome variable is a novel index of cannabis policy across US states. A dynamic ordered logit model with spatial effects is employed to test the influence of a number of independent variables from the domains of federal and state politics, preferences and characteristics of the electorate, and spatial factors. According to the empirical results, both, electorate preferences and spatial dependence play a significant role in policy-making. Other significant predictors of US cannabis policy seem to be race, the fraction of elderly in a state, having access to the coast and the Great Lakes, a state's budget deficit and real GDP growth. Government ideology is only relevant when the preferences of the electorate are not fully accounted for. This indicates that either the preferences of the Republican or Democratic Party towards cannabis regulation do not differ substantially with regards to cannabis policy, or that the preference of the electorate dominates preferences of the two parties. It seems that cannabis is not a battlefield for partisan politics.

In the following, section 2 highlights the political structure under which cannabis policymaking happens and offers a framework for analyzing the process; combining recreational and medical cannabis. Section 3 explains the methodology. This includes the cannabis policy score, the newly created dataset and the variables used. Afterwards, section 4 presents the empirical approach and section 5 discusses the results. A conclusion and policy outlook are given in section 6.

## 2. Drug policy framework

## 2.1 The political structure of drug policy in the US

In Figure 6 the process of cannabis policy-making on US state level is displayed. There are three mechanisms to change drug policy: (1) popular or legislative referenda induced by the state government, (2) an initiative by the state's electorate and (3) direct legislation (University of Southern California, 2015). Legislative referenda are possible in all states and

mandatory for all constitutional amendments, expect in Delaware. These referenda are prepared by the government. Popular referenda instead are initiated by the citizens through a petition and the collection of signatures. 24 states allow for a popular referendum, which allows public voting on a policy measure already enacted by the government. The popular referendum process is not used as much as the initiative process. Initiatives let citizens create a petition, collect the required number of signatures and place an issue on the ballot. Again, this is possible in 24 states, many of which are the same as the popular referenda states<sup>14</sup>. Direct legislation of cannabis deregulation is possible, but only used on rare occasions for medical cannabis (Boehmke, 2005). However, Vermont might be the first state to legalize recreational cannabis directly.

Once a ballot measure is held, there are two possible outcomes for cannabis policy. On the one hand, the proposal could be rejected, which leaves the former cannabis policy in place. The former policy is either prohibition, if it was never changed, or the amended medical and/ or recreational cannabis policy. On the other hand, the constitutional amendment could be accepted by a majority of voters, which would lead to a modification of cannabis policy and a higher degree of deregulation than before<sup>15</sup>. Nevertheless, if an initiative is approved by the electorate, but not in line with the government preferences, the government can undermine the newly created deregulation by passing a counter-acting policy. This is a rare occurrence, but occurred with the failed attempt to legalize medical marijuana in Arizona in 1996 (Kilmark, 1998).

Between 1990 and 2014, 47 legislative changes with regards to cannabis deregulation were passed in the US states. Of these 47 amendments, 18 were induced by the electorate through initiatives and subsequent ballot measures. This included all four cases of legalization of recreational cannabis. Initiatives seem to be used more often for deregulation of recreational cannabis rather than medical cannabis (47.4 % versus 30 %, respectively). It has to be remembered that only 27 US states allow the electorate to start an initiative/ popular referendum and that they accounted for 29 of the 47 changes.

<sup>&</sup>lt;sup>14</sup> 21 states have both, popular referenda and initiatives. Florida, Illinois and Mississippi do not allow popular referenda, but initiatives. Kentucky, Maryland and New Mexico do not allow initiatives, but popular referenda.

<sup>&</sup>lt;sup>15</sup> The regulatory change could go in either direction, but every single change in US states' cannabis policy in the period from 1991 onwards was in the direction of deregulation.



Figure 6: Simplified model of the process of cannabis policy making in the US states.

These legislative processes are embedded in the federal structure of the US that gives the states leeway to implement regulation on state level. It allows state policies to serve an experimental function through which other states learn from experiences of forerunners and adapt their policy accordingly. For the issue of cannabis regulation the process of repealing the prohibition of alcohol in the US in 1932/1933 provides a starting point for an analysis of drug policy. In both cases, states had the digression to implement a policy of choice. In a topdown approach, the constitutional amendment on alcohol prohibition was first repealed on federal and then on state level (Kyvig, 1979). Even though cannabis prohibition is amended on state level due to the federal commitment to the UN Single Convention on Narcotic Drugs, the key policy determinants on US state drug policy seem similar in nature. These include the varying ideologies of the state government, differences in political and economic constraints, policy diffusion across the US states and legislative conflict between the state and federal level (Kyvig, 1979; Warburton, 1932). Based on the drivers of the repeal of alcohol prohibition we expect that the most salient factors are each state's political orientation in the three government bodies, the drug-related costs (the need to balance the state budget) and the spatial ties with other deregulated states due to trafficking of alcohol/ cannabis, a learning effect based on experiences of first-mover states and an increased pressure on dry/ prohibitionist states.

#### 2.2 The political process of drug policy in the US

The political structure of initiatives, legislative effort and referenda defines the constraints and sets the framework for cannabis policy-making. Following the Downsian (1957) model of electoral competition, candidates' only motivation is to hold their office and compete for votes by committing to electoral platforms that are promises of policies. The electorate votes according to its preference. In order to maximize the probability of winning, candidates of the opposing parties are incentivized to offer the policy preference of the median voter. The established "Downsian paradigm" (Lee, Moretti & Butler, 2004) mediates this strong assumption of policy convergence. However, the paradigm states that electoral competition leads to a partial policy convergence, which assumes that opposing candidates moderate their policy stance. If we add the assumption that politicians are motivated by policy outcomes, partisan preferences can lead to policy outcomes which diverge from the median voter preference.

In the field of cannabis policy, the possibility of initiatives and popular referenda strengthens the link between the preference of the electorate and policy outcome (Besley, 2002). The electorate bases its decision on politicians' commitment to a certain cannabis policy. Nevertheless, the voters can also amend the constitution a 60 per cent majority or start the process of cannabis legalization by popular initiatives. This heavily constrains the government from implementing a cannabis policy against the will of the majority of the electorate.

Besides reflecting electoral and party preferences, the decision of the government on cannabis policy is affected by the budgetary burden of the enforcement costs. These enforcement costs are, first of all, related to the drug policy regulation. The enforcement of a more restrictive regime requires higher expenditure regarding police and the prison system. Secondly, the level of enforcement is affected by the social cost of related criminal activities and violence. Criminal activities from drug use and the surrounding black market negatively affect the well-being of the population. According to Becker's (2006) model of optimal enforcement the government compares the social costs of drug consumption to the enforcement costs of the prohibition regime. The level of enforcement is efficient where the marginal cost of enforcement equals the marginal benefit of a reduction in consumption.

Aligning the theory of optimal enforcement with an accountability effect on the government, we can deduct the expected enforcement under electoral accountability. The electorate is negatively affected by crime and demands the government to inhibit its extent by enforcement. A government which is concerned about its reelection reacts to the demands of the electorate and adjusts its policy accordingly. Thus, the level of law enforcement increases with higher crime rates and a higher prevalence of cannabis consumption.

The costs the government has to bear as an effect of the level of enforcement drains on the government budget. Hence, the government has to either increase taxes or reduce other expenditure in response. With increasing costs the burden as well as the disutility of reducing other policy efforts, expenditure or increasing taxes becomes too high to bear. The government is more probable to switch to a more deregulated regime with less enforcement costs.

Some empirical evidence on the government costs of depenalization exists: Owens (2014) empirically examines the effect of market legality on crime for the prohibition of alcohol. He finds evidence that a prohibitive drug regime reduces the extent of violence from intoxication, but increases black market induced crime. In a natural experiment Adda, McConnell & Rasul (2014) show that cannabis possession increased after depenalization. Nevertheless, the overall crime rate decreased as it allowed the police to reallocate their effort towards other crimes. While this increased welfare, the higher extent of consumption brought about an increase in health expenditure (Kelly, 2014) and these offsetting costs of deregulation have to be considered when explaining government policy.

In light of the political structure and based on the literature we propose various state characteristics and external factors which theoretically could affect cannabis policy-making. In *state politics* the government possibly tries to implement its own agenda according to its ideology. Furthermore, it has to take enforcement costs into account and economic pressure increases the opportunity costs of upholding a rigid drug regime. Politicians on state and federal level could also be more inclined to deregulate cannabis when they face elections. Electoral competition incentivizes politicians to follow *population preferences*, and the channel of popular initiatives and referenda further strengthens the effect on policy outcomes. Externalities from deregulation in drug policy in other US states can affect the cost consideration of the incumbent government and it can learn from the experiences of other states acting as policy innovators. The easiness of importing drugs is another *spatial factor* which possibly affects demand and the cost calculation of the government. Finally, *federal and international pressure* can affect the policy making of US state politicians.

#### 2.2.1 State politics

The political landscape in the US is shaped by the two main parties – Republicans and Democrats (Grofman, Griffin & Glazer, 1990). Both parties try to gain control over the available political positions within each state<sup>16</sup> (Enelow & Hinich, 1984). Ideology in state politics is an important measure of the willingness to liberalize drugs (Galston & Dionne, 2013; Carroll, 2005). Therefore, the political affiliation of the state governor is a crucial factor. However, the governor's office is not the only political institution in each state; rather it is part of the so-called trifecta (Hill, 2002). A trifecta includes the governor, the state senate and the state house. Each of these government bodies can be taken by either party with the exception of Nebraska as the only unicameralist state (Massicotte, 2001). This leads to *the 1<sup>st</sup> hypothesis: A Democratic governor/ a Democratic Trifecta is more likely to deregulate cannabis*.

Both, the budget deficit and real state growth, constrain the government in choosing its policies. If a government faces an economic downturn, it will be pressured to adjust state expenditure. Cannabis deregulation might be a consequence of budget scrutiny, especially since enforcement costs for prohibition are substantial (Caulkins & Kilmer, 2014). This entails that cannabis policy changes, especially when legalization of either medical or recreational cannabis is involved, could be aimed at a reduction of the budget deficit through tax revenue and the creation of a new industry (Caulkins et al., 2015b; Caulkins, Hawken, Kilmer & Kleiman, 2012)<sup>17</sup>. Therefore, *the 2<sup>nd</sup> hypothesis is that a government under greater economic pressure will have an additional incentive to deregulate.* 

Cannabis policy, for medical and recreational marijuana, has to be approved by the state's electorate. This voter approval is often aligned with presidential or midterm elections to increase turnout (Biggers, 2011). Furthermore, cannabis policy can be used as a political instrument to build a reputation or increase one's chances of reelection. Under the assumption of asymmetric information, voters use policy outcomes to evaluate an incumbent's type and governments could be inclined to implement drug policy according to the electorates' preferences close to elections. An election year should increase the number of policy

<sup>&</sup>lt;sup>16</sup> For a first application of the median voter theorem see Downs (1957).

<sup>&</sup>lt;sup>17</sup> In 2014, its first year of recreational cannabis legalization, Colorado earned 53 million US\$ in tax revenue (Colorado – Department of Revenue, 2015).

changes, which generates the  $3^{rd}$  hypothesis: More (federal and state) elections create more opportunities to deregulate cannabis.

## 2.2.2 Domestic factors (Population preferences)

The demographic characteristics of the electorate often shape drug policy since they lead to different preference sets between US states (Warburton, May & Hough, 2005). Besley & Case (2000) identified the most salient population characteristics related to policy changes<sup>18</sup>. All of them are included in this analysis and explained in the following. Two important factors for cannabis policy are the fraction of the population that is elderly (over 65 years of age) and the ethnicity of the population. The elderly population is less likely to consume cannabis, which gives them a more conservative take on cannabis policy (Palali & van Ours, 2014). The subgroups of Hispanics and African Americans are (wrongly) thought to consume more drugs (Zimmer, 1997). Racial profiling in enforcement of cannabis offences is still present (Ramchand, Pacula & Iguchi, 2006; Gross & Barnes, 2002). A higher percentage of these population groups could then lead to more efforts to diminish drug-related crime, which increase the law enforcement costs. Furthermore, these minorities might be more inclined to favor parties that support deregulation in order to relieve some of the law enforcement pressure. *The 4<sup>th</sup> hypothesis is: If a lower percentage of elderly & a higher percentage of Hispanic/African Americans are present, deregulation is more likely to happen.* 

Income per capita was used as a control vector to account for the influence of financial resources to purchase drugs, which the European Monitoring Center for Drugs and Drug Addiction (2008) argues is one of the main factors for abstaining from drug use. Cannabis is sold in bigger quantities in wealthier countries (Little, Weaver, King, Liu & Chassin, 2008) and recent studies measure higher prevalence rates with higher affordability levels (ter Bogt et al., 2014). Therefore, a higher GDP per capita should indicate more cannabis use, higher costs of enforcement and subsequently a preference for cannabis deregulation. *This generates the 5<sup>th</sup> hypothesis: Higher income per capita is related to more deregulation* 

A black market for drugs reduces the well-being of the electorate. The population will then demand government intervention; on the one hand, to inhibit illegal activities and on the other hand, to reduce the social burden of drug users. In the case of cannabis policy in the US, cannabis consumption saw a substantial increase; by around 30 percent between 2006

<sup>&</sup>lt;sup>18</sup> Besley & Case (2000) argue that the US state specific variables need to account for the elderly population, the diversity in race, income per capita and the burden of (cannabis) treatment in relation to the total burden.

and 2010 (Caulkins, Kilmer Reuter & Midgette, 2014). A higher number of (past) users increases the likelihood of deregulation due to their own experience with cannabis use (Palali & van Ours, 2014). To proxy for cannabis consumption levels, cannabis treatment admissions through self-referral, by a doctor or the community and the cannabis treatment admissions through the criminal justice systems can be explored. The former is a proxy for cannabis consumption and the latter for cannabis-related arrests. Moreover, more treatment admissions could reflect higher treatment and enforcement costs that states might want to reduce by deregulating cannabis (Becker, Murphy & Grossman, 2006). The policy response will most likely balance the marginal cost of enforcement with the marginal benefit of reduced crime on the chances of reelection. Accordingly *the*  $6^{th}$  *hypothesis supposes that a higher prevalence of cannabis use should be connected to faster deregulation.* 

Black market activities and cannabis-related crime depend on the price of a unit of cannabis. Becker (2006) argues that enforcement costs are linear to the rigidity of the enforcement regime, and a higher level of enforcement will increase the market price. The effect of the price of cannabis leads to two counteracting effects: On the one hand, a lower price could increase market demand and speed up the process of deregulation through more users (Caulkins & Bond, 2012). On the other hand, a higher price could increase drug-related crime, change the level of law enforcement and lead to a potential deregulation (Reinarman, 2009). Higher prices could also increase the willingness of the electorate to petition for deregulation (Palali & van Ours, 2014). This gives rise to *the* 7<sup>th</sup> hypothesis: Cannabis prices are related to deregulation, but the direction is not clear.

All these factors reflect voter' preferences and proxy for cannabis consumption as well as the related costs for the state budget. Therefore, it is necessary to separate the preference of the electorate (that can be voiced through referenda or petitions) from the cost issue as well as from the preferences of the government as explained in section 2.2.1. The groups that have a negative perception of cannabis, such as elderly or middle class families, are more to vote for the Republican Party (Gelman, 2014; Feller, Gelman & Shor, 2013). This can be captured in the following  $\delta^{th}$  hypothesis: If a higher share of the state population votes for a Republican presidential candidate the likelihood of cannabis deregulation will decrease.

#### 2.2.3 Spatial factors

Spatial diffusion of cannabis policy sums up three processes that could potentially be prevalent in cannabis policy-making: (1) a learning effect, (2) yardstick competition or (3)

negative externalities. The question is whether cannabis policy is a top-down phenomenon produced by the state government. On the one hand, the government can observe deregulation in other states and decides to take a similar approach. On the other hand, the change could also be produced by the increased enforcement costs that states experience when they adjoin a state that has liberalized cannabis (negative externalities) (Caulkins et al., 2015a). This learning effect is induced by uncertainty, which stems from the lack of empirical evidence, the difficulty of measuring consumption and price of an illegal good, and the small number of policy experiments (Pacula & Sevigny, 2014; Kilmer et al., 2010). Nevertheless, the process could be a bottom-up event sparked by the electorate that wishes to implement the same deregulation as in a nearby state (yardstick competition) (Besley & Case, 1995b).

Spatial dependence is often present between political entities in social, monetary or other policy areas (Plümper & Neumayer, 2010). Caulkins et al. (2015a) also think that policy spillovers could exist between different US states, especially if they are small or highly populated, like Vermont<sup>19</sup>. This could induce a top-down or bottom-up process of harmonization, which under the general movement towards deregulation would increase the speed of cannabis deregulation (French, 2005). This expedites *the 9<sup>th</sup> hypothesis: Proximity to one or more deregulated states increases the probability of deregulation*.

Geographical characteristics of a state play an important role in the tendency to deregulate cannabis. Mexico is the most influential player in drug trafficking world-wide, holding an estimated 70 percent of drugs smuggled into the US (Cook, 2007). These countries share a border in California, Arizona, New Mexico and Texas (United Nations Office on Drugs and Crime, 2012; FBI, 2010). The expenditure on law enforcement at the south-western border is substantial with drug control as one of the main concerns (Andreas, 2009). Drugs do not only reach the US via the Mexican border, but also by shipments from Latin-America (United States Embassy, 2012) and from Canada (Brunet-Jailly, 2004). The higher the imports from any given country, the more possibilities exist to cover up smuggling operations (Russo, 2014). The United Nations Office on Drugs and Crime (2013) identifies coastal and Great Lake regions as easier entrance points for illicit drugs. This easy way of importing drugs should increase the supply and lead to lower prices, higher demand and possibly a policy

<sup>&</sup>lt;sup>19</sup> This could be due to the interconnectedness of states through smuggling, drug tourism and law enforcement in border areas.

reaction. Therefore, we presume in *the 10<sup>th</sup> hypothesis that geographical proximity to Mexico* & coastal access increase the speed of deregulation.

#### 2.2.4 Federal and international pressure

The Obama administration has adopted a policy of non-enforcement of federal law in the states that have deregulated cannabis (Caulkins, Hawken, Kilmer & Kleiman, 2012). This contradicts the UN Single Convention on Narcotic Drugs from 1961, which requires federal states to enforce the prohibition in all constituent states (United Nations, 2013). They will also refrain from state-federal law suits, e.g. challenging the constitutionality of state laws in the Supreme Court (Southall & Healy, 2013). Support for President Obama appears to be associated with pro-cannabis attitude and support for cannabis deregulation seems to be higher in Democratic states (Hunt & Saloga, 2013). However, this could change with a new Presidential administration and there is a credible threat of federal-state conflicts and law suits (Garvey & Yeh, 2014). Kelly & Witko (2014) provide evidence for a federal policy effect on unemployment. They suggest that budget and spending decisions are a likely dependent on the party in power. Cox & McCubbins (2005) emphasize the importance of the House of Representatives for the federal policy agenda in the US. This leads to *the 11<sup>th</sup> hypothesis: A democratic president will tolerate and may even foster cannabis deregulation.* 

#### 2.3 The analogy between medical and recreational cannabis deregulation

The pharmaceutically pure active ingredients of marijuana (THC) can reduce pain, nausea related to chemotherapy and muscle spasms in persons with multiple sclerosis (see Clark, Capuzzi & Fick (2011) for a summary of studies). However, the number of studies on the medical effects of smoked cannabis is limited. Non-medical cannabis on the other hand, is used as a recreational drug similar to alcohol or tobacco (Degenhardt et al., 2008). The recreational user base is substantial, with around 200 million annual consumers and a retail market of 126 billion Euros annually (United Nations Office on Drugs and Crime, 2013; United Nations Office on Drugs and Crime, 2005).

