

Undergraduate Thesis

Literature review- marijuana legalization effects in social and economic variables

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Table of Contents

Introduction.....	3
1. Objectives	5
1.1 General Objective.....	5
1.2. Specific Objectives:.....	5
2. Methodology.....	6
3. Country situation analysis	6
4. Theoretical Framework	11
4.1 Gateway effect towards other substances.....	11
4.2 Marijuana Price elasticity.....	14
4.3 Cocaine and other stronger drugs price elasticity	19
4.4 Cross elasticities between Marijuana and harder substances	21
4.5 Marijuana liberalization socioeconomic effects.....	22
5. Concluding Remarks.....	25
References	28

List of Figures

Figure 1. Legalization vs Decriminalization	7
Figure 2. Gateway Hypothesis.....	12

List of tables

Table 1. Marijuana Price Elasticities.....	15
Table 2 Cocaine elasticities	20

Introduction

Considering the information presented in the World Drug Report published by the office of drug and crime from the United Nations (United Nations, 2021), the number of Cannabis users has increased by nearly 18% during the last decade. In this order of ideas, in 2017, around 183 million people worldwide consumed drugs in the previous year, in 2019, this number reached 200 million and kept on getting bigger until this day, when 285 million people used cannabis in the last year and more than 36 million of these people suffered from consumption disorders in 2021.

Another relevant point that reflects the relevance of this topic, is how Cannabis based products have been changing its composition and becoming more potent (ElSohly et al., 2016). There's also evidence that fewer young people see it as harmful or realize the actual consequences of its consumption a trend that risks increasing the negative impact of cannabis on younger generations (Ashton, 1999). Given this behavior in younger populations described above, (Järvinen & Demant, 2011) analyzed the normalization of cannabis use among young people. They based their study on a data collected from interviews conducted on young people followed from when they were 14-15 years old in 2004 until they were 18-19 years old in 2008. Their general results conclusion is that during this period, participants had an attitude shift towards cannabis use, by becoming more predominately positive and accepting, which they define as a "normalization" of cannabis use. In addition to this, it is important to highlight how the "trend" described above can have an increase effect in the demand and consumption of more harmful and dangerous drugs, what is called the "getaway hypothesis" (D. Kandel, 1975; D. B. Kandel et al., 1992; D. B. Kandel & Adler, 1982).

Given the growing normalization marijuana consumption has acquired, and the increase in its prevalence of use, some countries have made the decision to put in play liberalization policies for the cannabis market. At one side, Uruguay applied a total liberalization of the substance, for both supply and demand, and other governments have

focused on legalize and/or decriminalize either or both the medical or recreational uses, like some states in the United States and countries in Europe, among others. Market liberalization policies remain to be controversial, for which researchers have taken efforts to measure the positive and negative effects in different cultures and contexts.

Thus, it is important to highlight the positive and negative effects that have been found in the literature on marijuana legalization. Beginning with the possible positive consequences, (Donohue III et al., 2011) affirm that a decrease in the violence generated by the black market (murder and violence of illegal drug dealing) is to be expected, accompanied by cost reduction of criminal justice enforcement. Another positive effect has to do with the amount of tax revenue (Miron, 2005) that can be invested in education, sports, and other programs to treat addiction. In addition, there can be a control on the quality of products, as well as labels that inform about the active components and the consequences of cannabis consumption. Another important issue is that young people would not have a criminal record (Jacobi & Sovinsky, 2016), which would eliminate the cost that this represents in society and that sometimes is an obstacle to access the formal labor market.

Among the negatives is a price drop of the substance, given the elimination of many transaction costs involved in illegality (Becker et al., 2006) and therefore an increase in consumption; this is considered as a market failure, for which given the case, governments have to intervene, imposing taxes (Donohue III et al., 2011; Jacobi & Sovinsky, 2016), licenses or quotas (Thomas, 2019). This is related to the increase in the cost related to abuse and the higher number of addicts, especially among young people. In addition, since the 1990's, the question whether access to marijuana brings with it an increase in the consumption of other hazardous substances has been raised (DeSimone, 1998). This has been referred in the literature as the gateway hypothesis.

Given the latter, marijuana legalization has become nowadays a very controversial topic among different countries and states. This is because according to several economic, health and public well-being studies analyzed below show that marijuana legalization and decriminalization can have diverse effects in society. All in all, in order to identify and analyze the effects marijuana legalization can have in different economic and social variables, it is imperative to develop a literature review that compiles theoretical and empiric information about the effects that have been observed in countries and states that conducted either a legalization or decriminalization and the potential effects that this measure can have in economies and societies that are in the process of evaluating this liberalization approach.

1. Objectives

1.1 General Objective

Revise the literature available to classify and analyze the effects marijuana legalization can have in economic and social variables, which include the increased consumption of this substance, the increased consumption of stronger drugs, and what is the role of public policy to compensate for the negative externalities marijuana liberalization policies can bring.

