



**Czech University of Life Sciences**

**Faculty of Economics and Management**

**Department of Economics**

Bachelor Thesis

**Impact of Cannabis Legalization Upon Economy**

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

## BACHELOR THESIS ASSIGNMENT

Alexander Hilli

Economics and Management

Thesis title

**Impact of cannabis legalization upon economy**

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### Objectives of thesis

The main goal of this thesis is to evaluate impact of legalisation of marijuhana upon economy and show these impact in economy of Czech Republic. Main focus will be held on the expected change of public finance which comes from taxation, and also on some problems that might occur in case of legalisation such as health issues, illegal production or dealing across borders.

The main reason why is marijuhana still illegal is lack of political will to change it therefore this thesis will focus on finding the opinion of the common public about the legalisation in order to find whether there is public will for it and therefore an incentive for politicians to act.

### Methodology

In theoretical part the thesis will focus on comparison of economies (Colorado, Netherlands) before legalisation and after and the changes it made to the economy and then deducing what impact it would made on economy of Czech Republic.

For the practical part there will be a survey among general public in order to calculate the percentage of those who are in favor of legalisation. This will be done by quantitative analysis of responses obtained from general public.

**The proposed extent of the thesis**

40 pages

**Keywords**

Legalisation, Marijuana, Cannabis, Impact of legalisation,

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**Recommended information sources**

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### **Declaration**

I declare that I have worked on my bachelor thesis titled "Impact of Cannabis Legalization Upon Economy" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any other person.

In Prague on \_\_\_\_\_, 2018

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# Impact of Cannabis Legalization Upon Economy

## Summary

Cannabis legalization is often discussed topic in the modern society in 21<sup>st</sup> century. While some of people are strictly against, saying that it would lead to higher drug use, increased health risks and other problems associated with higher consumption of the drug, others are voting for legalization arguing that the current system is not preventing the cannabis use among people and that society can benefit from the legalization both economically and socially. In this thesis the sole focus is on the economical point of view and the cost and benefit reasoning behind the legalization process. On a proposed model of legalization in Czech Republic the costs and benefits will be calculated as they are expected to come in the year of legalization and after it will be determined whether the legalization would be economically beneficial or not for the society in Czech Republic and its people.

**Keywords:** Legalization; Cannabis; Czech Economy; Cost-Benefit Analysis; Linear Regression; Trend Analysis; Impact of Legalization; Cannabis Use in Czech Republic; Cannabis Associated Healthrisks; Taxation

# Legalizace konopí a její dopad na ekonomiku

## Souhrn

Legalizace konopí je často diskutovaným tématem v moderní společnosti 21. století. Zatímco někteří tento nápad zcela odsuzují, argumentují tím, že legalizace by vedla ke zvýšenému užívání drog, zvýšeným zdravotním rizikům spojeným s užíváním a dalším problémům, jiné hlasy jsou pro zavedení legalizované formy konopí k rekreačním účelům. Mezi jejich nejčastější argumenty patří, že system tak jak je nastaven nyní nefunguje, nezabraňuje užívání konopí a že by bylo přínosnější pro společnost jako celek, aby bylo konopí zcela legální. Tato práce se soustředí výhradně na ekonomické aspekty spojené s legalizací konopí a zaměřuje se na analýzu nákladů a přínosů které se dají očekávat při zavedení legalizace. Na navrhovaném modelu legalizace tak, jak by s největší pravděpodobností proběhla v České Republice, podle nejhlásitějších zdrojů společenské diskuze, přínosy a náklady jsou spočítány tak, jak je nejpravděpodobnější že nastanou a poté je určeno, zda-li je legalizace z ekonomického hlediska prospěšná nebo neprospěšná pro společnost jako takovou.

**Klíčová slova:** legalizace; konopí; Česká ekonomika; analýza nákladů a přínosů; lineární regrese; trend analýza; dopad legalizace; užívání konopí v ČR; zdravotní rizika spojená s konopím; daně

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# 1 Introduction

This thesis is focused on the problem of cannabis legalization and its effects that it has upon the economy. Legalization is a process that is a current trend all over the world, many states and countries are currently trying to determine whether it would be profitable or harmful to allow its citizens to consume cannabis products for recreational use. Places like Colorado, California, Uruguay, Washington and others took a progressive approach legalizing the products and others, such as New York or Norway, are currently talking about introducing such policies as well. Problem with legalization will be one of the most discussed topic in most of the developed countries in the near future all over the world.

By installing the most probable model, according to current social discussion in Czech Republic, this thesis will explore the possible effects that the legalization would bring economically to this country. Establishing the costs and the benefits of such policy this thesis will answer the question whether it would be financially beneficial for the economy of this state to introduce cannabis legalization policy into its system. It must be remembered that legalization of cannabis for recreational would touch many aspects of a society, not just economy of a state, but also the legal changes that would have to be made. This thesis is focusing only on the economical aspect.

It is probable that legalization of cannabis could become one of the defining moments of 21<sup>st</sup> century. Many countries are entertaining the possibility of putting the cannabis on the same level as tobacco or alcohol and according to the voices of experts and journalist there will be more to come in the next few years. But let us not forget that each country has specific customs, demography and history and therefore what might be successful in one does not have to be necessary successful in others. That is why this thesis is focused solely on Czech Republic and its factors that would most likely be affected.

## **1.1 Research question**

The question that this thesis is answering is as follows: Would it be financially profitable for the state to introduce fully legalized cannabis products for recreational use into its economy?

### **1.1.1 Research limitation**

During this research there were some limitations. There are very few theses on this topic as it is a new problem that society is facing only in the last few years and there are no theses focusing on the topic chosen in this particular thesis. This generated some problems mainly because of lack, or even sometimes non-existing data focused solely on cannabis products. Because it is now regarded as part of the illegal drugs, most of the data are for the whole group of illegal drugs and therefore there had to be estimates made for how much of these would belong to cannabis. Most of the data are older because it takes a lot of time to make the yearly statistics.

Also, there are ethical issues while dealing with this sensitive topic, as it is still an illegal product therefore an attempt on making a public survey could be taken as a criminal offense (spreading of toxicomania). Without an ethical approval from a major institution such a survey involving the general public cannot be done without the risk of consequences.

## **2 Objectives and Methodology**

### **2.1 Objectives**

Objective of this thesis is to determine whether the cannabis legalization for recreational use would be economically and financially beneficial for the state of Czech Republic. By comparing the Czech data to data from Colorado, where legalization process has been done in 2014, this thesis will answer the question above. Using the method of comparing social costs to social benefits at the end of this thesis there will be one definite answer, whether the legalization of cannabis for recreational use would bring more money into the public resources or not.

### **2.2 Methodology**

#### **2.2.1 Cost/Benefit Analysis**

##### **2.2.1.1 Method**

Cost-Benefit Analysis is a collection of methods used to determine social costs or social benefits of implementing some process or innovation into the company or society. It is a useful tool to determine whether something is beneficiary for the company or society or it should not be introduced. It is widely used for example in a business world, when deciding whether the investment is appropriate for the company or not. However, it is not a unified method for determining such policies. It is a collection of methods, mainly taken from Welfare economics that are used to calculate the total social costs (TSC) and total social benefits (TSB) and by subtracting total social costs from total social benefit it will show whether it is a good change or not. If the result is more than 0 then it would be reasonable to think about implementing such policies as it has more potential benefits than costs. On the other hand, if the outcome is less/equal to zero then such investment does not make sense as it would not bring any significant income and therefore it is better to use the money somewhere else.

When comparing investments or innovations, better is the one with the higher positive outcome, as it will bring us more revenue in the future. On the graph below, the optimal quantity, which will bring the most benefits, is shown. It is in the point where the difference between total social costs and total social benefits is the biggest.

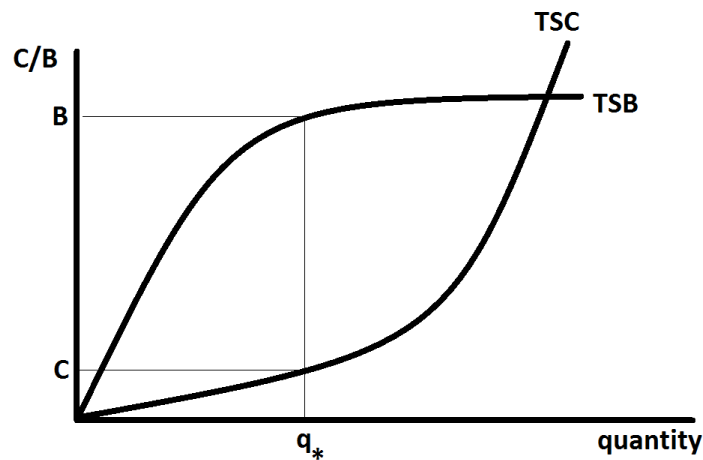


Figure 1 - Cost/Benefit optimum

The individual costs and benefits are computed using other methods such as trend analysis, predictions based on the data from previous years or statistics that are publicly accessible. (Mishan and Quah, 2007)

## 2.2.2 Trend Analysis

### 2.2.2.1 Linear Regression

The main method used in this thesis is a trend analysis, specifically linear regression applied to a time series. Linear regression is statistical method used to illustrate the relationship between 2 or more variables. One of them is called dependent variable,  $y$ , because its value depends on the other one which is called explanatory variable,  $x$ . There can be infinite number of explanatory variables in the model. It has many practical uses, one of them is forecasting. The method of linear regression provides the model into which  $x$  can be put and the model will generate an unknown  $y$ .