In many of the US states medical cannabis is easy to obtain and can also be used as a recreational drug (Hoffmann & Weber, 2010). For example, in California the "patient" population consists mainly of young males, who are unlikely to suffer from cancer or severe neurological problems (O'Connell & Bou-Matar, 2007). Moreover, a fee-based medical

business branch appeared that exclusively provides Medical Marijuana Identification Cards<sup>20</sup>. This has enabled the deregulation of recreational cannabis policy in the guise of medical use in California. Nevertheless, medical and recreational cannabis laws are also used as substitutes in other states (Chu, 2014).

Even though the use of these two cannabis products is considerably different, the state's incentives to deregulate them are similar. The first and most salient reason is the tax revenue generated (Oglesby, 2012; Miron & Waldock, 2010). Second, any relaxation of prohibition could entail savings in the state's budget according to Evans (2013) and Kilmer et al. (2010). This is mainly related to a decrease in criminal justice expenditure. Third, productivity gains might be visible through a reduced number of court appearances, less work-days missed and the reduction of racial disparity (Caulkins & Lee, 2012; Moran, 2010).

Uncertainty is an important constraint on users under most medical and recreational cannabis policy regimes. For medical cannabis, the Supreme Court ruled in *Gonzales v. Raich* that even if state law allows medical use, federal prosecution is a possibility (Okie, 2005). For recreational cannabis, states differ in their severity of punishment for cannabis-related offences (Pacula et al., 2005). These varying enforcement regimes blur the division between medical and recreational cannabis further. Moreover, the different de facto and de jure laws are complex and often citizens are not aware of the prevailing policy and which acts are punishable (Reuter, 2013).

Medical and recreational cannabis policy can be amended through ballot measures (University of Southern California, 2015). This means that either the electorate or the government has to initiate the democratic process of policy modification. A ballot measure can be accepted or rejected, but it seems to be important that both, the citizens and the government, agree with the policy change. If the citizens do not agree, they can reject the proposal or call for a popular referendum of an enacted cannabis policy (possible in 24 states). If the government does not agree with an initiative passed by the voters it can create undermining counter-legislation (Kilmark, 1998). For the two cannabis products the political process is very similar and has seen both, acceptance and rejection.

Whatever reason(s) might be at play when a state decides to relax its cannabis regulation, it is important to assess the relationship between medical and recreational deregulation of

<sup>&</sup>lt;sup>20</sup> Go to <u>http://mmjdoctor.com/</u> for an example.

cannabis in order to fully assess the legislative change. The reasons for policy changes are often not clear and this paper will shed some light on the underlying processes.

## 3. Methodology

## 3.1 The outcome variable: An index of cannabis policy

Research on policy as an endogenous variable has been conducted in the realm of fiscal or taxation issues (Besley & Case, 1995) and is scarce in the field of drug regulation. Nevertheless, the substantial variation in cannabis policies over time allows for analysis of its determinants (Reuter, 2013).

We created a novel index to measure each state's inclination towards cannabis. At one extreme is prohibition under which any cannabis-related offense will be punished as a criminal act with a consequent criminal record for the perpetrator and a possible prison sentence as a penalty (Pacula et al., 2005). If recreational use and possession of cannabis are decriminalized, this penalty is turned into an administrative punishment up to a threshold amount of grams that differs between states. This offence will usually result in a fine for the offender. Legalization is the legal availability of cannabis for any adult to use and the other extreme of the cannabis policy index<sup>21</sup>. Similar to other soft drugs, like alcohol or cigarettes, cannabis can be produced, distributed and purchased legally.

For medical marijuana laws, the cannabis policy scale is based on the classification of Hunt, Miles & Boustead (2013)<sup>22</sup>. If MMLs are absent, a regulation for therapeutic research can still exist. This exemption grants the right to obtain cannabis for research purposes from the National Institute of Drug Abuse (National Institute of Health, 1999). Medical marijuana is regulated more strictly, if laws are centralized. Hunt, Miles & Boustead (2013) define this through the low probability of pharmacies dispensing cannabis, while weakly centralized laws permit legal distribution of medical marijuana through pharmacies or other dispensaries.

Table 6 displays the cannabis policy index, which ranges from complete prohibition to recreational legalization, with weakly centralized medical marijuana laws (MMLs) in between. The index ties in recreational regulation with medical marijuana regulation and has

<sup>&</sup>lt;sup>21</sup> For a summary of cannabis regulation by state see White House – Office of National Drug Control Policy (2015).

<sup>&</sup>lt;sup>22</sup> For a more thorough discussion of each state's MML see Pacula, Boustead & Hunt (2014).
a total of 10 categories. The categories are ordinal that show an increasing propensity to deregulate cannabis in the recreational and medical sphere<sup>23</sup>. A change in cannabis policy is defined as occurring in the year the decision is taken rather than the year that the law takes effect. This ensures that the determinants of drug policy leading up to the policy change are adequately captured. Only de jure and not de facto laws are considered in this analysis.

<sup>&</sup>lt;sup>23</sup> For use of ordinal policy measures resort to Page & Shapiro (1983).

0	1	2	3	4	5	6	7	8	9
Prohibition				Recreational decriminalization	Recreational decriminalization	Recreational decriminalization	Recreational legalization	Recreational legalization	Recreational legalization
	Therapeutic research	Centralized MMLs	Weakly centralized MMLs		Centralized MMLs	Weakly centralized MMLs		Centralized MMLs	Weakly centralized MMLs
State cannabis law	s in 1990:								
AR, AZ, CA, CO, DE, DC, FL, HI, ID, IN, IA, KS, KY, LA, ME, MA, MI, MN, MO, MT, NE, NV, NH, NC, ND, OH, OR, PA, SD, TN, TX, UT, VA, VT, WV, WY	AL, GA, IL, MD, NJ, RI, SC, WA	CT, WI		AK, MS, NY					
State cannabis law	s in 2014:								
AR, FL, ID, IN, IA, KS, KY, MO, ND, SD, TN, UT, WV, WY	AL, GA, SC	LA, NH, PA, TX, VA, WI	AZ, DE, HI, IL, MI, MT, NJ	MS, NE, NC, OH		CA, CT, DC, MA, ME, MD, MN, NV, NY, RI, VT			AK, CO, OR, WA
Number of states p	assing through each	category at some poi	nt during the observa	ation period:					
37	12	7	18	7	1	12	0	0	4

Table 6: Categories of cannabis propensity in the US states and each state's classification in 1990 and 2014 (beginning and end of the observation period).

In table 6 each state's position on the policy scale is captured at the beginning and the end of the observation period. Since multiple changes are possible throughout those 24 years the number of states that passes through each category at some point of the observation period is also recorded. In Figure 7 the number of yearly changes along with the number of cumulative changes is highlighted. Over the years, 47 changes occurred and an increasing variation of cannabis regulation is visible.



Figure 7: Annual and cumulative number of changes in cannabis policy in the US states from 1990 to 2014.

In order to grasp the dynamics of drug policy adjustments from 1990 to 2014, Figure 7 displays the annual changes as well as the cumulative number of changes. A change is defined as an increase in the state's cannabis policy score introduced earlier. The annual changes vary between 0 and 8, which stands for the number of states that incremented their cannabis regulation propensity in any given year. The right side y-axis is a cumulative count of those annual changes, which add up to 47 over the entire observation period. This highlights the diversity in cannabis policy across US states and the need to understand the differences in speed and depth of cannabis deregulation (Table 6).

In Appendix 1 (Picture 1-6), data for cannabis policy from 1990 to 2014 are analyzed for the 50 US states and the District of Columbia (Washington DC)<sup>24</sup>. The last map exhibits an overview of the entire time period (see Appendix 1, Picture 7). The overall development does not seem to be as strong on the east coast compared to its western counterpart. However, it is important to note that some of the east coast states started out in higher categories than the west coast due to the early decriminalization of recreational cannabis, for example New York.

The maps indicate that cannabis policy has changed along the coasts first. Moreover, policy changes extended to deeper levels in coastal regions, which reached higher categories of the cannabis policy index. This holds for both, 5-year intervals and total development. It also becomes apparent that many Midwestern states started in category 0 in 1990 and had the same cannabis policy in 2014.

The mean change from 1990 to 2014 for all 51 states on the cannabis policy scale amounts to 3.08 categories. This is a substantial average increase since a three category increment signifies not only a change in medical, but also in recreational cannabis policy since the categories range from 0 to 9. An example is the change in Alaska's cannabis policy. In the beginning of the observation period, in 1990, Alaska had already decriminalized recreational marijuana (category 4) and enacted a weakly centralized medical marijuana law in 1998 (shift to category 6). In 2014, it moved to the highest category (9) with a vote to legalize recreational use of cannabis while the medical marijuana laws remain in place. A second example with less variation is Arizona. This state started in the prohibition category (0) in 1990 and changed to category 3 in 2010 when it created a weakly centralized medical marijuana law.

<sup>&</sup>lt;sup>24</sup> These will hereafter be referred to as 51 states or 51 units of analysis.

# **3.2** The independent variables

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum				
Indiana State University (2015):									
State Politics Dummy	1250	0.46	0.49	0 (Republican)	1 (Democrat)				
Trifecta Control (Scale from 0 to 1)	1225	0.51	0.37	0 (Republicans control the trifecta)	1 (Democrats control the trifecta)				
Republican Voters per state (% in each federal elections)	1275	46.99	10.96	6.5	72.8				
Federal Election Year Dummy	1250	0.24	0.43	0 (no)	1 (yes)				
State Election Year Dummy	1250	0.28	0.45	0 (no)	1 (yes)				
Chantrill (2015):									
Budget Deficit or Surplus (% of GSP)	1275	-2.83	2.57	-17.35	13.86				
Real State Growth (in %)	1275	2.52	2.78	-10.3	20.3				

United States Census Bureau (2015):									
Elderly (fraction of state population aged above 65)	1275	0.13	0.02	0.04	0.19				
Race (fraction of state population that is African American/ Hispanic)	1275	0.20	0.14	0.01	0.72				
United States Bureau of Economic Analysis (2015):									
Income per capita (US\$)	1275	31636.14	10131.48	13286.00	79010.00				
	United States	Department of H	ealth and Human Servic	es (2015):					
Cannabis treatment admissions (proportion)	1028	2.06	2.78	0.00	21.27				
Cannabis treatment admissions through the criminal justice system (proportion)	1028	2.04	2.42	0.00	13.65				
High Times Magazine (2015):									

Price, US\$ per ounce (median)	1071	299.56	299.56 109.51		750				
Nations Online (2015):									
Mexico Border Dummy	1275	0.08	0.27	0 (no)	1 (yes)				
Coastal/ Great Lake Dummy	1275	0.59	0.49	0 (no)	1 (yes)				
Border Count Dummy	1275	4.41	1.62	0	8				
Presidential Dummy	1275	0.56	0.50	0 (Republican President)	1 (Democratic President)				

Table 7: Descriptive statistics for the independent variables.

The State Politics Dummy and the Trifecta Control variable are similar in nature, but the former is measured as a binary variable and the latter on a more nuanced scale. On the one hand, the State Politics Dummy can take the values 0 for a Republican, 1 for a Democratic and 0.5 for an independent governor<sup>25</sup>. If a change occurs during the year, the fraction of time with the Democratic governor in power is used as a reference point. The mean (0.46) shows that between 1990 and 2014 a few more states were governed by a Republican than a Democrat. On the other hand, Trifecta Control is measured on a scale from 0, which indicates a pure Republican trifecta, to 1, which stands for a pure Democratic control of two institutions. These values are calculated as fractions, if an election changes the party composition during the year. The mean value is 0.51, which displays a very balanced division of offices between Republicans and Democrats.

The Republican Voter variable differs by state and captures the percentage of the population that voted for the Republican candidate in the most recent presidential election<sup>27</sup>. In the observation period the mean share of Republican voters was 47 percent of the population<sup>28</sup>. The variance between states is high: on the one hand, the District of Columbia (Washington DC) shows the lowest support for the Republican Party with only 6.5 percent in the 2008 presidential election. On the other hand, almost 73 percent of Utah's electorate supported the Republicans in the 2012 presidential election.

The Election Dummies are employed to indicate whether a federal or state election occurred in any given year<sup>29</sup>. The dummy will take the value 0 for no election and 1 for an election year. About 25 percent of the years between 1990 and 2014 are federal election years and almost 30 percent are state election years.

The Budget Deficit is calculated through the following formula: ((State Revenue – State Expenditure)/ Gross State Product)\*100. The variable ranges from -17.35 to 13.86 percent. The mean value for the Budget Deficit variable is at -2.83 percent, which means that states have a slightly negative annual budget outcome. Real GDP growth goes from -10.3 to 20.3

<sup>&</sup>lt;sup>25</sup> The data are available at Indiana State University (2015).

<sup>&</sup>lt;sup>26</sup> The data are available at Indiana State University (2015).

<sup>&</sup>lt;sup>27</sup> See 4.2 for an explanation of the use of federal data.

<sup>&</sup>lt;sup>28</sup> The data are available at Federal Election Commission (2015).

<sup>&</sup>lt;sup>29</sup> The data are available at Indiana State University (2015).

percent. The average state growth is positive with a mean of 2.52 percent. Both variables are available from Chantrill (2015).

The population characteristics can be described as follows: About 13 percent of the population is elderly (above 65 years) and the variable shows a range from 4 to 19 percent<sup>30</sup>. The Race variable (Hispanics or African Americans) shows a large difference between states with a minimum of 1 and a maximum of 72 percent. The mean lies at 20 percent of the population being considered Hispanic or African American<sup>31</sup>. Income per capita averages at 31,600 US\$ across states, but fluctuates between 13,300 US\$ and 79,000 US\$<sup>32</sup>.

Further domestic factors include the cannabis treatment admissions through self-/ community- or doctor's-referral or criminal justice referrals and the cannabis price. Ideally, prevalence of cannabis use should be used as a variable. However, the lack of data makes it necessary to employ a proxy. The United States Department of Health and Human Services (2015) publishes annual data on the number of people treated with cannabis-related problems. These data are separated into self-/ community- or doctor's-referral and criminal justice referrals<sup>33</sup>. The former is a proxy for cannabis consumption and has a mean of 2.06 % of the total population and a range from 0 to 21.27. The latter displays a mean of 2.04 % of the total population and a slightly lower range from 0 to 13.65 and is a proxy for cannabis-related arrests. Cannabis prices were extracted from High Times Magazine (2015) and aggregated on annual basis per state<sup>34</sup>. The price of cannabis varies substantially between states. It was as low as 40 US\$ per ounce and as high as 750 US\$ per ounce. On average, consumers paid almost 300 US\$ per ounce across states.

Spatial characteristics are neighboring the Mexican border, being a coastal and a Great Lake state. The importance of the Mexican border is captured with a dummy that takes the value 1 for the neighboring US states, which amounts to 8 percent of the states. The sea access is analyzed through a dummy for being a coastal or a Great Lake state (Atlantic, Pacific, Gulf of

<sup>&</sup>lt;sup>30</sup> The data are available at United States Census Bureau (2015).

<sup>&</sup>lt;sup>31</sup> The data are available at United States Census Bureau (2015).

<sup>&</sup>lt;sup>32</sup> The data are available at United States Bureau of Economic Analysis (2015).

<sup>&</sup>lt;sup>33</sup> Both are calculated as a proportion: the number of cases in a particular state/ the number of total referrals in that particular year.

<sup>&</sup>lt;sup>34</sup> The median is a better measure than the mean due to the low number of observations per state per year and the considerable variance. See Anderson, Rees and Hansen (2013) for another application of the price indicator.

Mexico, Arctic Ocean or Great Lake abutter). 59 percent of the states have access to a coast and the Great Lakes.

A presidential dummy is integrated to capture the federal level effect. This variable can take the value 0 for a Republican President and 1 for a Democratic President. The mean value is 0.56, which shows that the observation period from 1990 to 2014 was almost equally split between the two main parties with a slight advantage for the Democrats

Some of the independent variables are lagged by one year to account for the decision-making process that takes place before a policy change occurs. Any policy issue that is taken up has to be discussed and, in the case of drug policy, a constitutional amendment has to be prepared (Room, 2014). Therefore, one should look at the lagged covariates to identify the determinants that are present before the political process of cannabis policy change starts.

#### **4. Empirical Results**

## 4.1 Correlations and spatial econometric methodology

The correlations in the correlation matrix (see Appendix 3) confirm some of the theoretical arguments. States, which have a Republican Governor (State Politics), whose Trifecta (Trifecta Control) is dominated by the Republican parties and which exhibit a large share of Republican voters, are more inclined to have rigid cannabis regulation. Additionally, the correlation between the government variables is high at 60 per cent, which raises the question if it is the preference of the electorate or of the ruling party that affects cannabis policy-making. Various other factors, such as being a coastal state, higher income per capita, a larger share of Native Americans and Hispanic Americans, the year of state government elections, higher treatment and arrest occurrences as well as a higher price of cannabis, seem to reflect characteristics of a state with a higher probability of less rigid drug policy.

To detect a spatial dependence pattern we apply various test statistics. Spatial dependence means that a variable at one point in space depends on the values at contiguous points. Applied to the policy arena this translates to the dependency of policy in one state on the policy among its neighbors; this is positive or negative. A pre-defined weights matrix specifies how other locations affect the value at any other location. We use (1) a first order contiguity matrix, (2) a weight matrix based on a decaying distance function between states as well as (3) an ideological distance matrix and (4) a geographical-ideological distance

matrix to define the spatial links. We use row-standardization of the weight matrix which sums up the partner's weights to one for each state. This takes into account that politicians can only process a certain amount of information from outside. The more states affect the choice of policy the lower is each individual state's influence.

In a first step, we analyze the spatial correlation in cannabis policy across US states by applying the Moran's  $I^{35}$  and the Geary's  $C^{36}$  test. We evaluate both, the spatial distribution of cannabis policy across US states in 2014 as well as the dynamic development across the time-span from 1990 until 2014<sup>37</sup>. For both, the policy in 2014 and the development over time, we find robust positive spatial correlation. This means that US states with similar cannabis policy prescriptions cluster over space in 2014 and that US states with similar developments cluster over time group in space. However, besides spatial diffusion the existence of spatial dependence in policy can occur for various other reasons such as spatial heterogeneity or spatial patterns in influential factors, or in our case they could be influenced by the concentration of cannabis legalization in coastal states.

We rely on a regression model with spatial effects to analyze the existence of diffusion and evaluate the domestic determinants of the design of cannabis policy.

## 4.2 Econometric methodology

We applied a dynamic ordered logit model with spatial effects to test for spatial spillovers as well as domestic factors that determine the choice of regime of cannabis policy across US states. The latent variable  $y_{it}^*$  for individual *i* at time *t* is related to a vector of observable

$$I = \frac{N}{s_0} \frac{\sum_i^N \sum_j^N w_{ij}(x_i - \vec{x})(x_j - \overline{x})}{\sum_i^N (x_i - \vec{x})^2}, i \neq j,$$

where  $w_{ij}$  is the weight matrix,  $x_i$  and  $x_j$  the respective observations of unit i and j, N is the number of observations and  $S_0 = \sum_i \sum_j w_{ij}$  is a standardization factor for the weights. A value for I>0 indicates positive spatial autocorrelation and a value of I<0 negative autocorrelation. ıs

$$C = \frac{N-1}{25_0} \frac{\sum_{i=1}^{N} \sum_{j=1}^{N} w_{ij} (x_i - x_j)^2}{\sum_{i=1}^{N} (x_i - x_j)^2}$$

where C close to 0 signals positive spatial correlation and at values close to 2 negative autocorrelation.

<sup>37</sup> See Appendix 2 for the output.

<sup>&</sup>lt;sup>35</sup> The Moran's I is structured as a correlation coefficient such that

domestic characteristics  $X_{it}$ , a temporally lagged dependent variable  $y_{i,t-1}$ , a spatially lagged dependent variable  $\sum_k w_{ikt} y_{kt}$  as well as time fixed effects  $a_t$  and  $\varepsilon_{it}$  as an identically and independently distributed error process.