1.2. Specific Objectives:

- Detail the countries that have applied marijuana liberalization policies and the way the supply and demand of this substance is regulated.
- Compile information available in the existing literature about the marijuana and cocaine price elasticity of demand as well crossed-price elasticities for other harder drugs.
- Validate with different academic information sources the denominated Gateway effect, which states that marijuana acts as an access door to initiate consumption of stronger drugs, for which its legalization can cause an increase in consumption levels of other riskier substances.

- Analyze public policies and their impact on cannabis legalization effects, specifically in socioeconomic variables.

2. Methodology

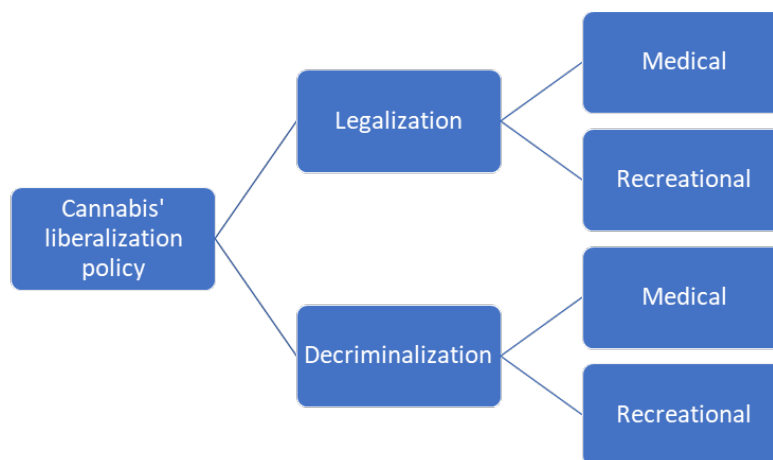
To conduct a complete literature review that allows to identify the effects that marijuana legalization can have over different socioeconomic variables, exhaustive bibliographic research will be done, collecting data and information from legit data sources such as: Science Direct, EBSCO, Willey, Springer, JStor, WoS, Scopus, among others for which EAFIT has subscription. This way, the intention is to collect from high quality academic journals the greatest amount possible of articles that include significant information about the topics mentioned previously in the specific objectives.

As information and results of previous conducted research are collected, data will be stored and organized and classified by topic, specified in the theoretical framework, which are price elasticities of demand and price-cross elasticities, to evaluate the effects that price changes can have in marijuana and other illicit drugs consumption levels, to validate the Gateway hypothesis. In addition, information about liberalization policies applied in other countries will also be included, along with the socioeconomic effect these policies can bring.

3. Country situation analysis

It is pertinent to define the diverse ways in which cannabis liberalization policies can be applied, to fully understand what the advantages are, as well as the limitations of each, and the potential socioeconomic consequences they can bring. Figure 1 illustrates the two ways different countries apply liberalization policies:

Figure 1. Legalization vs Decriminalization



Source: own elaboration based on (Nkansah-Amankra & Minelli, 2016a).

According (Nkansah-Amankra & Minelli, 2016b)¹, legalization is the scenario where a substance once banned by the law, becomes permissible to use, without being convicted or fined. However, this act can have some restrictions to control the substance supply and demand, like imposing a minimum age to purchase, a maximum amount someone may carry or possess, requirements for suppliers to have licenses and among others. Decriminalization is when criminal sanctions are suspended against using or possessing a certain substance. Nevertheless, the drug remains to be illegal, and its use or possession is punished by other means such as civil fines, drug education, social work, and others. Finally, when a drug is decriminalized, dealing, selling, and producing it remains to be completely illegal and offenders will be prosecuted to the full extent of the law (Turnbridge, n.d.).

According to (Global Cannabis Report, 2021), seventy countries around the globe have legalized cannabis for some form of medical purpose, which from 26 give patients legal access to high THC products. In addition, 10 countries have legalized marijuana use for adults, from which 6 of them have established regulating distribution systems. In this order of ideas, it is evident that cannabis regulations differ from country to country. Some

¹ <https://www.turnbridge.com/news-events/latest-articles/decriminalization-vs-legalization/#>

countries, such as some US (Use States) (legal-adult use states) and Canada have been developing fully regulated markets, where there is a fully taxed and regulated framework for retail distribution of a wide variety of cannabis products for adults. Some other countries, such as Georgia and South Africa, have opted to take decriminalization methods, allowing individuals to cultivate and possess a certain amount of marijuana only for personal use. Finally, countries as Spain and Netherlands are well known for their cannabis legalization policies, which include the legalization of the market through retail and businesses that allow purchasers to consume the substance on site. Most countries that have started a slighter cannabis liberalization approach do so by adopting a framework that allows adults to use the substance only for medical purposes and under a medical prescription.