Linear regression used in this thesis fits the known data to model represented by equation  $y = ax + b$ , where  $a$  is the rate of change and  $b$  represent the intercept with the  $y$ -axis. It used to determine the relationship between 2 variables, in this case event over time, for example the rate of car accidents over period of years and predicting the number of events in the next time period. It is based on a fact that according to the previous events we are able to determine with some accuracy what the phenomenon will be in the future.

It must be said that this method is not suitable for making predictions for more than 2 or 3 time periods as the conditions can change massively in the horizon of more years. (Seber and Lee, 2003)

#### 2.2.2.2 Trend line

Trend line is the graphical visualisation of a trend. It can have any shape for example shape of logarithmic function, exponential function etc. In this thesis the majority of trend lines are lines ( $y = ax + b$ ). It allows us to visualise the trend and show the expected values for the next period. (Seber and Lee, 2003)

The graphical visualization as well as exact value in the future in this thesis is computed using MS Excel, specifically scatter plot graph with added trendline predicting the next 2 periods and a function =LINTREND.

One non-linear trend was used, specifically in the section 4.4.5. Vehicle Theft, to illustrate the current trend of car thefts in Colorado, because the coefficient of determination was much higher when polynomial function was used. There was no calculation made using this function, the sole purpose was to illustrate current situation.

#### 2.2.3 Monte Carlo Method

In order to get the most probable result, the Monte Carlo method will be used to determine the interval of probable solution. Monte Carlo has many uses in various fields, not only statistical but also mathematics, physics and others.

##### 2.2.3.1 Monte Carlo method

It is mainly used for risk analysis in companies. For example when a company needs to assess the risk of a new investment in a business. Firstly, the risk factors must be selected. The maximum number of risk factors should not exceed 3 otherwise the simulation might be inaccurate. The simulation itself is rarely done by humans, the analytical software is mainly used for computations. The program runs the simulation using a random, but pre-selected number of repetitions. After the simulation is finished, the software can deliver the result in graphical visualisation as well.

Monte Carlo uses numerous of repetitions of input, in this case costs and benefits, in order to get the most probable outcome, this case profit or loss. In this thesis the 1000 repetitions with 95% confidence interval will be used to get the probable outcome of this analysis in the real world.

The analysis will be done by analytical tool - Crystal Ball in MS Excel. This will not only provide the outcome, but also the graphical visualisation. (Hnilica and Fotr, 2009)



## 3 Theoretical part

### 3.1 Cannabis in general

The cannabis plant is divided into two main subspecies which are *Cannabis indica* and *Cannabis sativa*. *Indica* plants are shorter, darker and have less THC (tetrahydrocannabinol) than *cannabis sativa*. Because of its higher THC content, the *sativa* is the preferred among the drug users. (Atakan, 2012)

*Cannabis sativa* is a unisex plant, where the plants are either male or female. Female plants are often used for drug abuse due to their high content of THC. *Cannabis* grows most efficiently during the summer with normal temperatures around 22 °C however the most common way is to grow it inside using artificial lightning and special fertilizers. (Independent Drug Monitoring Unit, 2018)

#### 3.1.1 History

##### 3.1.1.1 Cannabis in China

The first find of *Cannabis* usage is dated up to 10,000 years ago in ancient China, specifically in Taiwan where they were using cannabis fiber to enhance their clothes and decorate their pots. In 1972, the discovery of ancient burial site, dating back to 1,100 B.C., revealed the cannabis fiber in the clothing. This find suggests that men has been using hemp for lot longer than originally thought. As they became more familiar with the plant, it was later discovered that male plants producing better fiber while the females have better seeds. Because of its strength, the Chinese archers replaced their bamboo strings with hemp fiber. Hemp fiber was also used to manufacture paper, one of the most important invention of that time.

Later it was used during surgeries as an anesthetic when mixed with wine. Although it could not provide completely pain free surgery it was helpful during difficult procedures. A completely pain free surgery was possible only when people took too much of this mix and they became unconscious.

Chinese were also aware of its strange, psychedelic effects. Some Chinese called Marijuana as “liberator of sins”. If too many seeds were eaten it caused one to “see demons”. For some it was the only reasons to use Marijuana, to be able to see spirits.

Taking advantage of these effects of Marijuana was a great problem in China, however it was overshadowed by alcohol abuse, which was even greater problem, and both were nothing compared to opium use, which overtook later.

#### 3.1.1.2 Cannabis in Japan

Like in China, hemp fiber was highly used in Japan for clothing, bedding and fishermen nets. Clothes made from hemp were used especially for religious and special occasions due to its association with purity. It was so important plant in Japan, that it was even mentioned in Japanese legends that explained the beginnings of all things. Hemp in Japan was a symbol for marriage. Wedding gifts were often made from hemp fiber and hemp strands were hung on the trees to bind the lovers together. It was also used during ceremonies of driving away the evil spirits.

#### 3.1.1.3 Cannabis in India

Cannabis plays a huge role in Indian social life. A special liquid form of cannabis called “Bhang” was extracted from leaves and used as a refreshment. It was and still is used during ceremonies such as weddings. It is often compared to what alcohol is in the West. During the Middle Ages, warriors drank bhang before going to the battles.

The earliest mention of bhang is in the fourth book of Vedas, written between 2,000 and 1,400 B.C. However, it was never used for medical purposes nor psychological relieve, it is associated with religious ceremonials. To the Hindu the plant is holy.

#### 3.1.1.4 Other places

Except the India and China, all the nations did not use cannabis for its psychedelic effects but rather for its fibers that helped them manufacture ropes, clothes and nets. In Rome f.e. it was used to produce strong ropes and an earache medicine.

(Druglibrary.org, 2018)

### 3.1.2 **Therapeutical uses**

Cannabis can be used for therapeutical purposes. Cannabinoids helps patients with spastic disorders appearing with neurological disorders such as sclerosis which involves muscle weakness and ataxia. Use of cannabis also helps to manage chronic pain. Variety of studies suggests that use of cannabis has better results than using codeine.

Among other uses there is anti-emetic use, preventing nausea while on anti-cancer drugs. It also helps with appetite stimulation which might be reduced due to using opioids, antiviral drugs or AIDS related drugs. Also helps with anorexia, can help with epilepsy and even glaucoma. Cannabis has also been used as part of an alcohol treatment, help during opioid induced withdrawal and there is potential to help with neurodegenerative diseases such as Alzheimer.

### 3.1.3 **Other uses**

For thousands of years cannabis was used for its strong fibre. The hemp fibre was used for manufacturing clothing, ropes, nets, decoration, paper, etc. Apart from India and China, cannabis was not used for its psychedelic effects but more for its strong and dependable fibre it produces.

(Kumar, Chambers and Pertwee, 2008)

## 3.2 **Health risks**

Even though it is known for its benefits, the cannabis uses also bear some health-related issues. These issues are more likely to happen when using long-term.

### 3.2.1 **Effect on mood**

Using cannabis produces euphoric feeling, which gives you feeling of happiness as well as state of increased awareness, sociability and sometimes depression. However, smoking can also cause dysphoric reaction such as panic attack, anxiety, paranoia and psychosis. These are more often related to overdose or unexperienced users.

### 3.2.2 **Effect on perception**

Cannabis use has some effect on perception. F.e. the colors might seem different, brighter, the music might be more “colorful”, emotions can have more meaning. Also, it effects the way we perceive time and sometimes the hallucination can occur, but only when high dosage is consumed.

### 3.2.3 **Effect on cognitive functions**

Cannabis use might prolong the reaction time, can affect the short-term memory and might have negative affect on confidence. As a result of all of these effects above the studies showed that cannabis has a negative effect while driving or flying an airplane. The risk of accident increases while under the influence of cannabis.

### 3.2.4 **Tolerance**

People can build up a tolerance towards cannabis effects which leads to increased dosage and can lead to drug dependency. The process of withdrawal is similar to the alcohol one and involves restlessness, anxiety and insomnia.

### 3.2.5 **Long-term effects**

It is not clear whether there is a permanent impairment related to the cannabis use however there is sufficient evidence of impairment lasting for days, weeks or months after long-term heavy user ceased to use cannabis. The most common problems were associated with memory, performance and attention.

### 3.2.6 **Other effects**

When smoked, the cannabis smoke contains most of the things that are present in cigarette smoke, apart from nicotine, therefore the health risks are similar to the ones when smoking tobacco cigarettes. The most common risk is lung cancer however it appears after a long-term heavy usage of the drug. Due to the way how cannabis is smoked, without filter, it is believed it possess 5 times greater number of carcinogens than a regular tobacco cigarette. The temperature of cannabis is also higher than the temperature of tobacco and usually cannabis smoke is inhaled stronger and kept in lungs longer, therefore it causes further damage to the lungs.

Cardiovascular events may occur due to the smoking cannabis cigarette, especially to people with pre-existing cardio problems.

Chronic cannabis use also possess reproductive risks, especially for mother during the pregnancy, however the effect is still not clear, and this area require further study.

(Ashton, 2001)

### **3.3 Stages of Legality**

In order to be able to talk about legalization process we have to define three stages of legality of cannabis.