We employed a dynamic spatial ordered logit model,  

$$y_{it}^* = \beta y_{it-1} + \psi X_i + \rho \sum_k w_{ikt} y_{kt} + a_t + \varepsilon_{it}$$
,  $i = 1, ..., N$ ,  $t = 1, ..., T$ ,  $k = 1, ..., K$ 

The latent variable  $y_{it}^*$  is expressed in the pre-defined order variable  $y_{it}$  by the observation rule  $y_{it} = l$  if  $\tau_l < y_{it}^* \le \tau_{l+1}, \tau = 0, ..., 9$ .

This places the government policy within a discreet set of choices where the coding reflects a rank of regimes, and higher ranking reflects higher values. We use a probability model estimated by maximum likelihood to determine the factors which affect the regime choice of US states.

The spatial auto-regression parameter  $\rho$  measures the effect of the weighted average of the lagged dependent variable in other units on  $y_{it}^*$ . It is defined as a N \* N \* T spatial weight matrix which represents the relative distance between N number of units I and N number of unit k in T number of time periods. Distance stays constant over time as long as we regard geographical distances, but changes when we introduce ideological distance. These weight matrices are multiplied with an N\*T matrix which contains the contemporaneous values of the dependent variables, with N number of units k and T number of time periods. A common miss-specification in spatial econometrics is related to the omission of controls for temporal dynamics and common shocks and trends which can lead to biased estimates for the spatial variable (Neumayer & Plümper, 2010). We would prefer to use unit fixed effects to control for unobserved spatial heterogeneity as well as for omitted variable biases, but under the high persistence of the policy variables the efficiency loss from neglecting the between country variation becomes costly. Instead we included regional, political and economic control parameters which should alleviate some of the biases and provide a consistent estimation.

In our regression we try to distinguish between preferences of the electorate and preferences of the ruling party. While the inclusion of characteristics of the population such as income per capita or the proportion of elderly provide a first step in controlling for different preferences, we subsequently introduce variables which account for both, state government ideology and Republican share in the last federal election. This allows us to make a statement about the extent of partisan politics in cannabis policy and the responsiveness of politicians to electorates' preferences. The use of federal election results is based on two premises. First, we assume that voters who vote for the Republican Party are more inclined to reject a move towards deregulation of cannabis. The description of Republican voters supports this argument as they are more probable to be conservative and more inclined to have a negative perception towards cannabis consumption. Second, using federal election data has an advantage over using state election results as they abstract from the strategic behavior of state politicians to use cannabis policy as a policy issue in state elections (Elinder and Jordahl, 2013).

Omitted variable bias is a potential problem with regard to the effect of the preference of the electorate. For example, a state which is close to border regions or to the coast is more likely to deregulate cannabis policy due to cost considerations, however, this state could also exhibit a high proportion of Democrat voters. The inclusion of the state specific variables alleviates this bias, in order to control for such issues.

We furthermore include a lagged dependent variable to account for common trends and time fixed effects to control for common shocks. We lag the independent variables as well as the spatial lag by one year, which is justified on theoretical grounds based on the time lag in the process of policy ratification. Moreover, it also mitigates possible endogeneity and reversed causality concerns.

## 4.3 Empirical results

The results on the determinants of cannabis policy are presented in Table 8. We started with a basic specification which covers standard US state policy making adjusted to the field of cannabis policy making (see section 2.1). We then add additional control variables in the realm of state politics as well as spatial factors and federal level determinants to test for robustness and elaborate on the significance of the additional determinants. The results of the ordered logit estimation are presented as odds ratios, where a value above one corresponds to a positive effect on the probability that states belong to a higher rank and values below one corresponds to a negative effect. The odds ratios are defined as the exponential coefficients of the ordered logit regression and allow for a quantitative assessment of the effect of the determinant on cannabis policy. The non-transformed coefficients would only indicate the direction and statistical significance of the impact.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Lagged	4.348***	4.385***	4.369***	4.356***	4.361***	4.439***	4.233***	4.301***	4.369***
Outcome	(12.10)	(11.61)	(11.32)	(11.23)	(11.31)	(10.73)	(10.30)	(11.39)	(11.32)
Elderly	-5.507	-8.761**	-17.35***	-20.46***	-17.21***	-17.81***	-17.30***	-17.91***	-17.35***
(fraction)	(-1.19)	(-2.05)	(-3.64)	(-3.67)	(-3.84)	(-3.47)	(-3.89)	(-3.71)	(-3.64)
Race	2.096***	1.871**	2.160***	1.998***	2.217***	2.810***	2.348***	$1.817^*$	2.160***
(fraction)	(2.83)	(2.29)	(2.93)	(2.64)	(3.02)	(2.78)	(3.38)	(1.89)	(2.92)
Income	1.401***	1.376***	-0.194	0.0633	-0.223	0.0485	0.148	-0.537	-0.194
per capita	(2.74)	(2.75)	(-0.35)	(0.12)	(-0.40)	(0.06)	(0.24)	(-0.91)	(-0.35)
Trifecta		$0.748^{***}$	0.331	0.303	0.337	0.270	$0.389^{*}$	0.349	0.331
Control		(3.19)	(1.52)	(1.41)	(1.59)	(1.14)	(1.67)	(1.55)	(1.53)
Republican			-0.0516***	-0.0520***	-0.0507***	-0.0630***	-0.0474***	-0.0505***	-0.0516***
Voters			(-3.43)	(-3.52)	(-3.39)	(-3.34)	(-3.17)	(-3.14)	(-3.44)
Decaying			0.570**	$0.545^{*}$	0.582**	0.607	0.583	0.574**	0.569**
Distance			(2.06)	(1.95)	(2.04)	(1.29)	(1.64)	(2.04)	(2.03)
State political	variables								
State	0.173								
Politics	(1.22)								
Federal			-0.0253						
Elections			(-0.04)						
State			-0.00459						
Elections			(-0.03)						
Budget				-0.0622*					

Deficit				(-1.81)					
Real					-0.0573**				
Growth					(-2.24)				
Domestic factors									
Cannabis						-0.0602			
Treatment						(-1.07)			
Criminal						0.0111			
Justice						(0.16)			
Price							0.106		
(median)							(1.01)		
Spatial factors								. h.	
Gr. Lake								$0.507^{*}$	
+ Coast								(1.80)	
Mexico								-0.0229	
Border								(-0.08)	
Federal level									
President									0.167
Dummy									(0.30)
Ν	1200	1176	1176	1176	1176	995	996	1176	1176
Pseudo $R^2$	0.697	0.702	0.706	0.706	0.706	0.708	0.697	0.707	0.706
Ll	-517.6	-494.1	-488.2	-487.5	-487.4	-407.8	-435.3	-486.3	-488.2

*t* statistics in parentheses, coefficients are expressed in odds ratios \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 8: Regression results and model specifications.

The results for the basic coefficients are fairly robust across the model specifications and in line with theoretical predictions. The main variable, Republican Voters is negative, highly significant and robust across all model specifications. If a state has more voters that favor the Republican Party in federal elections, it is less likely to deregulate cannabis. The other main indicator, is the spatial weight variable.

Model 1 uses the dichotomous state ideology variable that is substituted by the Trifecta Control variable in Model 2. These two specifications do not take the share of Republican Voters into account. We observed that the binary state ideology was not significant, in contrast to the more nuanced Trifecta variable. This implies that a simple distinction of states by their governors' party affiliation does not explain the effect of ideology on policy making.

A democratic government, according to the definition of Trifecta, significantly increases the probability that a states' policy is a regime with a higher level of deregulation. Nevertheless, the government ideology loses its importance and significance, when the Republican Voter variable is included (Model 3 to 9). This shows that the Trifecta variable mainly captures the preferences of the electorate, which seem to dominate possibly diverging preferences of the government in power.

In Table 9 we expand the model by adding subsequently different weight matrices. The weight matrix based on first contiguity and the weight matrix based on a decaying distance both appear significant and positive, which means that a state reacts in the same direction to policy changes in neighboring states. This weight matrix remains significant across 5 of the 7 model specifications (in Table 8). The weight matrix based on ideological distance and the matrix based on an interaction of ideology and distance both appear insignificant, and point to the direction that states do not react specifically to states whose governments are closer in terms of ideology. This abstinence of a possible learning effect between ideologically close governments further adds to the evidence that the preference of the government itself plays a minor role in drug policy making.

	Binary	Weighted	Ideology	Ideology/
	Neighbors	Distance		Distance
Lagged	4.355***	4.369***	4.368***	4.374***
Outcome	(11.39)	(11.32)	(11.51)	(11.41)
	1001***	17 25***	1 < 1 0***	17 17***
Elderly	-16.91	-17.35	-16.12	-1/.16
(fraction)	(-3.56)	(-3.64)	(-3.56)	(-3./6)
Race	2.125***	2.160***	2.097***	2.111***
(fraction)	(2.77)	(2.92)	(2.84)	(2.82)
Income	-0.192	-0.194	0.0635	-0.107
per capita	(-0.35)	(-0.35)	(0.12)	(-0.19)
Trifecta	0.351*	0.331	0.288	0.146
Control	(1.69)	(1.53)	(1.01)	(0.54)
Republican	-0.0522***	-0.0516***	-0.0509***	-0.0491***
Voters	(-3.52)	(-3.44)	(-3.43)	(-3.31)
Spatial	0.166*			
Weight	(179)			
vi orgini	(1.77)			
Decaying		0.569**		
Distance		(2.03)		
Ideology			0.268	
Matrix			(0.85)	
				0.420
Ideology/ Distance				0.428
Matrix				(1.53)
N	1176	1176	1176	1176
pseudo $R^2$	0.706	0.706	0.705	0.706
Ll	-488.5	-488.2	-489.3	-488.3

*t* statistics in parentheses

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 9: Regression results and model specifications for the spatial matrices, ideology matrix and the interacted ideology/ distance matrix.

The share of elderly in the population has a negative impact on the probability of belonging to a more deregulated policy regime. An increase in the proportion of Hispanics and African Americans in the population increases the probability of deregulation. We further tested in specification 3 through 5 the effects of state politics on the choice of cannabis regime. However, neither the year of federal or state elections explained the variations in cannabis policy. What we do find is a significant negative effect of the budget deficit and real GDP

growth in specification 4 and 5, meaning that states which face a lower growth rate are more likely to choose a higher policy regime.

The domestic factors cannabis treatment and criminal justice in specification 6 were insignificant as was the effect of cannabis price on cannabis regulation (model 7). In a next step (model 8) we included spatial factors in the regression, and while Mexico border proximity had no effect, the aggregated variable of Great Lake and coastal states had a positive effect on the probability of choosing a deregulated regime. In the last category (9) of the federal level, a change in the party affiliation of the president had no effect on the choice of policy regime<sup>38</sup>.

### 5. Discussion

It seems to be important that the whole political apparatus stands behind the change in cannabis policy, rather than just a single office. But even the variable Trifecta Control which captures government ideology and the strength of the ruling party does not remain robust across all specifications. We cannot be sure that the variable only includes the impact of the government ideology, and omitted variable bias may be an underlying factor. It could very well be that the electorate in states which elects Democrats has a more liberal attitude towards legalization of cannabis. Another possible explanation is a potentially higher prevalence rate of cannabis use. This would mean that the government ideology variable reflects this effect too.

To decrease the possibility of omitted variable bias and to separate the government preferences (Trifecta Control) from the electorate's preferences we include the Republican Voters variables. It remains highly significant throughout all specifications and it appears the cannabis policy changes are rather induced by electorate preferences than by government ideology. This is especially visible since Trifecta Control is not significant anymore, if the percentage of Republican voters is taken into account.

The decaying distance weight matrix and the first order contiguity matrix are significant, whereas matrices which assume an ideological distance between states are not. We assumed that states rely only on their direct neighbors with whom they share a common border. This is

<sup>&</sup>lt;sup>38</sup> The presidential dummy is a federal analogy to the State Politics variable (affiliation of the state governor). Additionally to the state-level Trifecta Control, a federal Trifecta Control variable was tested. However, as opposed to the state-level effect, the federal effect was not significant.

influenced by factors such as enforcement costs and tourism across state borders. However, this should be warranted, if we assume that externalities exist between all states and not only direct neighbors. Therefore, the first regression includes only direct neighbors, while the other model specifications work with spatial linkages between all states. Furthermore, it is necessary to include this extended weight matrix because we propose that governments change their policy due to new information from the implementation of cannabis deregulation in other states or that voters update their beliefs based on other states' policies. The insignificance of the ideological weight matrices counteracts this point in the sense that governments do not learn specifically from other governments to which they are ideologically closer.

In the case of the other political and socioeconomic variables, states with a high proportion of elderly retain rigid cannabis regimes, whereas states with a high proportion of citizens with Hispanic or African American heritage are more likely to have a more deregulated regime This is in line with the prediction that the preference of groups within the electorate and their proportion affect the policy choice of the government. The interesting finding here is that only income per capita loses its significance of an effect on policy outcome when including the share of Republican voters, but the variables for race and elderly remain robust. Apparently there is an additional effect of the proportion of groups in society, which could be explained by the popular referenda mechanism that gives the electorate an independent mechanism to change policy. The budget deficits as well as the real state growth appear to be decisive factors for a government to consider deregulation in times of tight budget constraints and difficult economic circumstances. Moreover, coastal or Great lake access makes deregulation more likely, which could be due to an easier and direct influx of smuggled products.

In the domain of cannabis policy-making, state governments seem to follow the wishes of the electorate, which is not the case in other policy areas. Industry lobbying usually shapes policy outcomes; however, the cannabis lobby is rather small compared to other fields, for example alcohol. This can be illustrated with national level lobbyism data. From 2006 to the present, 27 clients had a cannabis- or marijuana-related lobbyism goal, whereas the alcohol lobby had 188 clients<sup>39</sup> (Center for Responsive Politics, 2015). The cannabis lobby brought 348 issues with regards to cannabis regulation, which is much less than the 2548 issues raised by the

<sup>&</sup>lt;sup>39</sup> These lobbyism groups can be for or against cannabis/ alcohol. The comparison only shows the difference in size and number of players in the different lobbyism areas.

alcohol lobby. Comparing the National Cannabis Industry Association with the National Beer Wholesalers Association this gap becomes even more visible. The former spent 130.000 US\$ on lobbying between 2011 and 2014, while the latter had much more resources with 3.953.000 US\$ spent in the same timeframe.

## 6. Policy Outlook

This paper adds a new dimension to understanding the process of cannabis policy-making and complements the existing literature. Disentangling the dynamics behind cannabis policy could contribute to more efficient processes and decisions. Here, the variation in medical and recreational cannabis policy was exploited to shed some light on the underlying processes of decision-making in cannabis policy in the different US states.

The research question asked what the determinants of cannabis policy were. It turned out that a number of factors influenced US cannabis policy among which state electorate preferences and spatial learning appeared to be the most important ones. However, race, the fraction of elderly in a state, having access to the coast or the Great Lakes, the budget deficit, real state growth and the government ideology predicted the decision to change.

To a certain extend this insight can be used to predict upcoming policy changes regarding medical and recreational cannabis in the US. These policy changes do not seem to be influenced by any visible or apparent necessity, but rather by political considerations induced by the preferences and characteristics of the electorate. In 2013 and 2014 alone, 14 states decided to deregulate cannabis in some way – a phenomenon that cannot be explained by the need to change.

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## **Appendix 1 - ArcGIS**

The policy developments are grouped in 5-year intervals starting in 1990 and cutting the last interval short in 2014. The last map shows the development over the entire observation period from 1990 to 2014. A darker color indicates a higher cannabis policy score.



Picture 1: Distribution of the outcome variable in 1990.



Picture 2: Distribution of the outcome variable in 1995.



Picture 3: Distribution of the outcome variable in 2000.



Picture 4: Distribution of the outcome variable in 2005.



Picture 5: Distribution of the outcome variable in 2010.



Picture 6: Distribution of the outcome variable in 2014.



Picture 7: Development of the outcome variable from 1990 to 2014.

The pictures are produced with ArcGIS (ESRI, 2011).

# **Appendix 2 - Autocorrelations**

Moran's	I					
	Variables	I	E(I)	sd(I)	Z	p-value*
	Outcome 2014 Change in Outcome	0.232	-0.020 -0.020	0.097 0.097	2.588 2.577	0.005 0.005
Geary's	С					
	Variables	С	E(C)	sd(c)	Z	p-value*
	Outcome 2014 Change in Outcome	0.706 0.774	1.000 1.000	0.105 0.106	-2.800 -2.121	0.003 0.017
*1-tail	Test					

	Outcome	State Politics	Trifecta Control	Republican Voters	Federal Elections	State Elections	Budget Deficit	Real State Growth	Elderly (fraction)
Outcome	1								
State Politics	0.0139	1							
Trifecta Control	0.2199	0.6028	1						
Republican Voters	-0.1940	-0.0215	-0.2724	1					
Federal Elections	0.0398	0.0088	0.0044	0.0768	1				
State Elections	-0.0222	0.0178	0.0145	0.0055	-0.0712	1			
Budget Deficit	-0.1237	-0.0405	-0.1079	-0.0887	0.0220	0.0015	1		
Real Growth	-0.1484	-0.0539	-0.0707	-0.0603	0.0355	0.0557	0.4144	1	
Elderly (fraction)	-0.2189	0.0020	0.0267	-0.1988	0.0274	-0.0060	-0.2084	-0.0913	1
Race (fraction)	0.2063	-0.0867	0.0930	0.0695	0.0149	-0.0317	-0.0783	-0.0617	-0.1875

# **Appendix 3 - Correlation matrix**

Ino pe	come r capita	0.4079	0.0337	0.0349	0.0899	0.0262	0.0080	-0.1930	-0.2932	0.1032
Tr Ac	eatment Imission	0.2442	-0.0195	0.0074	-0.2874	0.0042	-0.0128	-0.0088	-0.0465	0.0412
Cr Ju	iminal stice	0.1698	0.0153	-0.0137	-0.2562	-0.0018	-0.0043	0.0490	0.0038	0.0971
Pri (m	ice iedian)	0.2000	0.0298	-0.0376	0.1436	0.0105	-0.0015	-0.2041	-0.3108	0.0423
M Dı	exico 1mmy	0.0540	-0.0919	0.0011	0.0171	-0.0020	-0.0171	-0.0260	0.0673	-0.2137
Co Di	oastal ummy	0.4092	0.0403	0.2536	-0.2035	0.0075	0.0009	0.0050	-0.0479	-0.1086
Co Gr	oast/ eat Lakes	0.2907	-0.0198	0.1275	-03082	0.0063	-0.0092	0.0430	-0.1085	-0.0327
Pro Di	esidential 1mmy	-0.0011	-0.0623	-0.0321	0.4855	-0.1220	-0.0061	0.0396	0.1001	0.0677
-	Race (fraction)	Income per capita	Treatment Admission	Criminal Justice	Price (median)	Mexico Dummy	Coastal Dummy	Coast/ Great Lakes	Presidential Dummy	
------------------------	--------------------	-------------------	------------------------	---------------------	-------------------	-----------------	------------------	-----------------------	-----------------------	
Race (fraction)	1									
Income per capita	0.1775	1								
Treatment Admission	0.0412	0.1662	1							
Criminal Justice	0.0971	0.1164	0.8475	1						
Price (median)	0.0423	0.5501	0.0626	0.0224	1					
Mexico Dummy	-0.2137	-0.0454	0.1049	0.1486	-0.0726	1				
Coastal Dummy	-0.1086	0.1911	0.2243	0.2013	0.0778	0.0479	1			
Coast/ Great Lakes	-0.0327	0.1902	0.3329	0.3461	0.0711	-0.0540	0.7177	1		
Presidential Dummy	0.0677	-0.1579	0.0031	0.0037	-0.1996	-0.0128	0.0161	0.0183	1	

# **Paper III**

The grass is always greener on the other side -

Prevalence of adolescent cannabis use and decriminalization

## 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, polity, corruption and interactions between the independent variables, this reduction is about 13 %. 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.

# JEL classification: H75, K42, P46

**Keywords:** Criminal Law, Decriminalization, Deterrence, Prevalence of Cannabis Use, Adolescents, Difference-in-Differences

## **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 (Hopfer, 2014; 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-indifferences 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. It can be stated as: What are the effects of cannabis (de)criminalization on cannabis consumption?