As mentioned before by (Haffajee & Mauri, 2021), marijuana regulation frameworks have been subject to changes in the law in several states across the United States, eighteen of them by decriminalizing use and possession of cannabis, 38 legalizing commercialization of medical cannabis and sixteen states legalizing both medical and recreational marijuana (Health Affairs Health Policy Brief, 2021). All in all, there are approximately 145 million Americans combined living in these eighteen where cannabis adult-use is permitted and 236 million Americans living across the 38 other states where medical use has been legalized, which means that in terms of percentages, 44% of the American adults have access to adult-use marijuana and more than 70% have access to legalized medical cannabis (The Global Cannabis report, 2021).

(Miron & Zwiebel, 1995), after observing study cases where cannabis has been legalized such as in states as Colorado and Washington, concluded taxation and revenue generation have become one of the principal political and economic arguments for legalizing Marijuana. However, although taxation to different sections of the supply chain of this substance can represent high government revenues, states with legal markets have established a wide range of tax rates ranging between 3.75% to 37%, which indicates that policy makers use taxes differently to control and regulate this market. Some states such as Washington is inclined into collecting profits from this by taxing all areas of the

supply chain by 37%, other states such as Massachusetts may be inclined to keep their tax rate low to 3.75% (Hansen et al., 2017).

However, marijuana remains still to be an illegal substance at the federal level, which means that consuming, producing and possessing it violate the drug federal laws (DEA, 2022). It is classified as a Schedule I drug in the Controlled Substances Act, given that the central government considers it is a high-risk substance given its high potential of abuse and it's no currently accepted medical use. In this order of ideas, all the states that have taken liberalization policies on recreational and/or medical marijuana, have done so against the federal law, but sticking to the right in the constitution that each state can create its own laws and have full authority of their government. Considering this situation, the Cole Memorandum was issued by the Department of Justice in 2013, which stated that the Department of Justice would not be against state marijuana legalization or decriminalization laws of each state, but it was revoked in 2018 by the attorney General Jeff Sessions² (Turnbridge, n.d.).

In 2018, Canada became the first G-7 country to fully legalize medical and recreational marijuana, and since then it has become the leader in the global cannabis market, where domestic cannabis sales through regulated outlets surpassed \$2.5 billion in USD and are expected to reach \$5.5 billion in 2025. (The Global Cannabis report, 2021). Canada is home to the biggest licensed producers in the world, which some of them are currently valued in billions of dollars and are conducting infrastructure and supply-chain investments into other cannabis companies worldwide to globalize their production and sales in newly legal markets. In this order of ideas, Canada is projected to continue to be the world's largest cannabis exporter through 2025, with Licensed producers being present in more than 20 countries.

² <https://globalcannabiscompliance.bakermckenzie.com/2020/01/06/the-sessions-memorandum-two-years-later/#:~:text=January%204%2C%202020%20marked%20the,%2Dcompliant%20marijuana%2Drelated%20activity>

Europe, with around 44.8 million cannabis users in total, has been home of several cannabis regulation reforms, with almost 30 countries granting patients with access to cannabis medical prescriptions, adding up to approximately 107,000 medical cannabis patients according to 2020 annual estimates by (The Global Cannabis report, 2021). The Netherlands is the most well-known country in Europe for his full liberalization policy, which allow people to purchase medical marijuana at regular pharmacies and grants access to recreational cannabis to adults through unregulated coffee shops, where adults can both buy and consume marijuana without going against the law.

Even though Cannabis remains to be federally illegal in Spain, there are 4.2 million cannabis users that get their product from the illegal market or by joining unregulated cannabis social clubs (Global Cannabis Report, 2021), which have become extremely popular among locals and tourists. Cannabis social clubs are private and non-for-Profit establishments where it member can legally join to produce and consume cannabis. According to (Murkin, 2014), cannabis social clubs (CSC) serve as a way of legalizing cannabis but not its wholesale commercialization, which have many social advantages such as promoting responsible consumption among members. In addition, by applying this non-commercial approach, profit motivation efforts disappear as cannabis producers will not have incentives to maximize their profits by encouraging people to initiate or consume more.

As presented in (The Global Cannabis report, 2021), Latin America is home to approximately 16.4 million cannabis users, according to annual estimates from 2020 that include users from both legal and illicit markets. Uruguay was the first country of the region to legalize adult-use cannabis in 2014, through a policy reform driven by the government, with the purpose of reducing violence related with drug trafficking and to take advantages of cannabis medical uses. To regulate the market, the Uruguay's government have a strict framework to control cultivation, processing, and commercialization of both recreational and medical marijuana. In addition, to have access

to legal marijuana, the government requires consumers to register to purchase from pharmacies, clubs or other dispensaries.