- 1.) Illegal
- 2.) Decriminalized
- 3.) Legal

#### **3.3.1 First stage**

The first stage, illegal, is when the state has zero tolerance towards cannabis. The possession, cultivation, distribution and use are all criminal offense and are punishable by jail sentence. Classic example of such a country is Saudi Arabia.

#### **3.3.2 Second stage**

Second stage, decriminalization, is when the state has some tolerance toward cannabis. F.e. in Czech Republic where the cannabis was decriminalized, possession and transportation of up to 15 grams is not a criminal offense and each person can grow up to 5 plants for personal use. However, the distribution is prohibited and there is no state regulation or taxation of sale.

#### **3.3.3 Third stage**

Third stage is legal cannabis. Controlled by the state, the production and the distribution are taxed. There are additional rules for distribution, such as users must be certain age etc., it is very similar to alcohol distribution, usually there are the same restrictions. The country where cannabis is fully legal is f.e. Uruguay but only for citizens of the state and up to a certain amount possessed.

### **3.4 In other countries**

When talking about cannabis legalization the country can take a lot from other countries, that are already implemented decriminalization or fully legalized cannabis trade. In this thesis there will be 3 main models introduced and their principles will be used when computing possible outcome on our economy.

### 3.4.1 Netherland's model

Netherlands is famous for its liberal approach towards soft drugs. Decriminalizing cannabis in 1976 it has become a popular destination for recreational drug use of people from all over the world. However, there are some condition that must be met in order to be able to obtain the drug. Cannabis is not fully legal in Netherlands.

In netherlands 16.1% of population between 15 and 34 years of age using cannabis regularly. This is less than for exampe in Czech Republic or France.

#### 3.4.1.1 Toleration policy for soft drugs

“The Netherlands has a policy of toleration regarding soft drugs. This means that the sale of soft drugs in coffee shops is a criminal offense, but the Public Prosecution Service does not prosecute coffee shops for this offense." (Government.nl, 2018) The same applies for members of the public in possession of small amounts. The small amount is defined by the Dutch government as no more than 5 grams of cannabis for personal use and/or no more than 5 plants of cannabis. The sale of cannabis in his forms of hash and marijuana is tolerated if there are some general conditions met. These involves conditions such as:

- the sale of hard drugs is not permitted
- the sale of cannabis to minors is not permitted
- the advertisement of the drugs is not permitted
- the sale of large quantities is not permitted

(Government.nl, 2018)

#### 3.4.1.2 Taxation in Netherlands

In Netherlands the income taxes from cannabis sale are around 400,000,000 euros per year. However, this number is a subject to many discussions because it represents the annual income tax of coffee shops, however because there is a big problem with illegal producers in Holland, who are able to operate thanks to the benevolent police, a lot of the money ends up in the hands of criminals. Therefore, the profits would be higher if it was not for the grey economy. (Tdpf.org.uk, 2018)

### 3.4.2 Colorado's model

After passing the Amendment 64, adults who are at least 21 years old can now possess up to one ounce (28 grams) of cannabis in the state of Colorado. This involves seeds, oils or edible goods. This limit is not bind to the Colorado citizens, so anyone can come and buy marijuana. Colorado is becoming fast the cannabis center of the world, the “new” Amsterdam for tourists from all around the world. Since June 2016 tourists are able to buy up to 28 grams of marijuana per one transaction. To avoid misuse, most of the shops will only serve you once a day. However, the use of the drug is not permitted in public places and there are very few places that allow on-site consumption. There are some private-smoker's clubs.

The driving under the influence is permitted up to the limit which is 5 nanogram per milliliter of blood. Transporting marijuana is legal if not publicly displayed however exporting is strictly forbidden. The law also allows to grow up to 6 plants. (Colorado Pot Guide, 2018)

#### 3.4.2.1 Taxation in Colorado

In 2017 the total tax revenue from marijuana sales reached 226,157,026 USD. The state retail tax in Colorado is 15% since July 2017. Previously it was 10%. The state share is 90% and the remaining 10% of collected taxes are in possession of local government.

State Tax Rate

Excise Tax Rate

Sales State Tax Rate

(Colorado.gov, 2018)

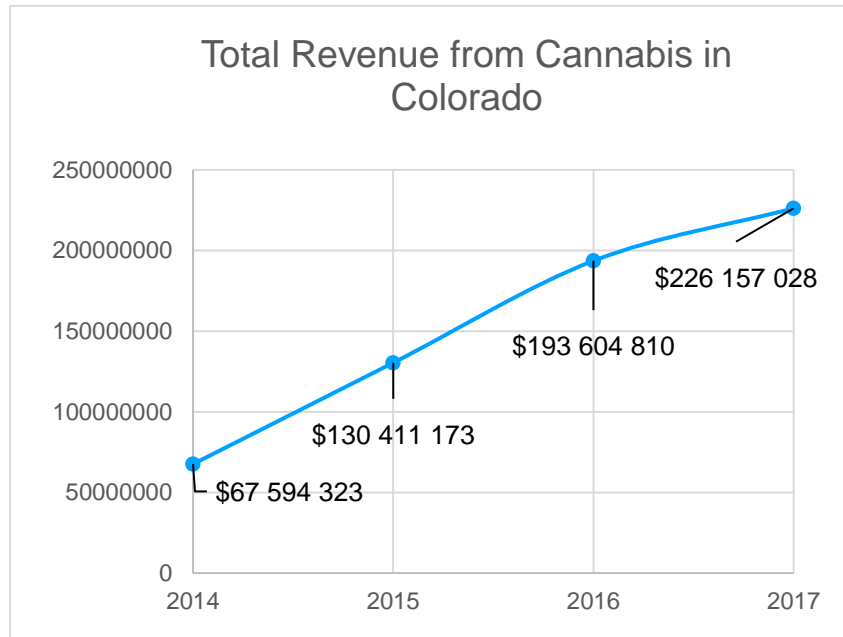


Figure 2 - Revenues in Colorado

### 3.4.3 Uruguay's model

In July 2017 Uruguay started to distribute cannabis for recreational use from pharmacies. Currently (August 2017) there are only 16 pharmacies that has signed up for distribution of recreational drug. None of the major pharmacy chains had agreed on selling. In order to be eligible to buy the drug, the person has to be citizen of Uruguay, over 18 years old and have to be registered in a government database, which currently has around 17,000 people registered. There is a limit of purchase, 40 grams monthly and 10 grams weekly. In this model the government takes the dealers function and take care of distribution itself. (DW, 2017)

There are over 7,000 home growers listed in Uruguay as well as 60 smoke clubs. Everything that Uruguayan government does towards the cannabis has the main reason to get rid of illegal producers and distributors and cut them off their money and preferably put the money into government pocket.

In a country with 3,500,000 citizens the 16 pharmacies, working as the drug dispensary, have no real chance in covering the demand for the whole country, but it is definitely a start. People, who are registered, can choose from 2 different kinds of plant, and they can buy a pack for 6,60 USD according to IRCCA. (Public Radio International, 2018)



### 3.4.4 Other models

#### 3.4.4.1 California

In November 2016 the Proposition 64 was passed in California legalizing the recreational use for people older than 21 years. Adults are able to possess up to 28.5 grams and they are able to purchase the same amount, but the sale are not yet possible. The government has to come up with dispensing system yet. The cultivation of up to 6 plants is legal. (Pot Guide, 2018)

#### 3.4.4.2 Jamaica

In 2015, cannabis was decriminalized in Jamaica. It can be sold for medical purposes and members of Rastafarian religion are allowed to use it during their religious practices. Tourists can also purchase the drug. The maximum allowance for possession is 2 oz, approx. 56 grams. By allowing the tourists to buy cannabis products, the local government encourages tourists to come and bringing money from tourism into this poor Caribbean country. (Pot Guide, 2018)

### 3.5 Situation in Czech Republic

In Czech Republic the cannabis use has been decriminalized and in 2017 a new law was introduced, redefining some terms.

- Unrightful carrying of amount of drug for self use is always against the law: in an amount small, it is processed during misdemeanor proceedings, in large quantities during regular trial.
- The fine can go up to 15,000 CZK during misdemeanor proceedings
- During trial the penalty could go up to 1-year sentence, prohibition of activity or forfeiture.
- If found guilty of possession of non-cannabis drug, the sentence can be up to 2 years.
- Unrightful growing plants for self use is always against the law: in an amount small, it is processed during misdemeanor proceedings, in large quantities during regular trial.
- The fine can go up to 15,000 CZK during misdemeanor proceedings

- During trial the penalty could go up to 1-year sentence, prohibition of activity or forfeiture.
- Any other criminal behavior, such as dealing, import, export etc. are dealt with with no regards toward the drug in question.

(Zákon č. 40/2009 Sb.)

### 3.5.1 Taxation in Czech Republic

There are three main taxes that might impact the legalization proces. It is value added tax (VAT), income tax and excise tax.

#### 3.5.1.1 Value Added Tax (VAT)

Value Added Tax is one of the most important sources of state incomes. It is paid in almost every transaction. The biggest difference of this tax is that it is calculated from the price, which means that we can see it in every transation on a receipt as a tax base and VAT. The tax rate in Czech Republic is 21 % (or discounted 15 % or 10 %)

#### 3.5.1.2 Income Tax

Income tax in Czech Republic is also very important source of public money. The income tax rate for individuals is 15 % and for companies it is 19%.