The empirical analysis, namely the difference-in-differences model, shows the significant difference between the criminalized and decriminalized countries. Countries that decriminalize cannabis experience a 12 % decrease of youth cannabis use after changing the law as compared to the group of criminalized countries, when controlling for unemployment, alcohol use, GDP per capita, a polity score, corruption and interactions. This finding remains robust across different model specifications.

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 concerns the 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 (Felix & Portugal, 2015). 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 (1968) 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 (1968), 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 (1968), 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 estimated 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 nonzero 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).

Sunstein (1996) reflects upon the expressive function of the law: Laws do not only govern citizens, but also carry the weight of making a statement, even if it is not enforced. Criminalization can be seen as a negative statement, which will be rebelled against. This is parallel to the argument Sunstein makes about an increase in flag burning, if the act is prohibited. Law, in this case decriminalization, can be used as a corrective for this behavior. Cooter (1998) explores this further and states that a legal equilibrium can shift. Decriminalizing cannabis would then not only shift the law, but also people's preferences. This would be a moral statement in favor of soft drugs.

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 annual 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<sup>40</sup>, potential European Union member states<sup>41</sup> and other European Region countries with high quality or synchronized data collection and reporting in common databases<sup>42</sup>. Anonymous questionnaires were employed to collect prevalence rates of cannabis use in adolescents in order to avoid answers biased by a social desirability effect.

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 and travel opportunities/ mobility are reduced. Stays abroad in countries that decriminalized cannabis and entry to coffee shops in the Netherlands are not easily done/ impossible for teenagers. This means that they will be

<sup>&</sup>lt;sup>40</sup> Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, France, Hungary, Ireland, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, and the United Kingdom

<sup>&</sup>lt;sup>41</sup> Iceland and Serbia.

<sup>&</sup>lt;sup>42</sup> Liechtenstein, Moldova, Switzerland and Ukraine.

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.

Observations of cannabis consumption 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. This eliminates the countries that changed towards a decriminalized approach before data was available<sup>43</sup>. The observations were yearly estimates of lifetime prevalence of cannabis use in order distinguish the effect from other changes in the same years.

Year of cannabis decriminalization	Countries
1997	Austria, Estonia, Ireland
2000	Portugal
2001	Croatia, Luxembourg
2003	Belgium
2004	Denmark
2007	Liechtenstein
2008	Moldova
2009	Serbia, United Kingdom
2010	Czech Republic, Ukraine

Table 10: Year in which decriminalization took place in the countries used for analysis.

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

<sup>&</sup>lt;sup>43</sup> For example the Netherlands due to their de facto legalization in 1976.

their policy on cannabis. 14 countries decriminalized cannabis for personal use and possession during the period of observation from 1990 to 2012 (see Table 10) 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.

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. 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 of decriminalization is visible in the within-country changes in cannabis use pre- and post-decriminalization. This approach follows the Neyman-Rubin causal model by comparing countries that decriminalized (changed the law) versus those that did not (Sekhon, 2008). The analysis was carried out with Stata 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 <sub>c</sub> in year <sub>t</sub>.  $\beta_0$  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. 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. This was done to account for the intra-group correlation, while the clusters (countries) themselves should be independent from each other. The fixed effect,  $\alpha_c$ , allows the intercept to differ from country to country. Nevertheless, the slopes were still expected 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.  $\varepsilon_{ct}$  is the country- and year-specific error term.

# 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 selection of variables follows the approach taken in Felix & Portugal (2015). Additionally, a "European Union" Dummy and a "former Soviet country" Dummy were tested, but not significant.

The extended formal specification of the model, with the four additional independent variables and their coefficients, is:

 $Y_{ct} = \beta_0 + \beta_1 Year_t + \beta_2 Policy_c + \beta_3 Treated/Post_{ct} + \beta_4 Unemployment + \beta_5 Alcohol + \beta_6 GDP + \beta_7 Polity + \beta_8 Corruption + \alpha_c + \varepsilon_{ct}$ 

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.

The level of corruption in each country is measured on a scale from -2.59 to 2.59 and can be found in the World Governance Indicators (World Bank, 2013). A bigger number of corrupt officials might facilitate the acquisition and consumption of drugs, especially if the (potential) users know that they can easily avoid punishment through bribes (International Narcotics Control Board, 2011).

#### 4.3 Limitations

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

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. The intention was to find at least one estimate of cannabis use from predecriminalization 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).

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.

## 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 annual prevalence rates (Hughes & Stevens, 2010).

	<b>Pre</b> -treatment period (1 <sup>st</sup> point of observation for non-treated countries)	<b>Post</b> -treatment period (2 <sup>nd</sup> point of observation for non-treated countries)
<b>Non-treated</b> countries # of observations	10.03 % 10	18.64 % 16
<b>Treated</b> countries # of observations	18.52 % 16	19.43 % 20

Table 11: 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 11, 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 11: (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	Mean	Standard Deviation	Minimum	Maximum	
Prevalence of adolescent cannabis use (%)	17.47	10.62	3.5	45.1	
Year of the observation	Not applicable	Not applicable	1990	2012	
Decriminalization (0=no; 1=yes)	0.58	Not applicable	0	1	
Treated + Post-legislation change (0=no; 1=yes)	0.32	Not applicable	0	1	

Table 12: Summary statistics for the variables used in the difference-in-differences model.

In Table 12 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).

	(1)
Year	$0.648^{***}$
	(3.50)
Treated	Omitted
Dummy	
Treated/	-6.328*
Post	(-2.00)
t statistics in paren	theses
* $p < 0.10$ , ** $p < 0.10$	$.05, ^{***} p < 0.01$

Table 13: Result of the difference-in-differences analysis.

The fixed effects model eliminates the country-specific characteristics. The result of the difference-in-differences analysis is significant at the 10 percent level. Decriminalizing cannabis leads to an average reduction of cannabis use by 6.33 %. The difference-in-differences estimator ( $\beta_3$ ) 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 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).

Variable	Mean	Standard Deviation	Minimum	Maximum
Unemployment (% of population)	8.36	4.37	0.5	23.6
Alcohol use (liters per capita)	10.86	2.06	6.05	14.74
GDP per capita (in constant 2005 US\$)	24952.09	21789.42	974.1	105306.8
Polity (from -10 = autocracy to 10 = democracy)	9.11	2.18	-5	10
Corruption (from -2.59 to 2.59)	0.95	0.98	-1.00	2.53

# 5.2 Extended model

Table 14: Summary statistics for the independent variables used in the difference-in-differences model.

In Table 14 the descriptive for the control variables are summarized. 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.

	(1)	(2)	(3)	(4)	(5)	(6)
Year	0.631***	0.853***	0.764***	0.702***	0.636***	0.755*
	(2.93)	(3.55)	(3.32)	(3.41)	(3.44)	(1.94)
Treated			Omi	itted		
Dummy						
Tracted/	7 122*	10 29**	6.026*	0 155**	6 771**	10.07**
	-7.133	-10.28	-0.030	-8.133	-0.7/4	-12.27
Post	(-1.87)	(-2.43)	(-1./1)	(-2.34)	(-2.13)	(-2.25)
Unemployment	-0 00199					1 1 1 7
Chempioyment	(-0.001)					(1.11)
	( 0.00)					(1.11)
Alcohol		1.362				0.348
		(1.21)				(0.21)
						~ /
GDP			-0.000284			$0.0197^{*}$
			(-0.76)			(1.95)
Polity				0.536		$13.06^{*}$
				(0.83)		(1.95)
Corruption					4.257	-5.518
					(1.13)	(-0.81)
т.,						0.00105*
Interaction						-0.00195
(GDP/ Polity)						(-1.94)

*t* statistics in parentheses \* *p* < 0.10, \*\* *p* < 0.05, \*\*\* *p* < 0.01

Table 15: Result of the difference-in-differences analysis with independent variables.

In Table 15 a number of models are specified. Each independent variable is tested individually (model 1-5) and model 6 combines them. The variable of interest, Treated/ Post remains significant and robust across all specifications. As visible from the coefficients of the variable Year, the mean prevalence of cannabis consumption increases by 0.6 - 0.8 percent every year.

Decriminalizing cannabis leads to an average reduction of cannabis use by 12.27 % when controlling for unemployment, alcohol use, GDP, polity, corruption and interactions. The difference-in-differences estimator ( $\beta_3$ ) shows the decline in cannabis use due to the policy

change (treatment), while controlling for the 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.

In the final model (6) an interaction term between GDP per capita is included since it tested significant. All other correlations between the explanatory variables were low and the interaction terms insignificant. Inclusion of this interaction increased the level of significance for the difference-in-differences model (Treated/Post variable). The significant explanatory variables are, naturally, the interaction term as well as both interactors: GDP per capita and polity. Both of their coefficients are positive, which leads to the conclusion that higher GDP and more democratic freedom are connected to a higher level of cannabis use. Therefore, it is important to control for them in the model and hold them constant, when assessing the difference-in-differences model.

#### 6. Conclusion

States that passed a new law regarding personal cannabis use and possession generally had a higher average of annual 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 13 % when controlling for unemployment, alcohol use, GDP, polity, corruption and significant interactions. 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 (Hopfer, 2014). 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 contribution of this paper is to generate evidence on the consequences of decriminalization and to supplement the pro-decriminalization literature with empirical support. 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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# Paper IV

# Who gets high(er)? -

# Stakeholders in cannabis policy

## Abstract:

Cannabis policy is shaped by a multitude of stakeholders ranging from international to local players. This paper employs stakeholder theory to position them in the realm of cannabis policy-making and explains their opposition or support of decriminalization. Moreover, a difference-in-differences analysis is utilized to show the substitution effect of cannabis for alcoholic drinks with a sample of 114 countries. Accordingly, not only the UN, but also the alcohol industry, has an interest to uphold the criminalization of cannabis agreed upon in the UN Single Convention from 1961. In the observation period from 1961 to 2010, 41 countries decriminalized cannabis. The trend of increasing alcohol consumption is slowed down by cannabis decriminalization, even after controlling for unemployment, GDP per capita, democratic freedom and the share of Muslims. Decriminalized countries experience about 15% less annual increment in alcohol consumption as compared to criminalized countries. Consequently, policy-makers need to consider stakeholder interests, when choosing a policy. However, they need to be careful to not succumb to the most power- or resourceful player.

## JEL classification: C33, H75, K32

**Keywords:** Decriminalization, Alcohol consumption, Difference-in-Differences, Stakeholder theory

## **1. Introduction**

Cannabis policy and the official attitude towards drugs are decided upon on national level. Each country has an official position on whether it respects the UN Single Convention from 1961, which means criminalization of cannabis (United Nations, 2014). However, a country is not a unitary actor; rather the decision-making process is determined by a multitude of stakeholders. This stakeholder's influence on the government varies, depending on the country in question, the attitude of the population and the stakeholder's financial resources.

Lobbyism has proven to change policy outcomes, for example in the areas of immigration (Facchini, Mayda & Mishra, 2011) or trade (Tovar, 2011). Both, supporters and opponents, can significantly influence the policy at stake (Facchini, Mayda & Mishra, 2011). Policy proposals for cannabis decriminalization were successful in multiple countries; the first one to relax cannabis policy was the Netherlands in 1976 (Cohen, 1996). In contrast, Canada's initiatives were shut down on two occasions, in 2002 and 2004 (Parliament of Canada, 2004).

Accordingly, it is important to analyze which stakeholders and interests are involved in the policy-making regarding cannabis, to determine their level of influence and in whose favor the issue is resolved (Wolman & Spitzley, 1999). Later on, this insight could be used by the government in order to manipulate individual participants and achieve the wanted outcome. Therefore, the research questions are: (1) Which stakeholders exist in cannabis policy-making and (2) why does the alcohol industry express a strong opposition to decriminalization towards the policy-maker?

The alcohol industry lobbies towards free trade and lowering alcohol taxes. However, during the last years they devoted a new branch of lobbyists to maintain drug prohibition (Center for Responsive Politics, 2014a). Accordingly, the lobbyism expenditure rose from 3 million dollars in 1990 to 16 million dollars in 2014. The alcohol industry claims that drugs are connected to illegal drug trade and abuse, which has to be prevented by any means.

The methods operated to answer the research questions are a theoretical stakeholder framework and a difference-in-differences analysis. The results expose that a number of stakeholders play an important role and that cannabis decriminalization significantly reduces the trend of the globally increasing alcohol consumption. After controlling for four different control variables, this decline can be quantified at 15% per capita in countries that decriminalize cannabis as compared to criminalized countries. The literature is ambiguous regarding the effect between alcohol and cannabis; they could be substitutes or complements

(Decker & Schwartz, 2000). The data at hand supports the substitution hypothesis between alcohol and cannabis and this seems to be the main concern of the alcohol industry.

In the following a literature review is presented (section 2). This section will discuss stakeholders in cannabis policy in the light of a basic stakeholder classification. Furthermore, the potential relationships between alcohol and cannabis are highlighted. Section 3 introduces the methodology and section 4 the empirical results. These results are elaborated on in section 5 and a conclusion is drawn in section 6.

#### 2. Literature Review

#### 2.1 Stakeholder in cannabis policy

According to Freeman (1984), a stakeholder is defined as "any group or individual who can affect or is affected by the achievement of the organization's objective". Mitchell, Agle & Wood (1997) developed a stakeholder analysis framework with seven categories<sup>44</sup>. For this analysis of the field of cannabis policy the stakeholders are classified in Table 16Table 16<sup>45</sup>. A visual representation of the stakeholder network was created with NodeXL and can be found in the appendix.

Each stakeholder can be identified through three attributes: (1) power/ influence on the policy-maker, (2) legitimacy of the relationship with the decision-maker and (3) urgency of the objective (Mitchell, Agle & Wood, 1997). Power implies that A can influence B to act in a way in which B would not have acted (Dahl, 1957). This influence can be of coercive nature through the use of force or a threat, manifested through material incentives (utilitarian) or symbolic (normative) (Etzioni, 1964). Legitimacy arises from a stakeholder's actions being socially desirable or appropriate (Suchman, 1995). Urgency is given, if the stakeholder is in need of immediate consideration through the policy-maker. This is defined in two dimensions that both have to be fulfilled: (1) the issue should be time-sensitive and delay unacceptable and (2) the stakeholder views the relationship to the policy-maker as critical or very important

<sup>&</sup>lt;sup>44</sup> Definitive, Dangerous, Dominant, Dependent, Demanding, Discretionary and Dormant (as ranked from most powerful to least powerful).

<sup>&</sup>lt;sup>45</sup> Stakeholder analysis is used to clearly define and describe each participant in cannabis policy. All stakeholders try to maximize their utility by influencing policy outcomes. This utility is not necessarily measurable in monetary terms, but could also be connected to morals or the reduction of their workload.
(Eyestone, 1978). In Table 16 the presence/ absence of each of the three attributes, power, legitimacy and urgency, is displayed.

Stakeholder	Classification	Power	Legitimacy	Urgency
Policy-maker	Definitive	ves – vote/	ves – legal	ves –
(Parliament)		determine	authority to	negotiations.
()		outcome	decide on	debates, time &
			cannabis	human capital
			regulation	used in order to
			regulation	determine level
				of (de)regulation
				or (de)regulation
International	Definitive	yes – UN Single	yes –	yes – time,
community/ UN		Convention on	international	compromise,
		Narcotic Drugs	hard law as	financial
		from 1961	basis to act	contribution to
				UN negotiations
Dung tuoffi ali ang/	Densonaus	the heiling		financial
Drug traffickers/	Dangerous	yes – brides,	no – no legal	yes – mancial
Dealers		intimidation,	way since their	resources
		assassination	existence is	
			illegal	
Alcohol industry	Dangerous	yes – ability to	no – no proper	yes – afraid of
		influence	political power	losses;
		through	or actions	substantial
		resources and	possible	resources
		political		(money/ time)
		pressure		used
	D. I.			
Public Health/	Dependent	no – not	yes – involved;	yes – taxes are
Medical Workers/		decisive in	treat disorders	used to pay
Substance abuse		policy-making		salaries; human
councils				capital
Police force	Dependent	no – not	yes – involved;	yes – taxes are
		decisive in	fighting drug-	used to pay
		policy-making	related crime	salaries; human
		_		

				capital
Prison guards/	Dependent	no – usually no	ves – jobs are at	ves – substantial
Unions	Dependent	political	stake	donations to
Cinons		influence	Stake	criminalization
		linituence		campaigns
				campargns
Schools/ Youth	Dependent	no – usually no	yes – need to be	yes –
		political	protected	educational
		influence		budget
Covernment	Dominant	NOS	vos ogondo	<b>no r</b> asou <b>r</b> aas
Government	Dominant	yes -	yes – agenda	no - resources
			setter	
		the Dealisment		concentrated on
		the Parliament		one proposition
Public opinion/	Discretionary	no – politicians	yes – can show	no - only private
Morals/ Church/		are elected to	discontent in the	resources
Families		represent society	next election	
			cycle	
Comment	Discustions		was wort of the	no only
Consumers	Discretionary	no – collective	yes – part of the	no – only
		action problem	electoral system;	private
			ability to vote	resources
Producers	Dormant	yes – jobs;	no – no legal	no – no urgency
		potential market	influence; illegal	
			sphere	
	Demacent			1-1
Tobacco industry	Dormant	yes – lobbyism,	no – no formal	no – delay of
		financial	political power	actions since the
		resources		1970s
	Dames I'			
Pharmaceutical	Demanding	no – revenue	no – no proper	yes – arraid of
industry		trom medical	political power	losses;
		cannabis patents	or actions	substantial

		prevent open	possible	resources
		political		(money/ time)
		opposition		used
Cannabis	Demanding	no – limited	no –	yes – recent
deregulation		financial	deregulation is a	trend to
lobbyists		resources	moral issue and	liberalize
			debated	cannabis

Table 16: Stakeholder in cannabis policy classified through the lens of stakeholder theory.

The most important stakeholder is the parliament or the policy-maker herself. The parliament votes on the decriminalization of cannabis and determines the level of (de)regulation (Hughes & Stevens, 2010; Parliament of Canada, 2004). Financial and human resources are needed for this political process that is often hotly debated (Cohen, 1994).

The UN is a definite stakeholder due to its strong influence and restraint on national politics through international hard law. 184 countries joined the UN Single Convention on Narcotic Drugs from 1961, which highly criminalizes cannabis (United Nations, 2014). Writing this Convention was a lengthy process that started in 1912 and took enormous efforts to negotiate between all parties. The international community exerts influence not only through Conventions, but also through a variety of political mechanism (Zimmer, 1997). When the Netherlands wanted to legalize cannabis in 1976, Germany and the UK threatened to cut off their oil supply (Cohen, 1996). Canada's efforts to decriminalize cannabis in 2002 were attacked by the International Narcotics Control board and the US. Since 85 percent of Canada's export went to the US at that time, they threatened to reduce trade as well as to delay border crossings (Parliament of Canada, 2004).

Drug traffickers and dealers are dangerous stakeholders due to their lack of legitimacy. They operate entirely in the illegal sphere, foster the black market for drugs and try to gain a broader consumer base through decriminalization and less law enforcement (Gray, 2010). However, their financial resources are vast and they use them to (1) corrupt, (2) intimidate or (3) assassinate officials (International Narcotics Control Board, 2011).

The alcohol industry is afraid of losses through cannabis as a substitute for alcohol (Anderson, Hansen & Rees, 2013b; Falcon, 2011). In California they spent about 100.000 dollar in 2008 and 10.000 dollar in 2010 in order to defeat the proposed cannabis reforms (California Secretary of State, 2010). They use their substantial financial resources in order to direct the public's and the policy-makers' opinion towards a criminalized approach. The industry also threatens to move business and factories abroad in case of relaxed cannabis laws in order to gain more momentum (Falcon, 2011). However, these actions cannot be regarded as legitimate, which makes them a dangerous stakeholder.

Negative medical consequences of cannabis use or addiction cannot be ignored under any political scheme for cannabis regulation (Wall, Poh, Cerdá, Keyes, Galea & Hasin, 2011). Public Health and medical workers are paid through taxes and are part of the human capital the state has to employ to reduce adverse effects of cannabis use (Hughes & Stevens, 2010). They constitute a dependent stakeholder due to their lack of political influence. However, healthcare professionals report that decriminalization reduced the patients' fear of criminal convictions and makes treatment easier (Harper, Strumpf & Kaufman, 2012).

The police force is part of the executive branch of a state and is paid through taxes. Human capital is invested in order to fight drug-related crime (Hughes & Stevens, 2010). It has been studied extensively that decriminalization would relieve the burden on law enforcement and shift resources to large-scale traffickers (MacCoun & Reuter, 2001). If individual users are not punished anymore and prison capacities are freed, a large budget of financial and human resources becomes available (Single, Christie & Ali, 2000). However, the police force is a dependent stakeholder since they carried out the state's will, but do not have a decisive input in politics.

The prison guard unions are one of the major opponents of cannabis decriminalization: They provide private financial support in order to keep cannabis criminalized. For example, they donated for the criminalization campaign in California to avoid relaxation of cannabis policy (California Secretary of State, 2010). When looking at the issue from their perspective, decriminalization would lead to fewer convictions and less prisoners, which in turn would mean a diminished need for prison guards (Falcon, 2011). They are trying to secure their jobs, but their interests are dependent on other stakeholders' political influence.

Adolescents are especially endangered by cannabis use since early onset is connected to lower educational outcome as well as physical and mental diseases (Hall & Degenhardt,

2009; Hall, 2008; Rey, Sawyer, Raphael, Patton & Lynskey, 2002). Schools are often targeted through educational campaigns against drug use since the number of cannabis users is increasing world-wide (Zimmer & Morgan, 1997). Nevertheless, their stakeholder status is dependent because they do not have the means to lobby for their own interests.

The government is a dominant stakeholder, since the relationship to the voting body (the parliament) is legally formalized and it is the legitimate agenda setter. However, resources need to be split between all areas of law and households. Every government has to evaluate the trade-off between the negative consequences and the economic impact of criminalization versus the international obligation to criminalize cannabis (Anderson, Hansen & Rees, 2013a). The intention to decriminalize cannabis is expressed to the parliament, which then has to vote on the proposition. This notion is often justified with public health benefits, reduction of law enforcement costs and cannabis as a substitute for excessive alcohol consumption (Anderson, Hansen & Rees, 2013b; Falcon, 2011).

The public is a discretionary stakeholder that elects officials in order to be represented in policy-making (Falcon, 2011). During the terms of the politicians the public has few ways to influence policy-making; however, it is possible to retaliate and show discontent in the next election cycle. It is impossible to assign one opinion to the public since it is often a question of simple majority which cannabis policy is supported. Morals and church-related ideas are opposed to a desire for a less paternalistic government.

Consumers are discretionary stakeholders with a legitimate right to vote, but no resources worth mentioning. Moreover, acting as an individual is costly and this entails a collective action problem (Sandler, 1992). Under decriminalization, cannabis users would be able to avoid criminal records as well as long-term problems with housing, employment and relationships (Lenton, Humeniuk, Heale & Christie, 2000; Lenton et al., 1999). It will also be easier for them to obtain life insurance or a donated organ, even if they consume cannabis on a regular basis.

Producers of cannabis are dormant: They could potentially influence political decisions since many jobs are connected to this industry and there is potential for a whole new market for cannabis pesticides or tool to harvest it more efficiently (Stone, 2014). If cannabis laws are relaxed their punishment would be lower. Punishment would even be absent, if cannabis would be legalized. Nevertheless, under criminalization they operate in the illegal sphere and have no urgency to change their status. The tobacco industry has an interest in decriminalization or even legalization of cannabis due to the complementary effect of cannabis and cigarettes (Cameron & Williams, 2001). Recently published evidence shows that the tobacco industry first made plans in the 1970s to establish a new line of cigarettes containing cannabis and that it is prepared to explore this new market (Barry, Hiilamo & Glantz, 2014). Nevertheless, the tobacco lobby does not see an immediate need for action.

The pharmaceutical industry demands medical cannabis patents and revenue on the one hand and opposes decriminalization of recreational cannabis on the other (Collen, 2012). This is due to the fear of financial losses since cannabis can be used as a substitute for prescription drugs and especially pain medicine (Reiman, 2009; Reiman, 2007). Similar to lobbyism groups from the alcohol industry, pharmaceutical companies try to generate scientific evidence against cannabis decriminalization.

Recently, a lobbyist group for cannabis deregulation has formed. Even though their number of lobbyists is small they contributed \$20.000, \$30.000 and \$60.000 in 2011, 2013 and 2014, respectively (Center for Responsive Politics, 2014b). This contribution is small compared to the financial investments of the alcohol lobby, which deprives the pro-cannabis lobby of power. The demand for deregulation is a timely one with 5 US states and Uruguay liberalizing cannabis sales (Room, 2014). Nevertheless, the topic of cannabis deregulation is still met with a lot of concern and moral debates (Böllinger, 2014).

### 2.2 Alcohol and cannabis

It is important to assess the economic characteristics of the relationship between alcohol and cannabis since there is potential to generate tax revenue for the government (Decker & Schwartz, 2000). Moreover, the quantity consumed of one or both substances could be reduced in order to diminish the external effects of substances. Health policy on either, alcohol or cannabis, might influence the demand for the other (Cameron & Williams, 2001). There are two possibilities: Reducing consumption of one could (1) reduce or (2) increase the demand for the other, depending on whether they are complements or substitutes (Caulkins et al., 2015; Caulkins et al., 2013). The mixed evidence on the relationship between alcohol and cannabis is presented in the following.

Reasons to believe that a complementary effect of alcohol and cannabis exists are presented trough US data (Farelly, Bray, Zarkin, Wendling & Pacula, 1999). Reducing consumption of

one substance will reduce the demand for the other too. Pacula (1998) finds that alcohol and cannabis are complements and that price increases for alcohol will decrease both, alcohol and cannabis consumption. This is consistent with the findings of Williams, Pacula, Chaloupka & Wechsler (2004) and Williams & Mahmoudi (2004). This effect is stronger for males, but it should still be considered when planning health policy (Williams & Mahmoudi, 2004). Users can choose between alcohol and cannabis based on their potential of addiction, relief of symptoms, safety, access and societal acceptance (Reiman, 2009).

An overwhelming amount of econometric research has concluded that alcohol and cannabis substitute and not complement each other (Anderson, Hansen & Rees, 2013b). The substitution effect is visible through cross-price elasticity of alcohol and cannabis in Australia (Cameron & Williams, 2001). An ongoing decline in Australian cannabis prices has generated a higher demand, but also reduced the amount of alcohol consumed (Clements, 2004). A higher price for alcohol reduces the number of road accidents due to alcohol intoxication, but increase the number of drug-related fatalities (Chaloupka & Laixuthai, 1994). Crost & Guerrero (2012) underscore that starting at the age of 21, cannabis is used less frequently in the US due to reaching the legal drinking age. In turn, increasing the drinking age leads to higher cannabis prevalence (DiNardo & Lemieux, 2001). Moreover, cannabis could be seen as a medicine; as an exit drug from prescription medicine and alcohol due to its substituting effect (Lucas et al., 2013). Alcoholics can control their addiction by using cannabis and this reduces the economic cost of alcoholics for society (Mikuriya, 2004). The goal of public health is to prevent or at least to reduce harm. Cannabis should be a harm reduction measure due to it substituting qualities (Reiman, 2009). It is chosen by addicts on basis of its qualities for symptom management, few withdrawal symptoms and few sideeffects.

#### 3. Methodology

The alcohol lobby invests large amounts of financial and human resources in order to prevent cannabis decriminalization (California Secretary of State, 2010). The underlying research question is trying to explore why the alcohol industry exhibits such a strong influence on the policy maker. After section 2 highlighted the multitude of stakeholders in cannabis policy, this empirical analysis serves as an example for stakeholder motivation and interest. The econometric analysis follows the approach taken in Felix & Portugal (2015).

Alcohol consumption in liters per capita per year was retrieved from the Global Health Observatory Data Repository (2014) of the World Health Organization. The alcohol consumption data is fairly complete for a large number of countries in the period from 1961 to 2010. The years 1960, 2011 and 2012 had to be dropped from the analysis due to the limited number of observations. Between 1961 and 1979 about 100 observations for alcohol consumption are available and between 1980 and 2010 around 120 countries recorded their alcohol consumption data. Therefore, all countries cover similar years of data, which makes them comparable.

The events of decriminalization are spread out over the observation period with the first event occurring in 1976 and the last event in 2013<sup>46</sup>. In total 41 countries decriminalized cannabis between 1961 and 2010. The distribution fits a normal distribution bell curve and is slightly skewed to the right. Decriminalization is seen as an exogenous shock. Data on cannabis policy (criminalization/ decriminalization) can be found in (1) the European Union's database (European Monitoring Center for Drugs and Drug Addiction, 2013) and (2) in a database established by the British Government (National Centre of Expertise on Drugs and Drugs Law, 2014).

A total of 5526 observation of alcohol consumption was collected for 114 countries<sup>47</sup> between 1961 and 2010. Following the difference-in-differences approach the pre- and post-treatment period was defined through the policy change in the countries that decriminalized cannabis<sup>48</sup>. Nevertheless, a pre- and post-period had to be found for the countries that do not

<sup>&</sup>lt;sup>46</sup> See Appendix for a list of countries that decriminalized cannabis and the year of decriminalization.

<sup>&</sup>lt;sup>47</sup> Algeria, Andorra, Angola, Argentina, Armenia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bhutan, Bolivia, Botswana, Brazil, Brunei, Bulgaria, Cameroon, Canada, Chile, China, Colombia, Comoros, Costa Rica, Croatia, Cuba, Cyprus, Czech Republic, Cote d Ivoire, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea-Bissau, Guyana, Honduras, Hungary, Iceland, Indonesia, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kyrgyzstan, Lao, Latvia, Lebanon, Lithuania, Luxembourg, Macedonia, Madagascar, Malaysia, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Morocco, Namibia, Netherlands, New Zealand, Nicaragua, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Senegal, Serbia, Sierra Leone, Singapore, Slovakia, Slovenia, Somalia, South Africa, South Korea, Spain, Sri Lanka, Suriname, Sweden, Switzerland, Syria, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, Uruguay, Uzbekistan, Venezuela, Viet Nam, Yemen

<sup>&</sup>lt;sup>48</sup> See Appendix for a list of countries that decriminalized cannabis and the year of decriminalization.

decriminalize cannabis<sup>49</sup>. To assure robustness three different models were established<sup>50</sup>. First, pre- and post-treatment was defined by the mean year of decriminalization (average between all 43 decriminalized countries). This was the year 2000. Second, the median (2001) was used. Third, there were three modes in the 41 observations of years of decriminalization: 1997, 2001 and 2009. Since 2001 is used in the second model and 2009 is almost at the end of the observation period, 1997 was chosen for the third model. This is macro-level dataset is analyzed as an unbalanced panel.

The formal equation of the model can be expressed as:

 $Log Y_{ct} = \beta_0 + \beta_1 Post_t + \beta_2 Treated_c + \beta_3 Treated/Post_{ct} + \beta_4 Unemployment + \beta_5 log GDP$  $per capita + \beta_6 Polity + \beta_7 Muslims + \delta_t T_t + \alpha_c + \varepsilon_{ct}$ 

The dependent variable ( $Y_{ct}$ ) is measured as the log-transformed alcohol consumption per capita in year t in any given country c. It is log transformed in order to attach more weight to an increase on lower levels of alcohol consumption. The basic effect for non-treated countries in the pre-treatment period is captured in the term  $\beta_0$  and is the equivalent of the intercept.  $\beta_1$  Postt as well as  $\beta_2$  Treated<sub>c</sub> are the coefficients and dummies needed for the difference-indifferences estimation. They are used in order to include a time- and treatment-dummy into the model. Post takes the value 0, if the observation is in the pre-treatment period and the value 1, if the observation is in the post-treatment period. Treated takes the value 0, if the country is not treated (keeps a criminalized cannabis policy) and the value 1, if the country is treated (decriminalizes cannabis).

The variable used to decide whether a significant effect on alcohol use exists between criminalized and decriminalized countries is  $\beta_3$  Treated/Post<sub>ct</sub>. This dummy will only take the value 1, if a country decriminalized cannabis and the observation stems from a year in the post-decriminalization period. All other observations will have the value 0 for this variable.

 $\beta_4$  Unemployment is the first independent variable. This is a standard control and based on the vectors employed by Anderson, Hansen & Rees (2013b). The data was retrieved from dataset of the World Development Indicators (World Bank, 2014) and is measured as the percentage of the total labor force that is unemployed. It is important to note that unemployment might have a negative coefficient, even though alcohol use has long been accredited for augmented

<sup>&</sup>lt;sup>49</sup> For a difference-in-differences approach regarding cannabis policy see Felix & Portugal (2015).

<sup>&</sup>lt;sup>50</sup> For a similar application see Allison (2009).

levels of drinking (see for example Popovici & French, 2013). Nevertheless, this hypothesis has been doubted from the very beginning (Forcier, 1988). Bolton & Rodriguez (2009) highlight that this relationship does not exist, if the unemployed receives benefits. In a time-series panel regression, Ogwang & Cho (2009) find a serious budget constraint for alcohol consumption through unemployment.

The time-series data for GDP per capita was matched to current US\$ for each data point and is available from the World Bank's World Development Indicators (World Bank, 2014). The variable  $\beta_5 \log$  GDP per capita is log-transformed<sup>51</sup>. Like the unemployment vector, this control is based on Anderson, Hansen & Rees (2013b). The coefficient is likely to be positive, since higher income means more ability to purchase alcoholic beverages (Lai & Habicht, 2011; Ogwang & Cho, 2009).

 $\beta_6$  Polity is a score that capture the level of democratic freedom of liberal ideology in any given country. It is based on research conducted by the Center for Systemic Peace (2014) and a combined score, which is displayed on a scale from -10 (full autocracy) to 10 (full democracy). An expected negative coefficient signals that more liberal environments will have higher levels of preventive health policy. This could happen through the establishment of active public health institutions (Mackenback & McKee, 2013), ideology against alcohol use (Karlsson, 2012) or increase of taxes (Lai & Habicht, 2011).

The percentage of Muslims in the population ( $\beta_7$  Muslims) is extracted from the World Religion Dataset by Maoz & Henderson (2013). The variable is expected to produce a negative coefficient, since this religion has values opposed to alcohol consumption and is expected to abstain (Tumwesigye et al., 2013). Nevertheless, a number of studies have found that alcohol consumption, although frowned upon, becomes more frequent (Hayward & Krause, 2014). This is a phenomenon especially observed in young men and goes along with heavy drinking (Baron-Epel et al., 2015). The prohibitionist approach to alcohol consumption differs substantially between Islam and other religions and therefore, only the Muslim share is considered as a control.

The term  $\delta_t T_t$  describes the included year fixed effects. Each year is coded as a binary category and the values *T* can take vary between 0 and 1. Here, 0 means the observation was not made within the year in question and 1 means that it was made during that time period.  $\delta_t$ 

<sup>&</sup>lt;sup>51</sup> This accounts for non-linearity.

is the coefficient for this dummy time regressor and the number of categories is the count of all years minus one, which serves as the base comparison. This control is necessary due to the long period of observation and the possibility of time-specific events during that time (Allison, 2009).

To avoid omitted variable bias due to heterogeneity in culture or exogenous behavioral biases, a fixed effects term is included ( $\alpha_c$ ). Therefore, only variation within countries is observed and the intercepts were allowed to vary by country. It was assumed that there were no further systematic differences and that the parallel trend assumption is not violated. An error term ( $\varepsilon_{ct}$ ) was included, which is country-specific as well as year-specific. Clustering the standard error at country level takes care of the serially correlated data since the observations stem from a time-series of years for a sample of countries. Bertrand, Dufflo & Mullainathan (2004) define this as a necessary measure, which can only be implemented, if a sufficiently large number of countries are sampled.

Drawbacks of the data have been carefully assessed and should not influence the outcome of the empirical analysis. Smaller countries had lower numbers of observations, but this is controlled for through year- and country-fixed effects. The dependent variable includes only recorded alcohol consumption from sales and not home production. However, this was a conscious choice since the alcohol industry's lobbyism is directed towards sustaining the liters of alcohol sold. This amount will already be affected by home production, even in the absence of cannabis decriminalization. The method, a difference-in-differences approach, has one major limitation: There should be no changes in treated versus untreated countries that cannot be measured (Harper, Strumpf & Kaufman, 2012). Nevertheless, data was clustered at state-level to avoid this bias.

# 4. Empirical analysis

Summary statistics are given in Table 17. These include descriptives for the dependent variable and the difference-in-differences variables. Alcohol consumption has 5526 observations with a mean of 5.5 liters of per capita alcohol consumption in the population aged 15 and above. The range of the variable spans from 0 liters to 26 liters of alcohol consumed. Log-transforming alcohol consumption leads to a small number of missing

observations since log of 0 is not defined and some countries observed 0 liters of alcohol consumption per capita per year in the population aged 15 and above.

The observations for the difference-in-differences dummies are complete with 5538 observations and all three dummies can take the values of 0 and 1, as explained in the methodology section. There are more pre-treatment observations than post-treatment observations. This is visible from the mean of 0.25 and is due to the fact that decriminalization was on average observed only in 2000. 43 countries in this sample of 114 countries decriminalized cannabis during the observation period and this is reflected in the mean of 0.33 for the decriminalization dummy. It means that more countries kept a criminalized policy. The treated/ post dummy is the most important one in the analysis and contains all observations that happened in the post-treatment period in decriminalized countries. The mean value is 0.09, which is also highlighted in Table 18. It shows that the number of observations in the post-treatment period for treated countries is lower than the other groups. Nevertheless, there are still around 500 observations.

Four independent control variables are included in the model: Unemployment, logtransformed GDP per capita, a polity score to measure democratic freedom and the share of Muslims in the population. The number of observations is 2804, 4918, 4814 and 5026 respectively. The mean percentage of unemployed labor force is 8.86, with the variables ranging from 0.2% to 59.5%. Mean log-transformed GDP per capita is 7.59 and the range is 4.04 to 11.63. Democratic freedom is measured as a polity score on a scale from -10 to 10 and countries average at a score of 2. The percentage of Muslims in any given country can range between 0 and 100%; the mean share of Muslims is set at 24%. The effect of the percentage of the population aged between 15 and 64 was also tested, but proved to be non-significant. Therefore, the variable was excluded from the model. Variation in the variables is large, which makes them well-suited for inclusion in analysis.

Variable	# of observations	Mean	Standard Deviation	Minimum	Maximum	
	Glo	Global Health Observatory Data Repository (2014):				
Log-transformed alcohol consumption per capita (in liter, 15 years+)	5429	1.094	1.495	-5.809	3.259	
Alcohol consumption per capita (in liter, 15 years+)	5526	5.530	4.739	0	26.04	
Year of alcohol consumption	5538	Not applicable	Not applicable	1961	2010	
	European Monitoring Center for Drugs and Drug Addiction (2013); National Centre of Expertise on Drugs and Drugs Law (2014):					
Pre- or post-treatment (0=pre; 1=post)	5538	0.245	Not applicable	0	1	
Decriminalization (0=no; 1=yes)	5538	0.326	Not applicable	0	1	
Treated + Post-legislation change (0=no; 1=yes)	5538	0.085	Not applicable	0	1	
	World Bank (2014):					
Unemployment (% of total labor force)	2804	8.860	6.039	0.2	59.5	
Log GDP per capita (in current US\$)	4918	7.593	1.560	4.036	11.627	
	Center for Systemic Peace (2014):					
Polity (scale from -10 to 10)	4814	1.962	7.460	-10	10	
	Maoz & Henderson (2013):					
Muslims (% of the population)	5026	24.02	36.84	0	100	

Table 17: Summary statistics (variables of the difference-in-differences model).