#### 3.5.1.3 Excise Tax

Excise Tax is a special kind of taxation. It is applied only for special kind of products such as gas and petrol, alcohol or tobacco. Rate of taxation for tobacco products in Czech Republic is set to 2,185 CZK per kilogram of tobacco or 1,42 CZK per one cigarette. However, the excise tax can be set to any amount by government and therefore it is quite flexible when talking about cannabis taxation.

(Marková, 2018)

### 3.5.2 Cannabis use in Czech Republic

According to National Monitoring Center for Drugs and Addiction (*Národní monitorovací středisko pro drogy a závislosti*) in 2016 30.5 % of adult population (aged between 15 to 64 years old) used cannabis related products. Czech Republic, with an adult population over 7,000,000 (EMCDDA Drug Report) where 30.5% of adults use cannabis in some of its form it makes it around 2,100,000 of potential users. Around half of those (48.8%) were in age from 15 to 34 years (young adults).

(Drogy-info.cz, 2018)

The size of the cannabis market is estimated up to 12 billion Czech Crowns. The estimated amount of sold cannabis in Czech economy is 60 tonnes of the drug with price of 200 CZK this area is generating up to 12 billion in gross profit all untaxed and without the state supervision.

(Pirátská strana, 2017)

### 3.6 Literature Review

According to (Pacula, R., L., (2010), the legalization could lead up to higher use among young adolescents. While some argue that there would be restrictions and enforcement from the state, the truth is that the initial age of both alcohol use and tobacco use is lower than age of first cannabis use experience. The question whether state can effectively prevent young adults from using forbidden substances when under age is ongoing.

(Monte, Zane and Heard, 2015) says, that the legalization of cannabis in Colorado lead to new production processes in manufacturing new and more efficient ways of producing the drug. According to this, it also lead to higher prevalency to skin burns, vomiting and healthcare visits. These were unexpected health issues.

According to (Kilmer, 2010) when cannabis legalized the price of a product could go down as much as 20 % of an illegal drug. Consumption would go up, but it is impossible to determine how much it would increase. Tax revenue are uncertain. And there is no certainty in the outcome of cannabis legalization (study was conducted for state of California).

## 4 Practical Part

### 4.1 Shifts on the Market

#### 4.1.1 Illegal Market

On the illegal markets the price is formed as costs of production plus the cost of breaking the law, in other words the cost of the penalty or fine that might come if caught during illegal activities.

#### 4.1.2 Effects of Legalization and Taxation on the Market

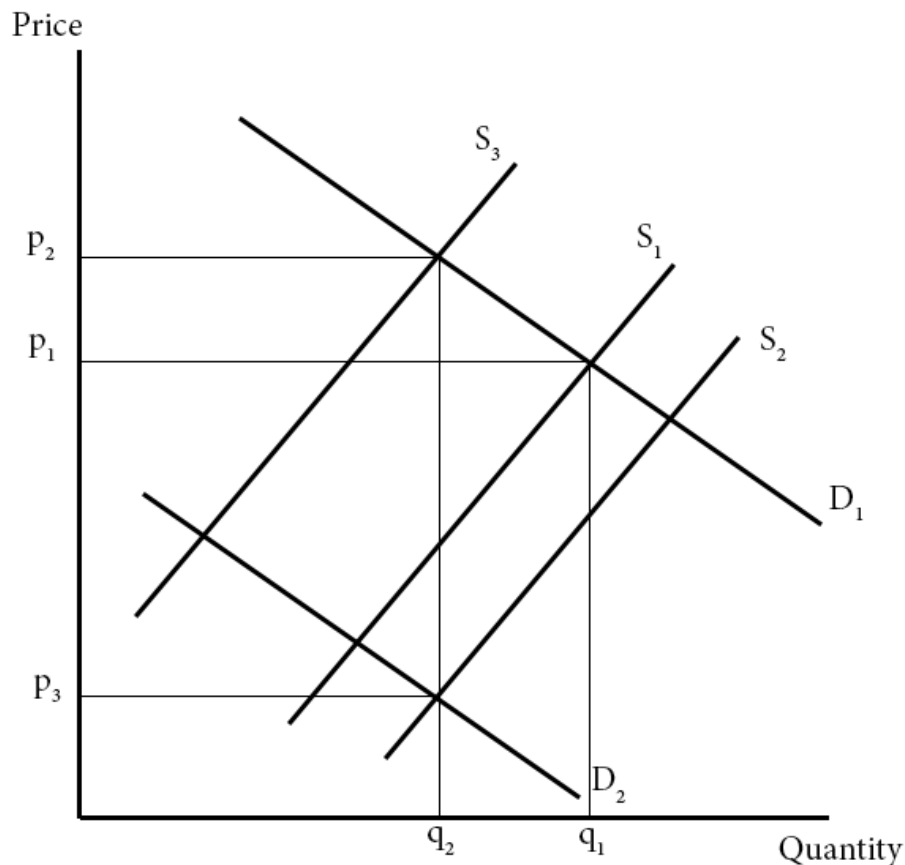


Figure 3 - Effects of legalization and taxation

If cannabis is not legalized, we have a market equilibrium at intersection of  $S_1$  and  $D_1$ . If cannabis is legalized the supply shifts right, because it is easier to sell, there is not the cost of risk while operating illegally, and people will try to make money in a new industry, therefore the total competition on the market is higher and the price decreases while the quantity supplied increases (point  $D_1S_2$ ).

If government introduces the excise tax on the cannabis related products, the cost of production rises and the whole supply shifts left to the  $S_3$ . Because of the higher price the consumers utility is going down and therefore the whole demand curve shifts down to the  $D_2$ . The new equilibrium is therefore at lower price, because the demand is not that high and at lower quantity as well. The difference between  $p_2$  and  $p_3$  is the excise tax rate and it can be adjusted by the government.

## 4.2 Proposed Model in Czech Republic

### 4.2.1 The Czech Model

In order to be able to determine the basic costs and benefits which are likely to come with the proces of legalization we have to introduce a model which we will use in order to simulate the situations that are likely to come. In this model some assumptions has to be made, some are probable and some are less probable. Some are very unrealistic but in order to estimate the costs they had to be made.

In this model the legalization process will go under full supervision of a state. The distribution channel will be made from already existing pharmacies which will now be selling cannabis for recreational use to Czech citizens who are older than 18 years old. The pharmacies will purchase licences from the state in order to be able to distribute the cannabis product. This licence will last for 12 months and will be paid annually by the pharmacies. In order to avoid customers going to the black market and buy „from the streets“, there is a price ceiling set by the government at 130 CZK per gram. This price is fixed for the purposes of this study. This is very unrealistic assumption because on the free market the price would oscilate. Some of the factors, such as car accident rates, were compared with data from Colorado as it has the most detailed data before and after legalization proces was introduced there, and then they were recalculated for Czech market.

In this model the calculations were made using the assumption that the Czech cannabis market is 60 tonnes/year. (Pirátská strana, 2017)

All the estimates were made for the next closest year in order to maintain the highest possible accuracy of trend analysis.

#### 4.2.2 Pricing Strategy in Czech Economy

The pricing strategy is crucial for successful implementation. The price must be lower than the products sold illegally on the streets. In order to do that there would have to be a price ceiling set on the product. According to police of Czech Republic, 1 gram on the streets costs around 200 CZK. To force people to buy the legal cannabis products, the final price could not surpass 130 CZK. In this price there is already all the taxation and it is therefore the final price for consumers.

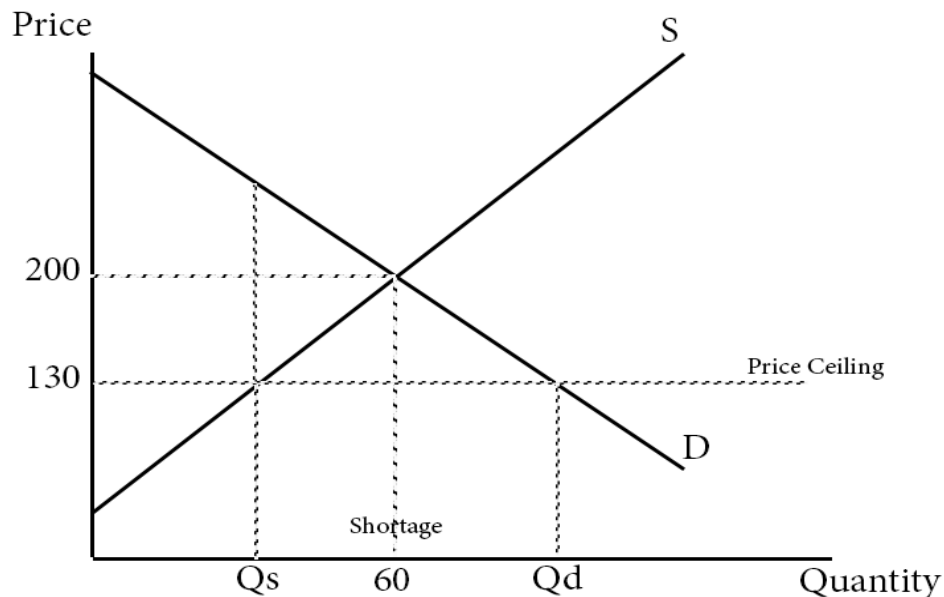


Figure 4 - Pricing Strategy

#### 4.3 Cost/Benefit Analysis of Legalization in Czech Republic

Costs and Benefits included in the study are:

- Repression Costs
- Healthcare Costs
- Income
- Externalities
- Individual Benefits from Use

#### 4.3.1 **Repression Costs**

These represent all the costs that the state has to put into fighting the cannabis black market and which would not be necessary after legalization. Among those which are considered as repressional costs are cost of police interventions, prevention programs, harm reduction, campaigns against drugs etc.