Figure 8 displays a line graph for the two groups: criminalized and decriminalized countries. The x-axis shows time in years and the observation period is between 1961 and 2010. The y-

axis models the log-transformed, average alcohol consumption per capita for the population aged 15 and above. The year 2000 is marked in order to show the pre- and post-treatment period for criminalized countries. It is visible that the trends are parallel and that the parallel trend assumption holds. The upper line has a number of sudden decreases during the 1990s, which is when an increasing amount of countries decriminalized cannabis. If no country would have decriminalized cannabis, the trends would likely stay parallel until the end of the observation period (Mora & Reggio, 2012). Meyer (1995) recommends this verification of the parallel trend in order to capture a true policy change effect.



Figure 8: Visual inspection of the parallel trend assumption.

Table 18 highlights the log-transformed alcohol consumption per capita between the criminalized and decriminalization countries at both points in time, pre- and post-treatment. Comparisons can be made between intra- and inter-group alcohol consumption levels. Intragroup alcohol consumption per capita rises for both, non-treated and treated countries. The increase 15.5% and 1.3% respectively. This means that alcohol consumption rises more for criminalized countries from pre- to post-treatment period and that the increase is quite substantial. An intergroup comparison is also needed since the starting points differ. On the log-transformed scale criminalized countries have a pre-treatment period average of 0.610 and decriminalized countries of 2.031. This is a difference of 1.421 and shows that alcohol consumption is higher in decriminalized countries.

A crude difference-in-differences model can be specified from those four groups underscored in Table 18. Without any control variables, the underlying formula can be stated as (Posttreatment mean  $_{\text{Treated Countries}}$  – Pre-treatment mean  $_{\text{Treated Countries}}$ ) – (Post-treatment mean  $_{\text{Non-treated Countries}}$ ) – (Post-treatment mean  $_{\text{Non-treated Countries}}$ ). In this specific example the formula is employed as: (2.044 - 2.031) – (0.765 – 0.610) = 0.013 – 0.155 = -0.142. Therefore, countries that decriminalize cannabis have a lower increase of alcohol consumption as compared to the countries that are not treated and did not decriminalize cannabis. The crude estimate of the effect of decriminalization is a 14.2% reduction of alcohol consumption per capita and year.

Alcohol consumption	<b>Pre</b> -treatment period	<b>Post</b> -treatment period
Non-treated countries		
Mean (log) Frequency	0.610 2808	0.765 870
Mean (absolute) Frequency	3.882 2848	4.271 882
Treated countries		
Mean (log) Frequency	2.031 1297	2.044 456
Mean (absolute) Frequency	8.869 1324	8.470 472

Table 18: Log-transformed and absolute alcohol consumption per capita.

Two-by-two table for criminalized (non-treated) versus decriminalized (treated) countries before and after treatment.

In the final model 2502 observations were used due to the completeness of their data for all variables for all three models. 114 countries were analyzed under this difference-in-difference approach. The number of observations per country was 21.9 on average. The robustness was checked by employing different cut-off points for the pre- and post-treatment period (2000,

2001 and 1997). All models are significant and even when testing their significance (1) without country fixed effects and (2) without country and year fixed effects significance still holds.

To assure robustness, variables were a number of specifications were used. In the basic model (1), no control variables were included, which increases the number of observations. Subsequently, unemployment, GDP per capita, polity and the Muslim percentage of the population were added. The post/ treatment interaction term remained significant for all of them. First, a basic difference-in-differences model without any explanatory variables (only pre-post dummy, treatment dummy and the interaction term). Standard errors are clustered at country level for all models.t statistics in parentheses

# \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

**Table 19**Table 19 reports the regression coefficients for the 2000 model and the matching p-values<sup>52</sup>. The most important variable in this model is the interaction term since it shows whether there is a significant difference between criminalized and decriminalized countries. After controlling for the independent variables, the log-transformed alcohol consumption per capita decreases by 0.136, 0.151 or 0.164 depending on the model specification. The treatment dummy is omitted since the countries are clustered as groups and these groups are collinear with the dummy.

The significant control variables are log-transformed GDP per capita and the share of Muslims; however, the other variables are important for the model fit and cannot be omitted. A 1% increase in logged GDP per capita leads to an approximate increase of 0.130 % in alcohol consumption. A 1% increment in Muslim population is predicted to upsurge alcohol consumption by 1.3%. The democratic freedom score and unemployment are not significant. However, democratic freedom as well as unemployment has a slightly negative coefficient. A 1% increase in unemployment would lead to -0.6% decrease alcohol consumption. All potential interaction terms were tested, but none proved to be significant. Therefore, they were not included in the final model.

<sup>&</sup>lt;sup>52</sup> See Appendix for the results of the 2001 and 1997 analysis.

	(1)	(2)	(3)	(4)
Pre or Post	0.0706	0.114	$0.128^{*}$	0.158**
Dummy	(1.00)	(1.60)	(1.68)	(2.16)
Treated	0	0	0	0
Dummy	(.)	(.)	(.)	(.)
Treated and Post	-0.0888	-0.136**	-0.151**	-0.164**
Dummy	(-1.01)	(-2.07)	(-2.13)	(-2.27)
Unemployment		-0.00514	-0.00670	-0.00605
		(-0.81)	(-0.99)	(-0.86)
GDP per capita		0.127**	0.133**	0.128**
(log)		(2.42)	(2.42)	(2.23)
Polity			-0.0000370	-0.000978
•			(-0.01)	(-0.17)
Muslim				0.0132**
(%)				(2.48)
N	5551	2785	2623	2546
t statistics in nonenthases				

*t* statistics in parentheses \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 19: Result of the difference-in-differences analysis (year 2000).

In order to verify the results of this analysis data on age-standardized liver cirrhosis death rates was extracted from the Global Health Observatory (2014a). A similar model as above was used to determine the significance of the interaction term (countries that are treated and in the post-treatment period). However, alcohol consumption was added as a control variable. The drawback of the data is the limited availability (between 2000 and 2005 only). Nevertheless, the difference-in-difference is still significant and shows that liver cirrhosis rates decline after cannabis decriminalization<sup>53</sup>.

## 5. Discussion

The most important variable of analysis is the interaction term. Comparing countries that decriminalized cannabis with the ones that keep a criminalized policy in the pre- and posttreatment period shows the difference-in-differences. Interpretation of the negative coefficient of the interaction term and the consequences for alcohol consumption has to be done

<sup>&</sup>lt;sup>53</sup> For the empirical results consult the Appendix.

carefully. Alcohol consumption has an increasing trend for both, criminalized and decriminalized countries. Nevertheless, when comparing the increase in consumption in the countries that decriminalized cannabis with the increase in countries that uphold cannabis criminalization it becomes apparent that this development is slower for decriminalized countries.

The problem of endogenous policy decisions has to be discussed since the difference-indifferences model operates under the assumption of an exogenous shock (Pickup & Evans, 2013). The argument about alcohol and cannabis itself is not affected by the endogeneity bias; however, the treatment effect calculation might be biased upwards (Amable & Françon, 2014). As a remedy, Antonakis, Bendahan, Jacquart & Lalive (2014) suggest the use of country- and year-fixed effects for longitudinal panels. Moreover, Besley & Case (2000) propose the inclusion of economic variables and highlight the need for a thorough theoretical basis for each control. Nevertheless, using a difference-in-differences framework with fixed effects diminishes the possibility to extrapolate conclusions beyond the study at hand (Wooldridge, 2013). All the recommendations to reduce problems arising from policy endogeneity have been followed in this study and the results are interpreted with care.

The reduction of the alcohol consumption per capita per year was 13.6% (15.1%, 16.4%). This is a significant decrease in alcohol use in countries that decriminalize cannabis and explains why the alcohol industry invests a large amount of money in order to fight decriminalization. It is not their willingness to strengthen international law (UN Single Convention of 1961), but their desire to avoid the substitution effect between cannabis and alcohol. The coefficients of unemployment, log-transformed GDP per capita and democratic freedom score are in line with the theoretical explanations. One of the significant variables is logged GDP per capita and a higher GDP was expected to lead to a higher alcohol consumption. Unemployment and polity were non-significant and their impact on alcohol consumption was rather small (below 1% change). However, it is important for the model fit to keep them in the equation. Both have a slightly negative influence on alcohol consumption.

The theory regarding the share of Muslims was not clear-cut. On the one hand, religious values suggest the abstinence from drinking and on the other hand, studies prove that Muslims are influenced by Western ideas and that heavy drinking happens more often within the Islamic community. The coefficient is positive and significant and supports the second hypothesis. Nevertheless, this could be due to a sampling bias since more data is available

from richer Muslim countries or a substantial Muslim population that is influenced by the generally moderate population (e.g. Israel, India). According to Stock & Watson (2007), coefficient directions do not always follow the first hunch, but this does not influence the analysis negatively.

Liver cirrhosis data was used to verify the results of the analysis of alcohol consumption. Not only alcohol consumption, but also liver cirrhosis rates, fell after cannabis decriminalization. Liver cirrhosis data itself was not used for the main analysis because of the limited availability. This means that the results have to be interpreted with care, especially because the number of observations is substantially lower than the dataset on alcohol consumption. Nevertheless, it is an adequate mean to cross-check the results of the analysis on alcohol consumption rates. In both models, on alcohol consumption and liver cirrhosis rates, the effect of decriminalization is visible. Alcohol consumption does not increase as much in decriminalized countries as compared to the increase in criminalized countries. Liver cirrhosis decrease more in decriminalized countries than in criminalized countries.

Research so far has not conclusively proven whether cannabis and alcohol are substitutes or complements. However, during the last decade more evidence has been generated for the substitution hypothesis (Anderson, Hansen & Rees, 2013b). The data on alcohol consumption and decriminalization presented in this paper shows that alcohol consumption fell significantly after decriminalization, if comparing decriminalized to criminalized countries. Moreover, the alcohol industry behaves substantially different than the tobacco industry. While lobbyists for the tobacco industry do not see a need to act against decriminalization, the alcohol lobby sponsors pro-criminalization measures. This insight should be used for better management of the stakeholder at hand, the alcohol industry.

### 6. Conclusion

The research questions were (1) which stakeholders are involved in policy-making for cannabis and (2) why the alcohol industry has a strong interest in preventing decriminalization of cannabis. The stakeholders are described and put into perspective in section 2. The alcohol industry was then used as an example to illustrate stakeholder interests and their lobbyism seems to be justified given that the analysis shows that cannabis can be used as a substitute for alcohol in some situations. The (ethical) implication is that policy makers should not succumb to pressure from the resourceful industries and rather act in the

interest of the country and its citizens. It is important for politicians and policy-makers to be aware of the mechanisms stakeholders use to reach their goals and to monitor the active stakeholders closely. Cannabis policy cannot be chosen on grounds of the amount of lobbyism or resources used by a particular stakeholder.

The title of the paper is: "Who gets high(er)?". This implies that some stakeholders succeed to influence cannabis policy in a way that suits them best. The alcohol industry has a strong interest in criminalization of cannabis and manages to uphold it. For example in California they used a substantial amount of resources in order to prevent a relaxation of cannabis policy and avoid any losses from reduced alcohol sales. This economic motivation is in line with the UN Single Convention on Narcotic Drugs from 1961, but it might not be the best choice from a public health or law enforcement perspective.

Policy-makers have to engage in stakeholder management, if they want to reach a certain policy outcome. Especially expectant and definite stakeholders need to be kept at bay while reaching a compromise. The policy outcome is highly dependent on effective stakeholder analysis since cannabis decriminalization has failed in some countries due to lobbyism from the UN or the alcohol industry and succeeded in other nations through active participation of law enforcement of public health officials.

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# **Appendix 1 - Stakeholder visualization**

Figure 9: Visualization of the stakeholder network for cannabis policy. Created with NodeXL<sup>54</sup>. (Supporters of cannabis decriminalization = green; Opponents of decriminalization = red).



<sup>&</sup>lt;sup>54</sup> Smith, M., Milic-Frayling, N., Shneiderman, B., Mendes Rodrigues, E., Leskovec, J., & Dunne, C. (2010). *NodeXL: a free and open network overview, discovery and exploration add-in for Excel 2007/2010.* Retrieved January 8<sup>th</sup>, 2015 from: http://nodex1.codeplex.com

## Appendix 2 - List of countries that decriminalized cannabis

1976 The Netherlands 1977 1978 1979 1980 1981 1982 1983 1984 1985 Lithuania 1986 1987 1988 Paraguay 1989 1990 Bangladesh, Italy 1991 1992 Norway, Slovenia, Spain 1993 Sweden, Venezuela 1994 Colombia, Finland, Germany 1995 1996 1997 Austria, Estonia, Ireland, Kyrgyzstan 1998 Uruguay 1999 Latvia 2000 Portugal 2001 Costa Rica, Croatia, Kazakhstan, Luxembourg 2002 2003 Belgium, Montenegro, Peru 2004 Denmark, Russia 2005 Turkey 2006 Brazil, Greece 2007 Chile 2008 Armenia, Moldova 2009 Argentina, Mexico, Serbia, UK 2010 Czech Republic, Ukraine 2011 (2012 Switzerland 2013 Jamaica)

# Appendix 3 - Model specifications for the cutoff points 2001 and 1997

	(1)	(3)	(4)	(5)
Pre or Post	0.0699	0.0901	0.102	$0.130^{*}$
Dummy	(1.00)	(1.29)	(1.37)	(1.81)
Treated	0	0	0	0
Dummy	(.)	(.)	(.)	(.)
Treated and Post	-0.0881	-0.125*	-0.139**	-0.151**
Dummy	(-1.01)	(-1.92)	(-1.98)	(-2.11)
Unemployment		-0.00506	-0.00657	-0.00586
		(-0.79)	(-0.97)	(-0.83)
GDP per capita		$0.127^{**}$	0.133**	$0.128^{**}$
(log)		(2.43)	(2.42)	(2.24)
Polity			0.0000199	-0.000905
-			(0.00)	(-0.16)
Muslim				$0.0130^{**}$
(%)				(2.45)
N	5551	2785	2623	2546

Result of the difference-in-differences analysis (year 2001):

t statistics in parentheses \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

	(1)	(3)	(4)	(5)
Pre or Post	0.0405	0.0787	0.101	$0.125^{*}$
Dummy	(0.58)	(1.23)	(1.50)	(1.93)
Treated	0	0	0	0
Dummy	(.)	(.)	(.)	(.)
Treated and Post	-0.0587	-0.120*	-0.139**	-0.150**
Dummy	(-0.67)	(-1.89)	(-2.03)	(-2.14)
Unemployment		-0.00481	-0.00627	-0.00554
<u>F</u> <u>J</u>		(-0.76)	(-0.93)	(-0.79)
GDP per capita		0.127**	0.135**	0.130**
(log)		(2.43)	(2.45)	(2.27)
Polity			-0.0000629	-0.00105
1 only			(-0.01)	(-0.18)
Muslim				0.0125**
(%)				(2.36)
N	5551	2785	2623	2546
t statistics in paranthasas	-			

Result of the difference-in-differences analysis (year 1997):

t statistics in parentheses\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

# Appendix 4 - Liver cirrhosis data

Variable	Coefficients (p-value) 2000	Coefficients (p-value) 2001	Coefficients (p-value) 1997
Observations	1563	1563	1563
Countries	69	69	69
Constant	8.791	8.759	8.686
	(0.128)	(0.130)	(0.132)
Pre- or post-	0.753	0.633	2.567
dummy	(0.341)	(0.423)*	(0.001)*
Treatment	Omitted	omitted	Omitted
dummy			
Interaction	-1.822	-1.758	-2.827
(Treatment and Time- period)	(0.022)*	(0.028)*	(0.000)*
Log Alcohol	4.648	4.680	4.584
consumption	(0.000)	(0.000)	(0.000)
Log GDP	-0.474	-0.472	-0.468
per capita	(0.488)*	(0.490)*	(0.492)*
Polity	0.205	0.205	0.199
	(0.001)	(0.001)	(0.001)
Muslim share	0.187 (0.311)*	0.181 (0.328)*	0.220 (0.228)*

# Paper V

# Two plants are better than one? -

## The effect of decriminalization on the eradication of cannabis

### Abstract:

Cannabis cultivation is a thriving business, whether for profit or personal use. The reasons for engaging in illegal drug growing and the effects of drug policy on it are mostly unexplored. This paper tries to shed some light on the impact of cannabis policy on this phenomenon through two models that predict first, the kilograms of marijuana herbs seized as an outcome variable and second, the number of cannabis plants eradicated. We found a significant policy effect on the number of cannabis plants eradicated while controlling for favorable outdoor (temperature) and indoor (electricity consumption) growing conditions, exports, land area, the rural population, corruption and neighboring countries that have previously decriminalized cannabis. However, the effect on the amount of marijuana herbs seized was merely weakly significant and only in a reduced sample of developed countries.

### JEL classification: C21, I18, K14

Keywords: Cannabis, Decriminalization, Treatment effect models, Deterrence, Criminal law

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### **1. Introduction**

The overall number of drug-related arrests has slightly increased in the last decade, most notably in the US (FBI, 2015; Dorsey & Zawitz, 2005). The number of arrests due to cannabis seizures is still the highest in the domain of drugs since it is a widely used drug. On the one hand, there are large-scale, commercial cultivators and on the other, small-scale individual growers. The smaller the growing operation, the lower is the risk of detection. Decorte (2010b) has identified the market of cannabis producers since as a neglected research area.

Willis (2008) characterizes the Australian cannabis cultivation market as one with a low detection risk, vast possibilities for profit and a high turnover of growers. Consequently, the number of cultivators is constantly growing. For example, Plecas, Malm & Kinney (2005) estimate that the harvest of marijuana leaves in kilogram tripled between 1997 and 2003 in Canada. This is due to (1) the market demand and (2) the size of the retail market. The number of cannabis users has increased to 200 million consumers annually (United Nations Office on Drugs and Crime, 2013) and the retail value is conservatively estimated at 126 billion Euros per year (United Nations Office on Drugs and Crime, 2005).

There are three viable policy alternatives for cannabis that can be observed world-wide: Criminalization, Decriminalization and Legalization (Pacula et al., 2005). Country-level legalization of cannabis has only occurred in Uruguay in 2013 (Room, 2014). Nevertheless, around 50 countries world-wide have opted for cannabis decriminalization. Under decriminalization the punishment for personal use and possession of cannabis is reduced to an administrative offence, as long as the amount of cannabis stays below a certain threshold. This does not affect the prohibition of cannabis cultivation. However, a behavioral change could be induced. Decriminalization is not comparable to legalization and does not entail any major policy changes like the generation of tax revenue.

When cannabis cultivation is illicit, several issues are important. First of all, the quality of the drug cannot be monitored. The user is often unaware of the contents and the strength of the drug, for example if toxic ingredients have been added (Burgdorf, Kilmer & Pacula, 2011). Second, cannabis potency can increase and unaware drug users might experience psychotic symptoms (Pijlman, Rigter, Hoek, Goldschmidt & Niesink, 2005). A third outcome is the inability of the government to collect taxes on the drug trade (Caulkins et al., 2013; Gettman, 2007).
The research question therefore tries to assess whether cannabis producers are affected by the prevailing cannabis policy. To answer this question, a random effects regression is employed for two annual outcome measures separately: (1) The kilograms of marijuana herbs seized and (2) the number of cannabis plants eradicated. The analysis is carried out for the full dataset of international panel data as well as for the subset of developed countries to assure data validity. The data is available for a time-series that ranges from 1980 to 2012 from the United National Office on Drugs and Crime. The results show that the effect on the amount of marijuana herb seizures is only weakly significant for the sample of developed countries. Under decriminalization slightly less herbs are seized, which could be due to either reduced law enforcement activity or decreased demand through the absence of the forbidden fruit effect. The number of plants eradicated increases under decriminalization, which might be due to increased domestic production and more demanding consumers.