According to Czech Police Presidium there were 217 927 criminal acts in 2016 from which 2,6 % (5,564) was drug related criminal acts. 3,657 people were restrained in drug related crimes. 1662 of those were restrained because of cannabis related crimes, which represents 45,4 % of all drug offenses. Most of the penalty for drug related crimes was a probation (65 %).

In 2016, Police spent 903.5 million Czech crowns on fight against drugs in Czech Republic. Under the assumption that cost of one restriction is the same no matter what drug, the total money spend on cannabis related crimes were 410.189 million Czech crowns.

In addition to the police costs of fighting the drug problem, there are also costs of government and government institutions which are battling the drug problem. These are in total amount of 363,984 thousands of Czech crowns for the year 2016. These costs are mainly associated with prevention, terrain programs, harm reduction, education, administration etc. This amount of money is for all drugs and therefore it is impossible to know how much goes to cannabis only, but it is reasonable not to count this as costs but just made an assumption that after legalization these would simply transform into costs of information campaigns, education and anything related to government efforts to inform public about the possible risks of long-term cannabis use.

#### 4.3.2 **Healthcare Costs**

##### 4.3.2.1 Insurance

Healthcare costs include all the necessary cost associated with drug use, computed from the amount of money paid from insurance companies to drug related patients. In 2015 (the statistics for insurance company expenses are computed with a delay from insurance healthcare bills) were 1,707 million Czech crowns from which 562 millions were given to patients with problems caused by drugs other than alcohol.

According to (MRAVČÍK, V. a spol, 2017) the approximate margin of cannabis on the illegal drug market in czech republic is around 67 % therefore the total amount of money given to cannabis users will be calculate as if one percentage point of a drug market would receive the same amount of money as any other percentage point. It is highly unlikely in the real world because the cannabis is proven to be less harmful than other drugs but the assumption is made for the purposes of this study. Therefore the total costs of insurance companies regarding the cannabis use in 2016 were 367.5 million Czech Crowns.

#### 4.3.2.2 Automobile accidents

As for another healthcare costs, we must think about accidents caused while driving under the influence of cannabis. One of many reasons why the cannabis legalization is so controversial is that the expected rate of driving accidents caused while under the influence of cannabis would go high. In this section we are going to take a look at the statistics of accidents caused by drugs, we will predict the future rates of accidents in relation with Colorado's accidents rates after introducing the legalized cannabis in 2014 and then we will estimate the cost of these accidents.

According to the statistics of Czech Police Department (Ředitelství služby dopravní policie Policejního prezidia České republiky, 2017) in 2016 there were 98,864 accidents on the Czech roads with total damage of 5.8 billion Czech Crowns. 4,373 accidents were caused why under the influence of alcohol and 251 of accidents were caused while under the influence of illegal drugs. Out of these 252 accidents 10 of them had fatal consequences.



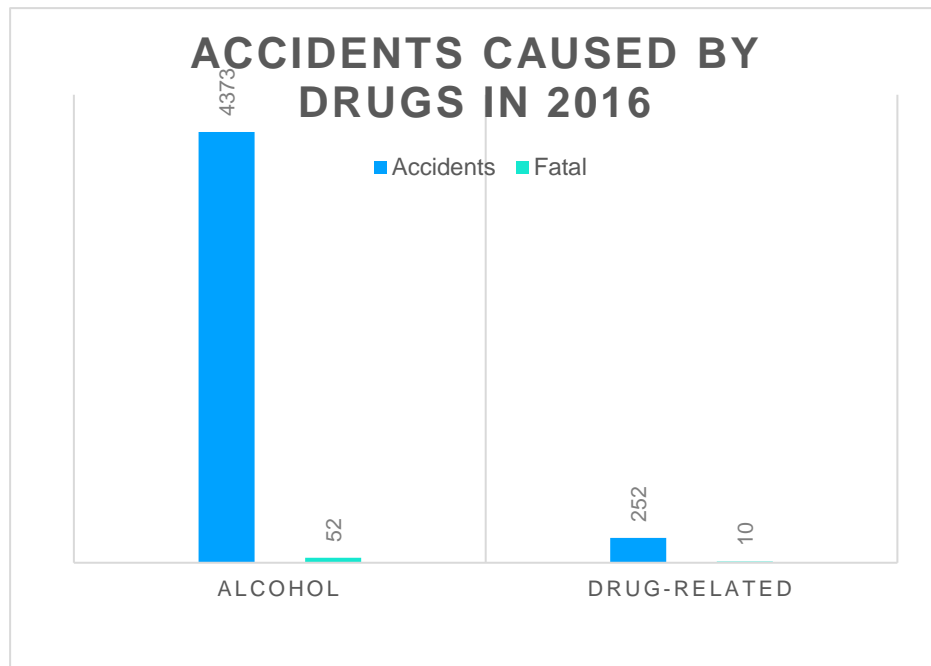


Figure 5 - Accidents caused by drugs in 2016

According to WashingtonPost (Washington Post, 2017a) the Colorado state had a slight increase of 3 % in a minor crashes after introducing legalization in 2014 but they did not experience increase in a fatal accidents. We can conclude that the legalization has a small, but significant impact on a minor, non-fatal crashes but there is no correlation between legalizing cannabis and deadly accidents. However it must be said that use of cannabis does increase chances of having a car accidents just like for example alcohol does.

While estimating the number of car crashes after legalization in the Czech Republic, since there is no annual reports on accidents caused solely by drugs, the assumption is that the number of fatal car crashes would stay the same, as it has been steady in the past years, and the number of accidents with no deadly consequences would go up by 3 %. From the trend we can then calculate that the predicted amount of car accidents under the influence of drugs will be 313 with 67 % accuracy.

Accidents Caused By Drugs		
Year	Total	Fatal
2011	149	8
2012	154	3
2013	213	10
2014	260	6
2015	301	12
2016	252	10
2017	258	10

Table 1 - Accidents caused by drugs

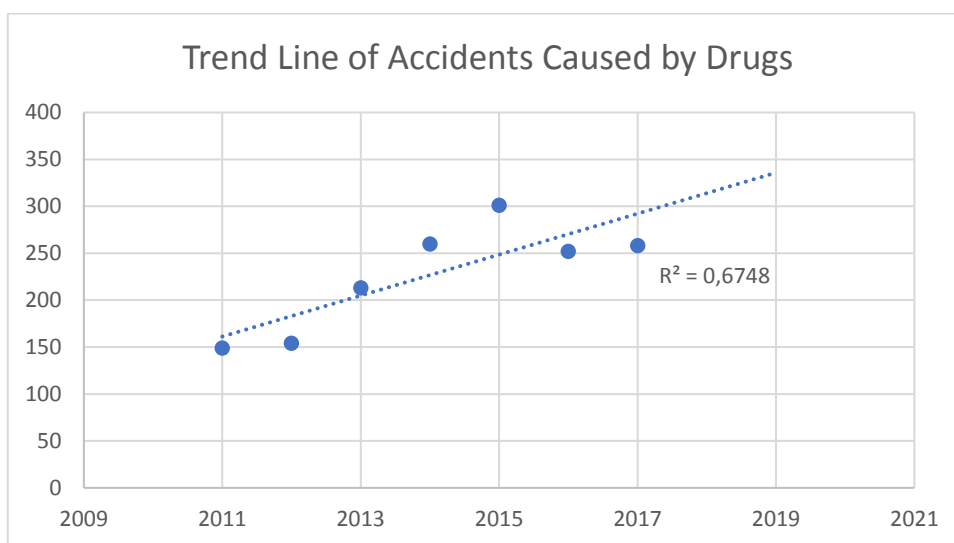


Figure 6 - Trend line of accidents caused by drugs

Let us assume that the increase in accidents would stay the same. While under this assumption the probable number of car accidents after legalizing is 313 of non-fatal accidents a year and 10 fatal accidents caused by drugs. According to the Czech judges and scientists from first medical faculty of Charles University (Válková, 2014) the price for society of one lost life of a healthy man is 10,051,200 Czech Crowns (in 2014). The amount was computed as a multiplication of monthly brutto wage with average length of work life. If we will have 10 casualties a year, the total cost of drug related car accidents will be 100,512,000 Czech Crowns.

According to the Czech police statistics 42 % of accidents caused by alcohol resulted in injuries and 5 % of accidents caused by alcohol resulted in serious injuries. Applying this scheme onto crashes caused by drugs, 109 accidents caused by drugs results in minor injuries and 14 of them has a serious injury as a consequence. The health costs of

a non-fatal accidents are already involved in the money insurance companies paid to the patients, via 4.3.2.1.