## 2. Literature Review

The discussion about sanctions in rational choice theory was initiated by Becker (1968) and Cooter (1984). Both agreed that higher sanctions lead to higher levels of deterrence. On the one hand, Becker (1968) highlights that offenders have to take all costs into account, for example the probability of arrest or social stigmatization, and combine this to produce a metaphorical price of committing a crime. On the other hand, Cooter (1984) states that a sanction is meant to deter illegal acts and it only comes into play when some disregard the law. Although other aspects of deterrence are important, such as certainty and celerity of punishment, contemporary drug policy has often focused on severity as a driver of deterrence (Kennedy, 2009). For example, Nguyen, Malm & Bouchard (2015) suggest that cannabis growers are deterred by the existing legal sanctions. Given that the laws for offences related to growing cannabis remain unchanged, the number of marijuana herbs seized and cannabis plants eradicated should remain stable, regardless of the legal regime (criminalization or decriminalization).

One has to look beyond the reasoning of rational choice theory to assess the reasons why cultivators may or may not be deterred by criminalization or why the deterrence is marginal. The severity of punishment as a driver of cannabis cultivation, as suggested by rational choice theory, might only be a partial explanation. Even though the laws on growing cannabis plants/ circulating marijuana herbs might be unchanged under decriminalization, a behavioral change

could be induced by the decriminalization of personal use and possession of cannabis. This hypothesis is supported by the findings of Barrat, Barrat, Chanteloup, Lenton & Marsh (2005): Cannabis cultivation depends on costs, needs and preferences rather than certainty or severity of penalties. Potter (2010) lists potential reasons for growing illicitly, which include (1) profit, (2) ideological or political factors, (3) medical and (4) personal use. These factors will be explored in the following.

Silverstone & Savage (2010) argue that profits are the main motivation for cannabis cultivation and herb production rather than lifestyle factors. Often, it is connected to money laundering to cover the profits made. In Quebec, cannabis growing is one of the most prevalent crimes and is used for diverse reasons ranging from money generation for gangs to personal use in the adolescent population (Bouchard, Alain & Nguyen, 2009). In the US, the profitability of the market has attracted Mexican drug-trafficking organizations (Payan, 2006). This market profitability depends more on the transaction costs prevailing in the market than the legal regime (Belackova, Maalste, Zabransky & Grund, 2014).

Much of the focus regarding cannabis cultivation has been placed on the large-scale operations; however, small-scale cultivators should be considered as well (Decorte, 2010a). They operate independently and often out of an ideological motivation (Decorte, 2010b). Deterrence of intrinsically motivated growers, who gain utility from the growing process and the resulting outcomes, is marginal (Weisheit, 1991). Those growers generally do not feel as if they are operating in the illegal sphere (Potter, 2010). Another, more political, reason is unemployment: Hafley & Tewksbury (1995) studied growers in Kentucky and found that cannabis cultivation was an important source of income in the absence of employment.

Many market participants grow cannabis for personal use and possession (Hammersvik, Sandberg & Pedersen, 2012). They do not produce more than they need since this would demand economic, technical and personal resources, such as time and commitment. Nevertheless, they affect natural resources by misusing water resources, chemicals and altering landscapes to fit the need of the cannabis plant. In California, this is frequently done by Mexican drug-trafficking organizations in remote sites where it is hard for law enforcement officials to control (Mallery, 2011).

Different lines of reasoning lead to varying predictions of cultivators` behavior. Does the amount of herbs seized and plants eradicated depend purely on market demand or is it affected by political changes and deregulation? This field is mostly unexplored because of the

illegality of cannabis production and the unwillingness of producers to admit their actions. However, the theoretical findings suggest that growing plants might be a small-scale or individual activity for personal reasons, while the amount of herbs in the market is connected to demand and profitability.

# 3. Methodology

The research question tries to identify whether cannabis producers are affected by the policy present in a country. The ideal outcome variables would be the amount of cannabis herbs consumed and the number of cultivated cannabis plants. However, these data are not available due to the illegality and prohibition of cannabis. To assess this market for cannabis cultivation, Wilkins, Bhatta & Casswell (2002) identified the number of cannabis herb seizures as the crucial starting point. Nevertheless, they analyzed the number of plants eradicated because of the lack of data on quantity seized. For this reason, we employ both proxies. It has to be noted that these proxies reflect both, the efforts of the producers and the law enforcement (Reuter, 1995). Therefore, the interpretation of the regression outcomes has to reflect this limitation.

In the following the equation for the econometric regression analysis is specified for marijuana herbs seized/ cannabis plants eradicated. Here, country-level data are analyzed as a panel. The model is formally specified as:

 $Y_{ct} = \beta_0 + \beta_1 \text{ Policy Dummy} + \beta_2 \text{ Temperature} + \beta_3 \text{ Electricity} + \beta_4 \text{ Exports} + \beta_5 \text{ Land} + \beta_6$ Rural + \beta\_7 Interaction(s) + \beta\_8 Additional Controls + \u03c0c + \varepsilon\_{ct}

A random effects model is fitted because fixed effects would only capture time-variant factors and some of the control vectors are time-invariant (Laird & Ware, 1982). The assumption is that variation between countries is uncorrelated with the control variables and random (Greene, 2008). A Breusch and Pagan Lagrangian multiplier test was significant and determined the appropriateness of the random effect model as compared to an OLS regression. Heteroskedasticity was controlled for through robust standard errors.  $\varepsilon_{ct}$  is the year-specific and within-country error denotation, while  $u_{ct}$  symbolized the between-country error term.  $\beta_0$  is the model intercept.

The outcome measures  $(Y_{ct})$  are the marijuana herbs seized in kilograms in the first model and the number of cannabis plants eradicated in the second. The cannabis trafficking data were available on annual level for a substantial number of countries in the online resources of the United Nations Office on Drugs and Crime (UNODC, 2014). This lead to an analysis of data from 102 countries, regarding marijuana herbs seized, and of 77 countries on cannabis plants eradicated. Seizure data was reported in kilogram found by the police for marijuana herbs and in number of cannabis plants eradicated. To assure comparability between countries these figures were divided by the population in millions. Population data can be retrieved from the World Bank's World Development Indicators (World Bank, 2014). Furthermore, the variables were log-transformed to improve linearity and give more weight to changes at lower seizure levels.

The time-series dataset is almost complete for the amount of marijuana herbs seized. One observation is available for 1970 and the time series starts in 1980 and ends in 2012. If only developed countries are considered, missing data is barely an issue. Data regarding cannabis plant seizures is available for fewer countries. The time-series ranges from 1980 to 2012 and using the smaller sample of developed countries mitigates the lack of data for developing nations.

A policy dummy is the independent variable of interest ( $\beta_1$  Policy Dummy). It takes the value 0 for criminalized countries and the value 1 for decriminalized countries. Through this value, criminalized and decriminalized countries can be compared on the outcome variables and the effect of cannabis legislation on the seizures of marijuana herbs and eradication of cannabis plants. The data was extracted from two sources: The European Monitoring Center for Drugs and Drug Addiction (2013), which has an extensive database for countries in the European region and the National Centre of Expertise on Drugs and Drugs Law (2014), which has a broader overview of a number of countries world-wide.

Multiple control variables were employed to check whether conditions were more favorable for growing cannabis or whether there was greater propensity to cultivate in some countries. These included: average yearly temperature ( $\beta_2$  Temperature), electricity consumption ( $\beta_3$ Electricity), exports ( $\beta_4$  Exports), land area ( $\beta_5$  Land), rural population ( $\beta_6$  Rural) and neonatal mortality. Correlations between the independent variables were tested and consequently, neonatal mortality was excluded. The correlation coefficient between the neonatal mortality rate and percentage of rural population was 0.70, which means that these variables would capture a similar effect. The robustness of the model was tested in a number of model specifications that added year-fixed effects, a landborder dummy (whether or not a country had a landborder with any neighbor that decriminalized cannabis) and a corruption measure.

The average yearly temperature indicates whether it is easier to produce cannabis in outdoor conditions. The data were retrieved from an online weather resource (Weatherbase, 2014). The general rule is that a higher average yearly temperature means better preconditions for outdoor cannabis cultivation (Rosenthal, 2014). Different authors publish varying optimal degrees Celsius, but an acceptable range is from 24 to 30 degrees Celsius (Green, 2009; Cervantes, 2006).

Electricity consumption is measured in kilowatt-hours per capita and the data can be accessed through the World Bank's Development Indicators (World Bank, 2014). This is used as a proxy for indoor cultivation (Cervantes, 2006). Higher electricity consumption facilitates indoor growing through two different mechanisms (Green, 2009): (1) more consumption is connected to better and constant availability throughout a country and (2) more consumption increases the chances that a large amount of electricity needed for growing cannabis indoors will not be detected.

Further control vectors are exports of goods and services as a percentage of the GDP, land area in square kilometers and rural population as a percentage of the whole population. These data are available at the World Bank website and part of the World Development Indicators (World Bank, 2014). The coefficients for all but the rural area were expected to be positive. Although not extensively researched, Russo (2014) finds that more drugs enter a country, if the level of trade is higher. This is connected to a lower risk of smuggling detection and exports are used as a proxy for this effect. According to case studies by Chouvy & Laniel (2007) many African and South American countries are major cannabis producers in their vast areas of deserted and climatically well-suited land. It might also be easier to hide patches of cannabis plants (Anastasijevic, 2008). Consequently, the land area is controlled for. Cannabis cultivation is difficult without the right knowledge and tools (Green, 2009). It is expected that the percentage of rural population negatively affects the number of people that have the right equipment for this task.

The landborder dummy is a manually computed and indicates whether a country has a landborder with any country that already decriminalized cannabis. Countries could be more likely to decriminalize, if they see the positive effects of decriminalization in a neighboring country (French, 2005). Moreover, there might be a spillover effect for cannabis cultivation,

if decriminalization increases demand. More corruption might increase the productivity of the producers or decrease the efforts of the law enforcement officials (Gray, 2010). This control is used since the herbs seized/ plants eradicated proxy cannot disentangle the efforts of the producers and the law enforcement officials. The variable is retrieved from the World Governance Indicators (World Bank, 2013).

A major limitation of this paper is the omitted variable bias. Models with random effects need to be specified with all influential individual characteristics included and some of them might not be salient or data are scarce (Greene, 2008). Nevertheless, the advantage of this modeling type is that generalization of outcomes beyond this specific dataset is possible. Another problem is the quality of data collection in different countries. Data might be collected more rigorously in developed countries. To avoid using low-quality data, the analysis is carried out for (1) the full sample and (2) a subsample of developed countries.

## 4. Empirical analysis

#### 4.1 Full dataset

In Table 20**Table 20** the summary statistics are displayed. The outcome variables are marijuana herbs seized and cannabis plants eradicated per 1,000,000 citizens per year. More observations are available for seized marijuana herbs, namely 2864, than for the number of eradicated plants, 1233. A mean of 6,400 kg marijuana herbs was seized and 224,631 plants were eradicated per 1,000,000 citizens was seized. The range is 0 kg to 1.9 million kg per 1,000,000 people (marijuana herbs seized) and 0.01 to 127 million plants eradicated per 1,000,000 inhabitants.

The explanatory variables include a decriminalization dummy with values of 0 for criminalized and 1 for decriminalized countries; about 40 % of the observations are from the period of decriminalization in the herb seizure model and 47 % in the plant eradication model. This neatly balances the sample. Furthermore, average temperature was 17 degrees Celsius and between countries it varies from around 0 to 28 degrees while electricity consumption in kilowatt-hours per capita had a mean value of 4000 and 4500 for the two models and a range from 18 to 52,374 kilowatt hours.

More vectors were deemed to be important explanatory factors: (1) The export of goods and services as percentage of the GDP, (2) land in square kilometers and (3) the rural population

as percentage of the whole population. Their mean values were 40 %, 700,000 square kilometers (range 2 to 16 million) and 37 % (herb seizures)/ 35 % (plants eradicated), respectively. 31 % of the observations had a decriminalized neighbor state, which is visible from the border dummy that can take the values 0 or 1. Corruption was 0.29/ 0.59 on average for the two models. This variable is measured on a scale from -2.59 to 2.59.

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum	Source			
Herb seizure model:									
Marijuana herbs seized (kg)/ population in million	2864	6401.30	65,591.14	0 (Brazil, 1981)	1,863,116 (Bahamas, 1982)	United Nations Office on Drugs and Crime (UNODC, 2014)			
Decriminalization Dummy (1= decriminalized; 0 = criminalized)	2864	0.40	0.49	0	1	European Monitoring Center for Drugs and Drug Addiction (2013); National Centre of Expertise on Drugs and Drugs Law (2014)			
Average annual temperature (in degrees Celsius)	2864	16.98	7.82	-0.6 (Russia)	28.5 (Djibouti)	Weatherbase (2014)			
Electricity consumption (in kilowatt hours per capita)	2367	4,050.05	4,803.86	18.4 (Bangladesh)	52,373.9 (Iceland)	World Development Indicators (World Bank, 2014)			
Exports of goods and services (% of GDP)	2714	40.99	27.25	3.2 (Ethiopia)	230.3 (Singapore)	World Development Indicators (World Bank, 2014)			
Land (in square kilometers)	2846	684,186.3	1,930,774	2 (Monaco)	16,400,000 (Russia)	World Development Indicators (World Bank, 2014)			
Rural population (% of total population)	2864	37.32	20.54	0 (Bermuda)	92.2 (Botswana)	World Development Indicators (World Bank, 2014)			

Border Dummy (1 = has a landborder with a decriminalized country; 0 = does not have a landborder with a decriminalized country)	2864	0.31	0.46	0	1	Manually computed
Level of corruption (scale from -2.59 to 2.59)	1680	0.29	1.05	-1.85 (Algeria)	2.59 (Finland)	World Governance Indicators (World Bank, 2013)
Plant eradication model:						
Cannabis plants eradicated (#)/ population in million	1233	224,630.8	3,838,836	0.01 (Tunisia, 1984)	127,000,000 (Belize, 1981)	United Nations Office on Drugs and Crime (UNODC, 2014)
Decriminalization Dummy	1233	0.47	0.50	0	1	European Monitoring Center for Drugs and Drug Addiction (2013); National Centre of Expertise on Drugs and Drugs Law (2014)
Average annual temperature (in degrees Celsius)	1233	16.26	7.38	0.2 (Mongolia)	27.4 (Senegal)	Weatherbase (2014)
Electricity consumption (in kilowatt hours per capita)	1068	4,458.47	5,070.99	18.4 (Bangladesh)	52,373.9 (Iceland)	World Development Indicators (World Bank, 2014)
Exports of goods and services (% of GDP)	1206	37.79	22.22	5.1 (Argentina)	181.8 (Luxembourg)	World Development Indicators (World Bank, 2014)

Land (in square kilometers)	1232	708,913.8	1,768,050	2 (Monaco)	9,093,510 (Canada)	World Development Indicators (World Bank, 2014)
Rural population (% of total population)	1233	35.12	18.87	0 (Bermuda)	85.6 (Papua New G.)	World Development Indicators (World Bank, 2014)
Border Dummy	1233	0.31	0.46	0	1	Manually computed
Level of corruption (scale from -2.59 to 2.59)	734	0.57	1.06	-1.64 (Algeria)	2.59 (Finland)	World Governance Indicators (World Bank, 2013)

Table 20: Descriptive statistics for the variables of analysis.

Figure 10 and Figure 11 display the trends for log of marijuana herbs seized and cannabis plants eradicated. The straight line shows criminalized countries and the gapped one decriminalized countries. Marijuana herbs seized have similar trends for both groups of countries. Both lines show the same in- and decreasing trends throughout the years with slightly more seizures in decriminalized countries. Towards the end of the sample period, the trends start to deviate more as more countries join the decriminalized group. Nevertheless, this similar pattern does not hold for the number of cannabis plants eradicated (Figure 11). The two lines show irregular changes and their trends do not match in a visual inspection. The number of plants eradicated in decriminalized countries seems to rise constantly, while criminalized countries have a rather stable average eradication number.



Figure 10: Trends for marijuana herbs seized for criminalized and decriminalized countries.



Figure 11: Trends for cannabis plants eradicated for criminalized and decriminalized countries.

In Table 21 the model specifications for herb seizures and plant eradications are summarized. Model 1 and 5 display the basic model without additional control variables. Model 2 and 6 include year-fixed effects to control for potential confounding trends in the time-series data. Model 3 and 7 also measure the effect of neighboring countries that have already decriminalized cannabis (Landborder Dummy). In the last specification, Model 4 and 8, we control for corruption.

For the first three specifications for each outcome variable more observations are available due to the lack of corruption data before 1996. The first three models for marijuana herbs seized includes 2322 observations for 102 countries, while the last specification includes 1379 observations for 101 countries. The observations per country average at 22.8 observations. The final models then merely consider the significant interaction. The first three models for eradication of cannabis plants are based on 1061 observations within 77 countries, while the fourth specification is based on 619 observations in 66 countries. The number of observations ranges from 1 to 32 and the mean number of observations per country is 13.8 observations. In the model for herb seizures there were three significant interactions between (1) decriminalization and temperature, (2) decriminalization and exports and (3) temperature and exports. When including all of them in the model (2) only the interaction between

decriminalization and temperature remained significant. Two interactions are significant for the plant eradication model (Electricity & Land and Rural population & Land). Each of the potential interactions was tested individually before combining the significant ones in the model.

The model coefficients remain robust across the specifications. In the models for the number of seized marijuana herbs the decriminalization dummy does not have a significant effect. The control vectors that turn out as significant are the kilowatt hours of electricity used, the land area a state possesses and an interaction between decriminalization and temperature. Time-fixed effects do not affect these results. Furthermore, the landborder dummies as well as the corruption vector turn out to be significant predictors for the number of marijuana herbs seized. In the models for cannabis plant eradication, policy plays a significant role at the 5 percent level. Furthermore, both, electricity and land area are significant explanatory variables. Two interaction terms are fitted: one between electricity and land and the other one between land area and the percentage of the rural population. Time-fixed effects increase the significance of the decriminalization dummy to the 1 percent level. Nevertheless, unlike for marijuana herbs seized, the landborder dummy and the corruption variable fail to be significant predictors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Basic	Year-fe	Landborder	Corruption	Basic	Year-fe	Landborder	Corruption
Decriminalization Dummy	-0.237 (-0.25)	0.0928 (0.09)	-0.434 (-0.48)	0.499 (0.49)	1.701** (2.42)	1.876 <sup>***</sup> (2.60)	1.652** (2.31)	1.175 (1.36)
Temperature	0.0524 (1.28)	0.0114 (0.30)	0.0615 (1.60)	0.0220 (0.50)	0.0907 (1.50)	0.0504 (0.81)	0.0934 (1.56)	-0.00552 (-0.08)
Electricity per capita (e-06)	70.1** (2.04)	-0.61 (-0.02)	55.5* (1.74)	52.2** (2.40)	115*** (3.91)	80.4** (2.38)	107*** (3.75)	22.4 (0.68)
Exports of goods and services	0.0105 (1.19)	-0.00418 (-0.57)	0.00618 (0.77)	0.000439 (0.05)	0.0188 (1.18)	0.00887 (0.50)	0.0165 (1.06)	0.00237 (0.19)
Land (e-07)	2.02 <sup>***</sup> (2.70)	1.94 <sup>**</sup> (2.35)	1.94 <sup>**</sup> (2.28)	1.35 (1.49)	8.69 <sup>**</sup> (2.36)	8.34 <sup>**</sup> (2.14)	8.05 <sup>**</sup> (2.32)	5.68 <sup>*</sup> (1.76)
Rural population	-0.0152 (-0.95)	0.0308* (1.76)	-0.00361 (-0.22)	-0.00442 (-0.27)	0.0157 (0.54)	0.0433 (1.57)	0.0229 (0.83)	-0.00218 (-0.09)
Interaction (Decriminalization & Temperature)	0.156 <sup>**</sup> (2.31)	0.147 <sup>**</sup> (2.05)	0.156 <sup>**</sup> (2.34)	0.134 <sup>**</sup> (1.97)				
Landborder Dummy			1.010 <sup>***</sup> (4.09)				0.640 (1.37)	
Corruption				-0.429** (-2.12)				-0.0919 (-0.29)
Interaction (e-11; Electricity & Land)					3.42 <sup>***</sup> (2.72)	3.06** (2.19)	3.72 <sup>***</sup> (3.14)	2.45 (1.34)
Interaction (e-08; Rural & Land)					-4.58*** (-4.63)	-4.13*** (-3.58)	-4.36*** (-4.81)	-2.97*** (-3.05)
Constant	1.953* (1.93)	-0.100 (-0.06)	1.344 (1.37)	2.676 <sup>**</sup> (2.42)	2.418 <sup>*</sup> (1.76)	2.029 (1.37)	2.045 (1.50)	5.910 <sup>***</sup> (4.69)
Ν	2323	2323	2323	1379	1061	1061	1061	619

N2525252525251577t statistics in parentheses; \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01Table 21: Models for the seizures of marijuana herbs (1-4) and eradication of cannabis plants (5-8).