The average cost of a car accident in 2015 was 34,546 Czech Crowns (Aktuálně.cz, 2016). With 323 probable accidents from which 10 of them are fatal, the total material cost of the accidents would bring the cost of 11,158,358 Czech Crowns to the society.

### 4.3.3 **Income**

#### 4.3.3.1 Tax Income

If we would stay loyal to the Colorado in all of its parts, we would be looking at some interesting tax revenues. With the estimated market size of 60 tonnes sold per year and the estimated price of 130 CZK we are looking 1,170,000,000 Czech Crowns of the income tax revenue from the sales only.

The Colorado scheme is quite simple in regard of taxation. The Excise Tax is paid only during the purchase of supplies from dealer, not during the final sale. These numbers also do not include the VAT because in American system the VAT is added after the purchase as a simple percentage of the price. All of these factors would have to be considered while trying to apply this scheme onto Czech economy.

Estimation of a tax income generated from cannabis legalization after introducing excise tax. As established earlier, the final price for consumers should not exceed the 130 CZK line. However, because of the tax laws and tax system in Czech Republic, there would have to be some changes made. The VAT in Czech Republic would have to be included in the price which would lower the salesmen margins. The cigarettes and tobacco products in Czech Republic are subject to 21 % taxation of Value Added Tax (27,3 CZK out of 130 CZK). It would be reasonable to believe that cannabis products would be in the same category when legalized.

The Excise Tax would be subject to political decisions but there already is a proposition in setting the Excise tax for legalized cannabis around 30 CZK per gram. If we would apply this proposition into our scheme we would have already 57,3 CZK tax revenue out of every 130 CZK purchase, leaving the total tax rate at around 44 %.

The Excise Tax and the VAT put together, while the assumption of 60 tonnes a year market is still being used, would generate 3,432,000,000 CZK. 3.4 billion Czech crowns every year on taxes.

And in addition to this the Income Tax (company 19 % and individual 15 % of their profit) would be received by the government as well from the suppliers and middlemen.

#### 4.3.3.2 Income from issuing licences

There is also income from licence fees issued to the licensed dealerships, in this model pharmacies. In last year they were on monthly average (Colorado.gov, 2018) 1,075,000 USD which represents around 5,7% of the total annual tax revenue. Applying this scheme onto Czech economy the licence fees would generate 66,690,000 of those 1,7 billion Czech crowns every year.

According to (Mitchell, 2018) there is currently 509 retail dispensaries in the state of Colorado. With nearly 5.6 million inhabitants it makes it 10,886 inhabitants per one dispensary. Applying similar ratio towards Czech republic, there would be around 965 cannabis dispensaries in the Czech republic.

Since there are no significant extra costs to the distribution channel because in Czech Republic there are currently more than 2,700 pharmacies (SÚKL, 2017) and they do not need to purchase any special equipment nor they need a special training for their employees we will consider only their cost of purchasing the licences from the state. The cost of a licence, while sticking with the Colorado numbers would be 69,108 Czech Crowns per one licence per year per one pharmacy. This represents a small amount considering the potential increase of sales. Therefore the price will stay like this for purposes of this study.

#### 4.3.4 Externalities

##### 4.3.4.1 Negative Externalities

One of the main problems with legalization is the fear from increased use among younger population. In Colorado there are reports on decrease use of cannabis products among young people after the legalization. (Washington Post, 2017b) This represents a major problem in Czech Republic and it could be a very positive factor of legalization because Czech Republic is among first in the world when talking about cannabis use among under aged citizens.

Other studies suggest that there was no change or slight increase in cannabis use among younger population, especially high schoolers. (Khazan, 2017) The reason for this uncertainty is that there was not enough time for research because legalization is still something new in the world.

#### 4.3.4.2 Positive Externalities

One of the biggest positive externalities of legalizing cannabis is the fact that it would reduce or even completely eliminate the grey economy of cannabis production and distribution. All the subjects that are currently operating outside the law would either make their business legitimate or they would be forced to quit due to fixed lower price which would force them out of the market.

The benefits are computed as tax income, licence fees and reduced police cost for hunting down criminals.

#### Individual Benefits from use

There is no method to determine the individual benefits or costs of using cannabis, however users often argue that cannabis use helps them to relax, help with appetite issues, to relieve from pain, physical or psychological, and that it has a positive effect on their well being. These factors are not easy to monetize however they can be regarded as a social benefit.

### 4.4 **Criminality change in Colorado**

One of many reasons why legalization is so controversial is because of the fear from increase of crime rate after the drug is legal. In this section we are going to assess the criminality rate change after legalization cannabis in Colorado.

In a table below there are data on all the major crimes reported to local authorities in the state of Colorado.

Crime Reports in Colorado					
Year	Homicide	Forcible Rape	Robbery	Burglary	Vehicle Theft
2006	157	2030	3780	31793	20305
2007	150	1949	3397	28119	16353
2008	151	2026	3186	26597	12740
2009	169	2097	3310	25647	12182
2010	129	2168	3131	25769	11114
2011	156	2236	3313	25574	10938
2012	160	2055	3349	25673	11947
2013	172	2903	3147	24769	12396
2014	150	2961	3031	23134	12478
2015	172	3275	3321	23333	15932
2016	189	3512	3518	23515	19430

Table 2 - Crime reports in Colorado

As it can be seen from the trend from previous, the homicide rates had not experienced any major increase or decrease in relation with legalizing cannabis in the state of Colorado. The same can be said about rapes, robberies and burglaries. In vehicle thefts there is a significant change in the amount of crimes committed after the legalization.

#### 4.4.1 Homicide

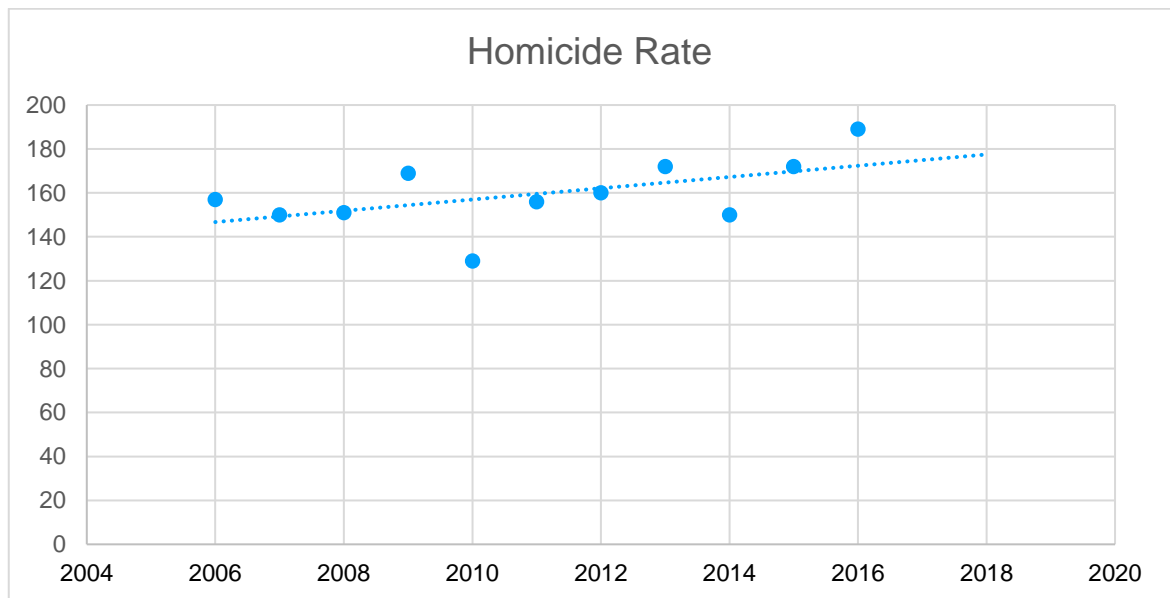


Figure 7 - Homicide rate trend

From the trend analysis of homicide rate there is no clear increase or decrease in homicides therefore we can state that the legalization in Colorado had no significant impact on homicidal rate.

#### 4.4.2 Forcible Rape

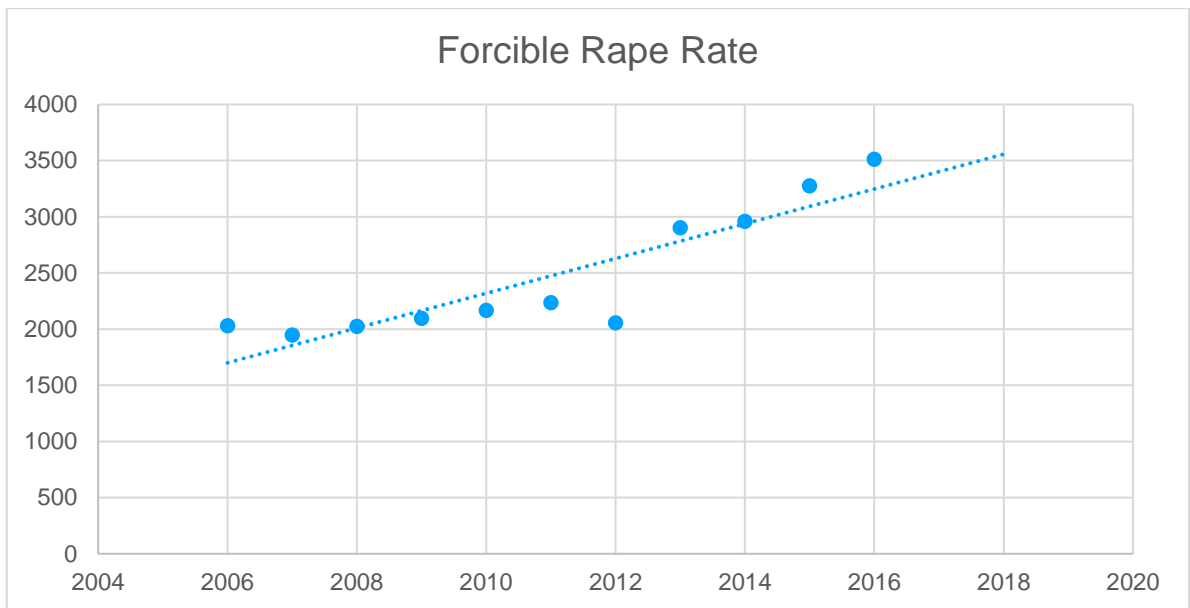


Figure 8 - Forcible rape trend

Like with homicides the rate of rape is following the trend from previous years. There had been a significant change before the legalization in 2013 but because it was before it is clear that the legalization had no impact on it and it is more deeper issue not related to cannabis use.