## **4.2 Developed countries**

To assess whether statistically significant results were only due to the limited quality of data collection and reporting in the developing countries, the same analysis was completed with a subset of the dataset. According to the United Nations (2014) classification of developed and developing countries, a smaller sample of countries was selected. In this sample, data quality was assumed to be high and collected with equal accuracy across countries.

961 observations in 40 countries were available for marijuana herb seizures in developed countries for the first three specifications and 594 observations for the last model specification (4). The number of countries remained unchanged and on average each country had 24 observations. These numbers are slightly lower for the eradication of cannabis plants: 549 observations across 33 countries for specifications 5 to 7 and 335 observations for 31 countries for specification 8. An average of 16.6 observations per country was collected.

In Table 22 the results of the empirical analysis are summarized. The decriminalization dummy is significant at the 10 percent level for marijuana herbs seized and at the 5 percent level for cannabis plants eradicated. Significant predictors were electricity consumption, the amount of land area owned and the respective interaction terms. There were two significant interactions, decriminalization dummy / temperature and exports / rural population for the marijuana herb seizure model. One interaction term was fitted between land area and the rural population for the cannabis plant eradication model. Time-fixed effects did not change the outcome for either model; the corruption variable failed to be significant. However, the landborder dummy was highly significant for both, herb seizures and plant eradications.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Basic	Year-fe	Landborder	Corruption	Basic	Year-fe	Landborder	Corruption
Decriminalization	-1.847*	$1.030^{*}$	-1.664*	-1.818	1.634**	1.519*	$1.416^{*}$	2.037**
Dummy	(-1.76)	(1.84)	(-1.70)	(-1.56)	(2.12)	(1.65)	(1.93)	(2.47)
Temperature	0.0358	0.185**	0.0683	-0.0510	0.185	0.0216	0.182**	0.0246
	(0.38)	(2.56)	(0.93)	(-0.46)	(1.61)	(0.24)	(1.98)	(0.24)
Electricity per capita	84 1***	42 7**	76 7***	53 3***	$114^{***}$	32.6	111***	36.3*
(e-06)	(3.17)	(2, 30)	(4, 17)	(3.68)	(5.09)	(0.61)	(6.10)	(1.75)
(000)	(3.17)	(2.37)	(4.17)	(5.00)	(5.07)	(0.01)	(0.10)	(1.75)
Exports of goods	-0.00852	-0.0281	-0.0108	0.00993	0.0253	-0.0142	0.0201	0.00434
and services	(-0.47)	(-1.43)	(-0.63)	(1.24)	(1.13)	(-0.94)	(0.97)	(0.30)
Land	2 41***	2 00***	2 20***	0 55***	20.7***	2 5 6***	22 5***	<b>5</b> 20***
	5.41	(2.00)	5.59	2.33	20.7	5.50	(12.0)	3.38
(e-07)	(6.20)	(2.71)	(5.02)	(3.10)	(12.78)	(2.80)	(13.96)	(4.97)
Rural population	-0.0779**	-0.0248	-0.0449	0.0111	-0.0539	-0.0371	-0.0190	-0.0625**
	(-2.37)	(-0.64)	(-1.40)	(0.46)	(-1.63)	(-1.21)	(-0.73)	(-2.16)
	***		**	**		× ,	· · /	× ,
Interaction	0.330	Not	0.281	0.330				
(Decriminalization &	(2.61)	Significant	(2.40)	(2.53)				
Temperature)								
Interaction	0.00163***	0.00145**	0.00143**	Not				
(Rural & Exports)	(2.87)	(2 31)	$(2\ 49)$	Significant				
(Rului & Exports)	(2.07)	(2.51)	(2.4))	Significant				
Landborder			$0.879^{***}$				$1.087^{***}$	
Dummy			(3.48)				(3.31)	
Commention				0.001				0.450
Corruption				-0.221				-0.459
				(-0.90)				(-1.43)
Interaction					-7.59***	Not	-8.09***	Not
(Rural & Land; e-08)					(-9.71)	significant	(-11.45)	significant
	0.001*	0.551	1 1 2 0			= ***	`	C 0.0.1 ***
Constant	2.331*	-0.571	1.128	2.583	3.009	5.635	1.825	6.821
	(1.72)	(-0.31)	(0.97)	(1.56)	(1.60)	(2.74)	(1.05)	(4.20)
Ν	961	961	961	594	549	549	549	335

*t* statistics in parentheses; \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01Table 22: Models for the seizures of marijuana herbs (1-4) and eradication of cannabis plants (5-8); only developed countries.

#### 5. Discussion

#### 5.1 Full dataset

The dummy for decriminalization was not significant, which indicates that the number of marijuana herbs seized may not differ under a policy of criminalization or decriminalization. Rational choice theory predicts this outcome since legislation regarding cannabis cultivation remained unchanged. According to this rationality theorem, punishment will be followed by at least partial deterrence. Nevertheless, the number of plants eradicated increased significantly under decriminalization. As explained in section 2, there is potential for a behavioral impact of a change in legislation in a related field. Ideological reasons and an increased feeling of safety under decriminalization could have contributed to this outcome.

Significant predictors in the model for marijuana herb seizures were electricity, land mass and an interaction (decriminalization and temperature). More energy used as well as more land area possession per country lead to a higher herb production; however, these positive effects were very limited with small coefficients. The categorical variable for decriminalization interacted with the continuous predictor for temperature. Therefore, both independent variables were necessary for the model. On the one hand, this means that the effect of temperature on the herb production was dependent on the prevailing policy. Given that all other variables are held at 0, a higher temperature leads to more herb production (coefficient 0.052 in the basic model), when a country has a criminalized policy (decriminalization dummy = 0). However, if the country decriminalizes cannabis for personal use, this effect is even bigger due to the addition of the coefficients (0.052 + 0.156\*1 = 0.208). On the other hand, the effect of decriminalization is affected by temperature. The coefficient (-0.237 in the basic model) shows that decriminalization is connected to less herb production, but only if the temperature is 0. At higher temperatures, more herbs are produced. This can be tested by using the equation -0.237 + 0.156\*Temperature.

In the model with cannabis plant eradication, the policy dummy, electricity used, land area and two interaction terms were significant. Decriminalization and more use of electricity lead to more cannabis cultivation; however, the coefficient for energy used is slightly above 0, which shows a marginal impact. The coefficient for land area is 0.015; the more square kilometers are available in any country, the higher will be the cannabis production and consequently the seizures. Moreover, the two interaction terms also have a limited positive (for the interaction between temperature and electricity) or negative (for the interaction between land mass and rural population) effect. An interaction means a difference in slopes; nevertheless, this change in the coefficient of the decriminalization dummy can be disregarded due to the low interaction coefficients.

There might be an ideological difference between cannabis herbs and plants. A cannabis consumer might feel more secure when buying a few grams on the illegal market. Opting for (home) cultivation of cannabis plants requires more skills, willingness to take a risk and a certain ideology. Moreover, herb consumers could be unaware of the policy change or fail to understand how it affects them. This could explain the significance of cannabis policy for the eradication of plants and the failure to be a significant predictor for cannabis herbs seized.

A possible explanation for the significant increase of cannabis plants eradicated after decriminalization could be that decriminalization might create more picky consumers. If personal possession is not prosecuted with a criminal conviction anymore, users can decide freely where and what to buy. The market structure changes and the users are free to opt out and grow a small number of plants themselves. This increases the level of domestic cannabis production and supply in general.

# **5.2 Developed countries**

The proxies used are the amount of cannabis herbs seized and the number of cannabis plants eradicated. Every proxy can only partially reflect the variable of interest; in this case the efforts of the cannabis producers and the law enforcement officials are entangled. Nevertheless, using a subset of developed countries mitigates this problem. Law enforcement regarding cannabis should be fairly similar in European countries due to the open borders of the Schengen area.

Similar considerations as for the full dataset apply for the subset of developed countries. Policy was a significant predictor of the number of plants eradicated and decriminalization leads to more plants being eradicated. However, in this smaller sample the policy dummy in the marijuana herb seizure model was weakly significant with a negative coefficient, which means that less herb was seized under decriminalization. This could have two potential reasons: (1) Law enforcement efforts decreased under decriminalization, making herb seizures a lower priority. Consequently, the kilograms of herbs seized dropped. (2) The behavioral impact of decriminalization diminished the so-called forbidden fruit effect and the number of consumers was reduced. The literature on the consequences of decriminalization has not yet concluded on whether it increases or decreases demand for cannabis herbs on the market. This sample seems to suggest the latter – an effect that is visible in the Netherlands. Even though 198

cannabis use and possession are de facto legalized, the number of cannabis users is one of the lowest in Europe. Parallel to the full dataset electricity consumption and land area were significant predictors with low coefficients. Moreover, the herb seizure model had two significant interaction, temperature and decriminalization as well as exports and rural population. This shows that decriminalization is again dependent on the average temperature. The plant eradication model only included one interaction between rural population and land area, but the coefficient was neglectable. An interesting finding is the high significance of the landborder dummy. If a country has a border with a country that already decriminalized cannabis, it is much more likely to decriminalize too. The coefficients are 0.88 and 1.09 for herb seizures and plant eradications, respectively.

#### **5.3 General remarks**

An important point of discussion is the herb seizure and plant eradication level. Since cannabis is consumed by 200 million consumers world-wide (United Nations Office on Drugs and Crime, 2013), it seems impossible that law enforcement manages to eradicate the entire cannabis production. Rather the seizure rate is estimated at 11 percent by Bouchard (2008) and at 26 to 31 percent by Wilkins, Bhatta & Casswell (2002). However, this only strengthens the findings since the analysis is conducted with a subset of the cultivators' population.

Cannabis policy (criminalization versus decriminalization) remains a significant predictor of the number of plants that are eradicated under each model specification and weakly significant for herb seizures in the sample of developed countries. Decriminalization led to more plants being eradicated and, to a limited extend, more herbs being seized in this sample. For developed countries, policy had a significant influence on the amount of herbs circulated at the 10 % significance level, but failed to be significant for the whole sample.

The full explanation for cannabis cultivation remains to be explored. This is a field wide-open for future research into the factors behind growing drugs and engaging into illegal activities. Nevertheless, this econometric analysis has provided some insight into the effects of policy on cannabis cultivators and their behavioral changes.

## 6. Conclusion

The research question asks whether cannabis cultivators are affected by the prevailing policy. On the one hand, the results show that the amount of herbs seized only exhibits a weakly significant change at the 10 percent level for developed countries. The coefficient is negative, which means that fewer herbs are seized under decriminalization. There are two possible explanations: Either the law enforcement activity decreases due to decriminalization and a lower priority of enforcing cannabis laws or the behavioral impact of eliminating the forbidden fruit effect leads to a decrease in demand for cannabis herbs. On the other hand, the change in cannabis plants eradicated after decriminalization was significant with more plants seized under a decriminalized regime. A possible explanation lies in the consumer choice to grow more plants for personal use in a domestic setting, if they are not satisfied with the quality or price of cannabis on the market.

The title, in line with a famous saying, asks whether two plants are better than one. It is important to mention that decriminalization does not entail any major policy changes regarding cannabis, such as increased funding – it is not comparable to legalization. As is apparent from this analysis, the effect on cannabis cultivation under decriminalization is significant. This held for the number of plants cultivated and showed that there was a behavioral mechanism involved in cannabis plant cultivation. Nevertheless, the cannabis market in general remains the same since only weak statistical significance could be found for the amount of marijuana herbs seized in circulation. Therefore, the answer to the question is that it decriminalization seems to increase domestic production and leads to an increase in cultivated plants.

The field of cannabis cultivation is mostly researched from a theoretical perspective so far. The few econometric studies to date raise major concerns about the availability and quality of data. However, data collection has improved over the last decade and might continue to do so. This will open up further research opportunities.

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# Conclusion

#### 1. The broader context

The UN Single Convention on Narcotic Drugs from 1961 is a binding hard law treaty that has been signed by 184 countries (United Nations, 2013). These countries are obliged to follow the schedules I and IV in the convention, which criminalize cannabis. However, a number of global players and organizations have emerged that condemn prohibition of drugs and argue specifically that cannabis be treated as a soft drug, for example the Global Commission on Drug Policy (2014) and the International Drug Policy Consortium (2014).

As displayed in the introduction (see Figure 2) around 50 countries world-wide have deviated from the UN Single Convention's prohibitionist approach to cannabis and opted for decriminalization. Because of to this pressure and lobbying, the Special Assembly of the UN for drug-related matters (UNGASS) has been brought forward from 2019 to 2016. This provides a huge opportunity for the further liberalization of policies towards cannabis and might lead to changes in the UN Single Convention from 1961 (United Nations Office on Drugs and Crime, 2015).

The Netherlands were the first country to decriminalize cannabis in 1976. However, they faced harsh international criticism for this move (Parliament of Canada, 2001). Moreover, Germany and the UK threatened to cut the Netherlands off their oil deliveries, if they proceeded with their plan to decriminalize cannabis (Cohen, 1994). Nevertheless, they went ahead and since then have created a successful drug policy, based on harm reduction and integration of drug users into society (Spapens, 2014; Spapens, Müller & van de Bunt, 2014).

A less successful example is Canada. Decriminalization of cannabis was proposed in 2002 and 2004, but failed both times because of the international ramifications (Parliament of Canada, 2004). First of all, the International Narcotics Control Board disapproved of the plans because they were not in line with the UN Single Convention from 1961. Second, and more importantly, the US stated that it would retaliate against a changed Canadian cannabis policy. This would include increased and more severe border controls, as well as reductions in trade.

## 2. The results

This dissertation explores the economic and social incentives to decriminalize cannabis and therefore, the reasons why countries have abandoned the provisions of the UN Single Convention on Narcotic Drugs from 1961. Furthermore, the stakeholders in cannabis policy making and their interest in (de)criminalization have been identified along with the market mechanisms. In the following a short overview of the results is provided.

In 1961, almost all countries world-wide agreed on cannabis prohibition; there was a single equilibrium point. Starting in 1976 with the cannabis decriminalization of the Netherlands, the development towards two equilibria was visible. On the one hand, some countries strengthened their prohibitionist policies towards cannabis. On the other hand, decriminalization was now a viable and widely used option. This outcome shows the dangers of premature harmonization: Cannabis policy was harmonized by lobbying by a few countries, led by the US. Decriminalization has proven to be beneficial for cost reduction in law enforcement and shifting public health expenditure. Nowadays, it is unlikely that a consensus on cannabis policy can be found.

The first paper tries to identify the reasons for decriminalization and the breach of the UN Single Convention on Narcotic Drugs from 1961. It is apparent from the analysis that economic incentives are very strong in the case of cannabis policy. Moreover, ideology and lobbying have a strong influence on the decision to (de)criminalize. Governments appear to decriminalize cannabis based on a small number of economic factors and then only when the public opinion opens an opportunity window. They often profit from observing neighboring countries and their efforts to decriminalize cannabis – this phenomenon is called "learning effect".

The political system of the US allows for separate federal and state level cannabis policies. Even though cannabis is federally prohibited, an ongoing liberalization and deregulation of cannabis can be observed on state level. Research on the determinants of these changes is scarce and potential determinants could stem from the domains of ideology, domestic politics, spatial ties or federal political factors.

The second paper tries to identify the determinants of cannabis policy in the US. It seems that electoral preferences and spatial policy diffusion play a significant role in policy-making. Nevertheless, other significant predictors of US cannabis policy seem to be race, the fraction of elderly in a state, having access to the coast and the Great Lakes, a state's budget deficit 206

and real GDP growth. It appears that cannabis policy changes are induced by political considerations rather than any apparent necessity.

Research on the effects of cannabis policy is as yet inconclusive (Hopfer, 2014); it could potentially lead to more or less cannabis use, as well as the possibility of no effect no effect. This dissertation suggests that cannabis decriminalization has not had a detrimental effect on consumption in the sample present. Furthermore, decriminalization may have more benefits than prohibition since it reduces law enforcement expenditure and creates possibilities for public health interventions, like harm reduction (Lenton, 2000).

The third paper highlights the effects of cannabis (de)criminalization on cannabis consumption. Generally, countries that decriminalized cannabis had a higher level of cannabis consumption than the countries that retained a criminalized approach. However, after decriminalization this difference disappeared. Those with a criminalized policy experienced a drastic increase over the years, while countries that decriminalized experienced almost no increase in cannabis use. In the recent decade many countries had to decide on the future of their cannabis policy. These governments often state the reduction in cannabis consumption as a social incentive to decriminalize.

Prohibition of cannabis is a failure. However, some stakeholders have a monetary interest in upholding criminalization. Nevertheless, this should not influence governments. The most beneficial policy for the state's citizens (possible small-scale users) needs to be adopted. Decriminalization allows for punishment of large-scale criminal, but not for small-scale users. In other areas prohibition was ruled arbitrary and overturned. For example the US alcohol prohibition, the fat tax in Denmark or the soda ban in New York (Snowdon, 2013). This needs to happen to cannabis prohibition too.

The fourth paper describes the stakeholders affected by cannabis policy. Each government will consider the stakeholders' input; however, some of them are more active and backed by more financial and human resources. They will lobby for the policy approach that they believe is more beneficial to them. For example, the alcohol industry sees cannabis and alcohol as substitutes and hence wants to prevent decriminalization. A government has to be careful not to accede to the most powerful and salient stakeholder, but rather consider all stakeholders equally.

The fifth paper explores the domain of cannabis production world-wide. It seems that decriminalization leads to a decrease in law enforcement activity, consumer demand or both.

Moreover, consumers appear to be more willing to resort to domestic growing of cannabis. This could be related to their preferences in price and quality of cannabis. Rational choice theory fails to explain this spectrum of results and behavioral incentives have to be considered to find the underlying reasons for changes in marijuana herbs seized/ cannabis plant eradicated after decriminalization.

#### 3. The future

Cannabis prohibition increases criminal activity since it creates an illegal market. The consumer base for cannabis is substantial and the demand is met through illegal means under criminalization. Moreover, cannabis users do not have access to harm reduction or other beneficial public health measure due to the fear of conviction with a criminal act. Decriminalization relaxes the punishment for individual users, while continuing to punish organized criminals.

The International Narcotics Control Board/ Commission on Narcotic Drugs were asked to reschedule cannabis to a less strict schedule on several occasions, but have not yet done so. This will hopefully be changed through the UNGASS meeting in 2016. Even though there will not be a single policy equilibrium in cannabis policy, decriminalization should not be condemned. It is important to remember that decriminalization has more similarities to criminalization than legalization (legalization is the absence of penalties).

Future research needs to find a practical hands-on approach, especially in Uruguay and the US states that legalized cannabis for recreational use (Colorado, Washington, Oregon, Alaska and Washington D.C). More evidence on the consequences of decriminalization and legalization should certainly be generated. Nevertheless, this should not prevent the adoption of a decriminalized cannabis policy in order to improve a country's economic and social situation.

The quotes by Anslinger and Friedman in the introduction show the controversy that started in the beginning of the 20<sup>th</sup> century – a controversy that has yet to be resolved. Exciting times for cannabis policy lay ahead with the variety of newly implemented policies. As the years pass the consequences of each approach will become more salient and evidence will be generated. I hope that decriminalization or even legalization will win that comparison and that cannabis will be treated like other currently legal drugs, namely tobacco and alcohol.

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