#### 4.4.3 Robbery

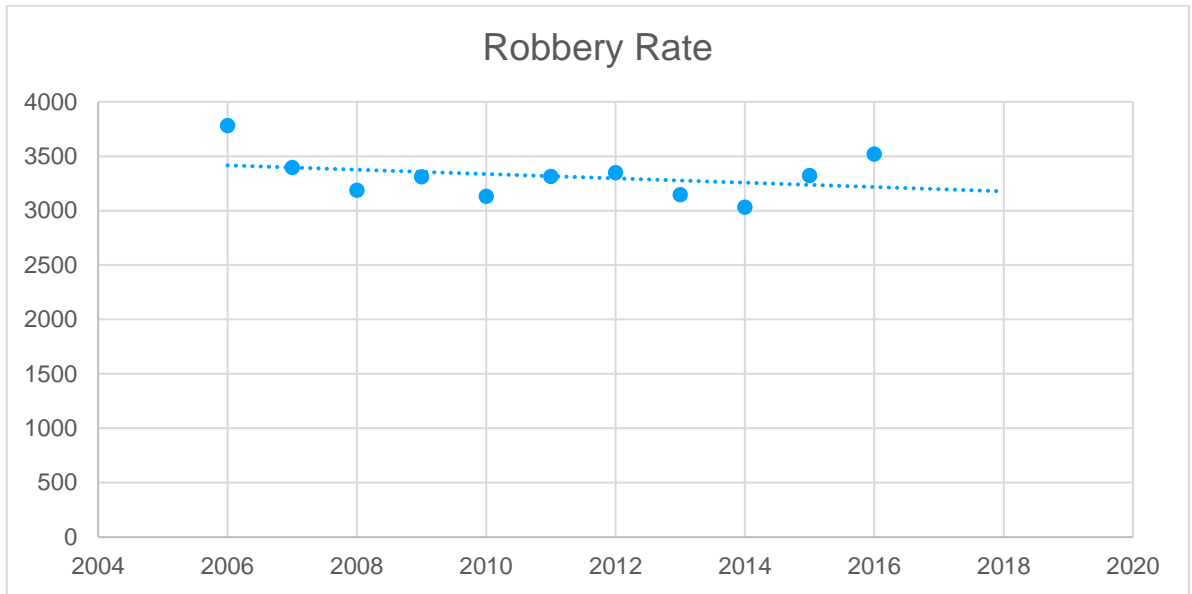


Figure 9 - Robbery rate trend

There is a slight increase of robbery rate after the legalization in 2014 but it is still within 10% of the trend therefore there is no reason to believe it has some correlation with cannabis use. But for this, more data are needed from years to come to safely estimate if it is the case.

#### 4.4.4 Burglary

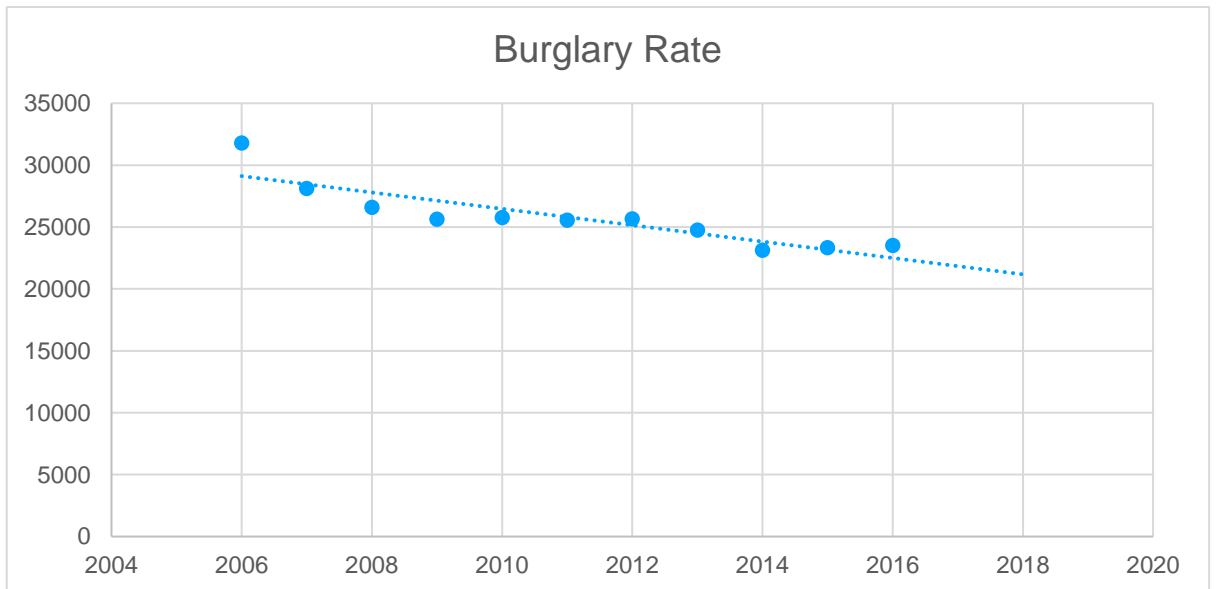


Figure 10 - Burglary rate trend



Legalization had no impact whatsoever on the number of burglaries in Colorado state. The rate is following current declining trend.

#### 4.4.5 Vehicle Theft

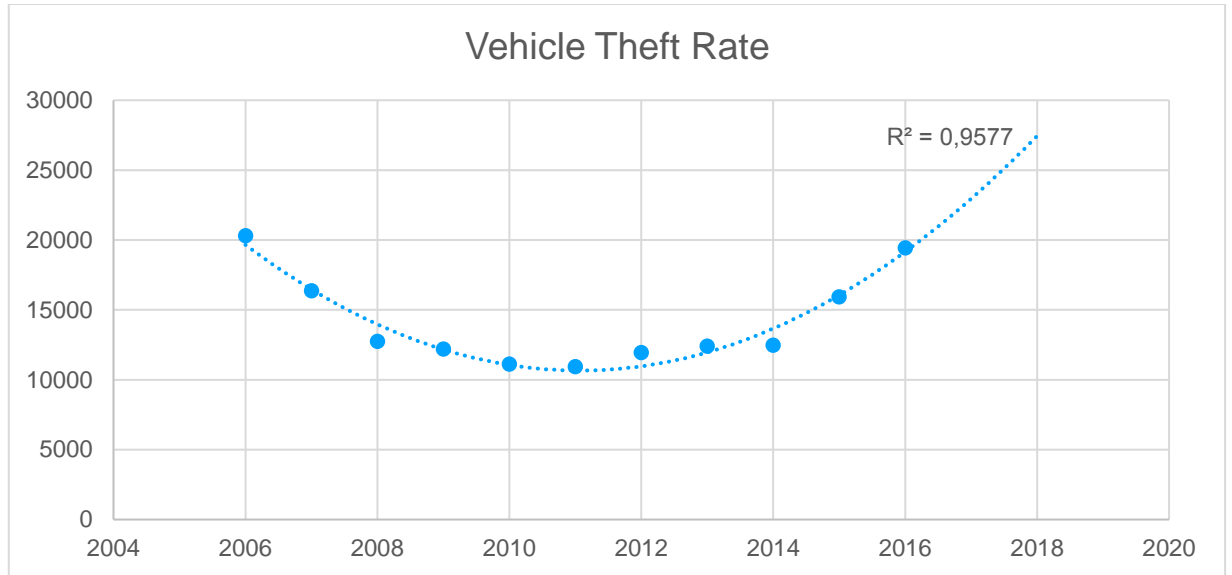


Figure 11 - Vehicle rate trend

The vehical theft rate rocketed after legalization in 2014. As it is seen from the trendline at a current rate the Colorado could have a serious problems with car thefts. The polynomial function was used to illustrate the increase as it follows the data almost perfectly with coefficient of determination at 95,77 %. There is no reason to believe the car theft rate would go over 30,000 per year as it has never happened before, the local authorities are already dealing with the problem by enforcing the rules with higher penalties and deploying more policemen to guard the property of its citizens. But it can illustrate up to where the number of thefts can go in the next 1 or 2 years.

There is no reason to believe that this rapid increase is solely thanks to the legalization proces but it is certain that it has some effect on it. This represents a major issue with legalization.

#### 4.4.6 Conclusion on Criminality change

As it can be seen from the graphs above the criminality rates in homicides, rapes and burglary follows the trends set from previous years. There was no significant change after introducing the legalization of cannabis in the Colorado state. On the other hand there is quite significant increase in vehicle thefts. From 2014 to 2016 the vehicle thefts increased by 55 % which is a massive increase. Following this trend the car thefts in Colorado would go up to 27,000 a year by year 2018. The legalization might not be an only factor here but it certainly had some impact on these numbers. The number of robberies went up slightly but it is still around the trendline set from previous years.

There are also reports on decrease use of cannabis products among young people after the legalization. (Washington Post, 2017b) This represents a major problem in Czech Republic and it could be a very positive factor of legalization because Czech Republic is among first in the world when talking about cannabis use among under aged citizens.

## **4.5 Application towards Czech Economy**

### **4.5.1 Total Social Cost**

The money spent by insurance companies on patients related with cannabis use problems are 367.5 million Czech Crowns.

The estimated cost of cannabis related fatal car accidents were computed as 100.512 million Czech Crowns.

The material costs of drug related accidents were estimated at 11.158 million Czech Crowns.

Cost of the informational campaigns and all the necessary educational activities are 363.984 million Czech Crowns.

The total social cost of legalizing cannabis for recreational use are 843.154 million Czech Crowns.

### **4.5.2 Total Social Benefits**

The estimated income from taxation is 3,432 million Czech Crowns.

The estimated income from issuing licences is 66.69 million Czech Crowns.

The money that Czech Police had to put into fighting cannabis use in 2016 was 410.189 million Czech Crowns. This money can now be used for different purposes.

### **4.5.3 Cost/Benefit**

All put together the benefits of legalization were 3,908.879 million Czech Crowns while the costs of legalization were 843.154 million Czech Crowns.

In total 3,065.725 million Czech Crowns would come into the economy from legalization of cannabis for personal use in the first year.

#### 4.5.4 Monte Carlo Analysis

**Forecast: Profit**

**Cell: G4**

Summary:

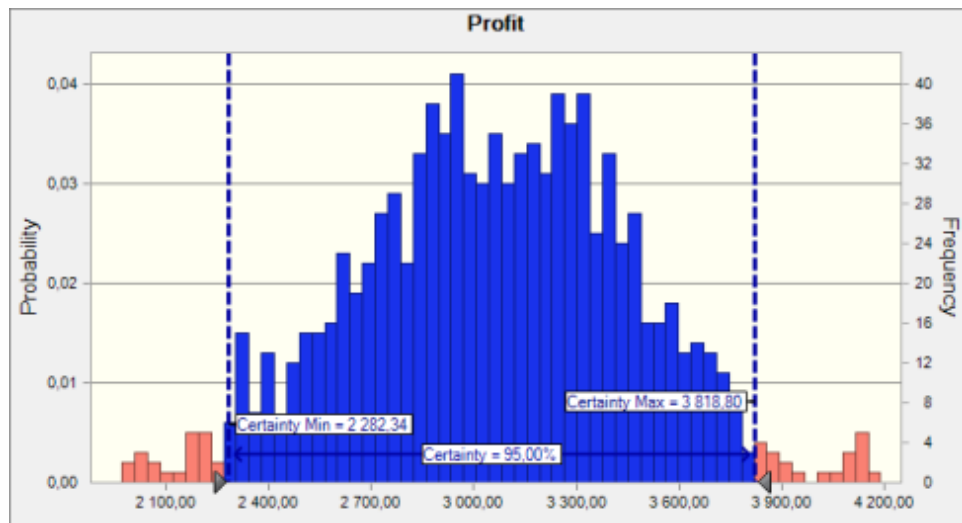
Certainty level is 95,0%

Certainty range is from 2 282,34 to 3 818,80

Entire range is from 1 634,41 to 4 291,47

Base case is 3 065,73

After 1 000 trials, the std. error of the mean is 12,71



Statistics:	Forecast values
Trials	1 000
Base Case	3 065,73
Mean	3 062,53
Median	3 065,17
Mode	---
Standard Deviation	402,02
Variance	161 619,90
Skewness	-0,0317
Kurtosis	2,99
Coeff. of Variation	0,1313
Minimum	1 634,41
Maximum	4 291,47
Range Width	2 657,06
Mean Std. Error	12,71

Figure 12 - Monte Carlo analysis

From the Monte Carlo analysis provided by Oracle analytical tool Crystal Ball, the assumed benefits in the first year of legalization, assuming it would take place in the next

year, would be with 95% confidence level between 2,282.34 to 3,818.8 million Czech Crowns.

As it is seen from the data above, the number of repetitions were 1000.

### **3-year forecast**

By comparing the rate of income in Colorado to Czech Republic and assuming the rate of income would follow similar pattern like in Colorado state, the income of the state in the first year would be 3,065.725 million Czech Crowns, in the second year it would grow up by 48,5 % to 4,552.601 million Czech Crowns and in the third year after legalization the income would increase by 16 % to 5,281.017 million Czech Crowns. The total income in the first 3 years would be 12,899.343 million Czech Crowns.

Since the costs are annually repeatable the total cost of legalization process in the first three years would be about 2,529.462 million Czech Crowns.

$$NPV = \sum CF_t / (1+r)^t - \text{Cost}$$

$$NPV = 12,899.343 / (1+0)^3 - 2,529.462$$

$$NPV = 10,369.881 \text{ million Czech Crowns}$$

Assuming the trend would be similar like in Colorado, in the first 3 years, the Czech state could get up to 10,369.881 million of Czech Crowns from introducing legalization process. And even after 4 years after legalization in Colorado, the income is still growing.

## 5 Conclusion

To conclude this thesis, we would have to get back to the very beginning and answer the question asked. Would it be profitable and beneficial for the state of Czech Republic to follow the current trend and legalize cannabis for personal recreational use?

As established in the beginning of this thesis, the main focus was on the economical aspect of this policy. And from economical point of view it is definitely beneficial for Czech economy to introduce such policy. After subtracting all the costs from expected benefits and using Monte Carlo method with 1000 repetitions and 95 % confidence interval to obtain the most probable real-life situation, the amount of money that would come into the economy is between 2.2 and 3.8 billion of Czech Crown in the first year. In the first 3 years, the expected income, assuming the revenue rate would be similar to Colorado's model, the legalization could generate around 10 billion of Czech Crowns of tax and additional income to the state. This money could then be used to improve the life of public, build new infrastructure, schools, hospitals, etc. As far as the question posed in the beginning of this work, it is safe to say that the answer was found, and it is a positive one. Apart from the state income there are other benefits associated with the process of legalization, such as the fact that it would help our country to get rid of the part of grey economy associated with cannabis production and distribution, also there has been cases of positive impacts of recreational use on general psychological well being of a person. On the other hand, there are many issues with cannabis legalization. Cannabis is often taken as gateway drug for other, more harmful substances. The increased use could lead to higher heartattack rate and other cardiovascular diseases as the most common use of cannabis is smoking. It could also be easier for underage people to acquire the drug, leading to higher use among young adults. However, there are reports from Colorado that the legalization had the opposite effect, leading the rate of use among young adults down. The big problem could be the massive increase in vehicle theft rate that Colorado experienced after introducing the legalization in 2014. There are currently no data or studies that are addressing the correlation between car theft rate and legalization, but the increase is there and therefore it cannot be ignored.

There are also a lot of legal issues that would have to be addressed, such as the laws, age restrictions, penalties for breaking the law etc. A lot of these could be similar to alcohol (such as driving under the influence) or tobacco laws that are already in the Czech system. This thesis is mainly focused on the economical issues with the process therefore it was not addressed as much as it would have to be when introducing the legalization in a real life.

Legalization process is a very complex solution to a problem that modern society in the 21<sup>st</sup> century is facing. There are many variables that have to be taken into consideration. The legal issues, the health risks, the criminality change as well as cultural customs and ethical issues. The truth remains that economically it is undoubtedly very profitable for the society. The current policy of repression is not working, the Czech Republic is still among the nations with the highest potency to use cannabis products while giving a lot of money trying to prevent people from using it. Both government and society can benefit economically from legalizing cannabis products and invest the money somewhere, where they are needed.

Taking all of the above into consideration, I believe that legalization has more benefits than it has costs and economically it makes perfect sense to legalize and tax the production and distribution of cannabis for recreational use. Having said that I still think that Czech society is not ready for introducing the process and I think it will take another 5 to 10 years. But I think it is a good thing because it will give us time to prepare the legislation with care, it will give us time to embrace the problems that are associated with legalization, such as drug tourism, and get ready for them in advance.

The main purpose of this study was to determine whether the legalization makes sense economically and to serve as a starting point for further research on this topic. The next step would be to eliminate the research limitations and conduct a survey involving the general public with ethical approval and determine whether Czech people would encourage the legalization process, or they would be strictly against it. Because the final decision will be on our politics, and if the people do not want it, then no political party will ever do it. And from an economical point of view, it would be a lost opportunity.

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