Most recently, in 2021, Mexico joined the list of countries to legalize adult-use medical and medicinal marijuana, when it's supreme court eliminated federal prohibition of use of medical and recreational cannabis. As reported in the (Oscar Lopez, 2021)³, the measure will allow Mexicans to consume marijuana, apply for permits to grow small number of plants at home and grant licenses to farmers and commercial growers to commercialize their product. Given the country's big population of approximately 120 million people, Mexico could potentially become the largest marijuana market in the world. Finally, Colombia has become a focus of attention for the global cannabis industry, as main companies in the industry consider Colombia has a great potential to become a medical cannabis exporter. This is because Colombia can offer low costs of production, natural ideal growing conditions, and experience hand labor to cultivate crops and export the product at a fraction of the cost of countries such as Canada (The Global Cannabis report, 2021).

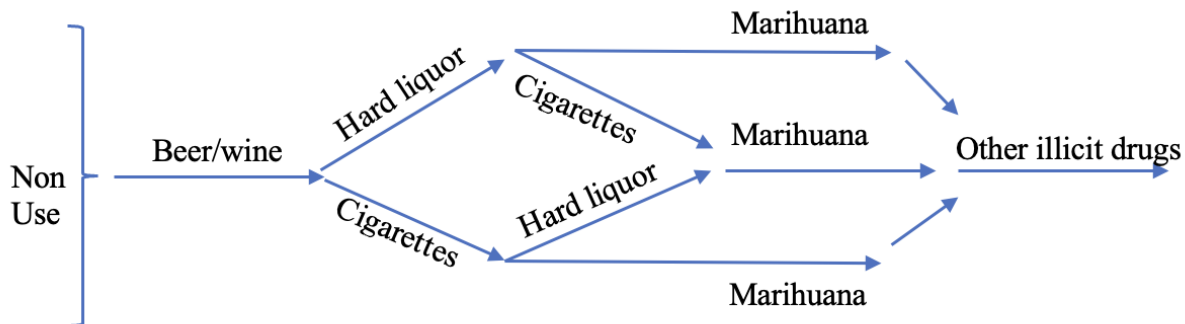
4. Theoretical Framework

4.1 Gateway effect towards other substances

The gateway hypothesis has been studied since the 1970's. (Kandel, 1975) proposed a model for involvement in drug use based in four stages: beer or wine; hard liquor or cigarettes; marihuana; and other illicit drugs (see Figure 2). The evidence suggests that these stages are culturally determined. The author argues that some of the youths who smoke, or drink continue to use marihuana, and some of the marihuana users progress further to use one or more other illicit drugs through adulthood. The empirical research found that marihuana use is a crucial step in the induction into illicit drug use (cocaine, methamphetamine, and heroin).

³ New York Times.

Figure 2. Gateway Hypothesis



Fuente: (Kandel, 1975)

Continuing the study of the Gateway hypothesis, (Kandel et al., 1992) whereas progression to illicit drugs among men is dependent upon prior use of alcohol, among women either cigarettes or alcohol is a sufficient condition for progression to marijuana. In short, the basis for the hypothesis is found in the common empirical findings that most users of more dangerous drugs started with drugs considered to be less dangerous (such as cannabis) and seems to be a staircase (Melberg et al., 2010).

Continuing the study of the Gateway hypothesis, (Kandel et al., 1992) reiterate how there is a sequence pattern between the consumption of legal substances and the transition to illegal substances. Likewise, using a longitudinal database that has been followed up from 15 to 35 years of age, they obtain differentiated conclusions by gender. The main finding is whereas progression to illicit drugs among men is dependent upon prior use of alcohol, among women either cigarettes or alcohol is a sufficient condition for progression to marijuana. It's important to highlight that the first substances they try are wine or beer. In addition, there is a low probability that young people consume marijuana without previously drinking alcoholic beverages and/or smoking cigarettes. Finally, "very few adolescents try illicit drugs other than marijuana without prior use of marijuana" (p:447).

This pattern isn't exclusive to the US (Kandel & Adler, 1982). Comparatively analyze the behavior towards the consumption of illegal substances in France in relation to the United States. They first find that consumption rates are lower in France, but that there are similarities in the way they engage in illicit drugs. Again, the observed sequence corresponds to four categories:

1. Beer/wine,
2. Distilled spirits and/or cigarettes,
3. Marihuana
4. Other illicit drugs.

In addition to the above, the authors address the issue of the relationship of adolescents with their peers and their parents. They point out that in adolescence, young people are uprooted from family values and are influenced by other young people (peers), based on the socialization theory (Kandel & Adler, 1982). In this regard, peers' alcohol use is presumed to be a direct cause of peers' marijuana use. Also, "peer marijuana use is assumed to affect the adolescent's attitudes about marijuana as well as actual use of marijuana" (p:301). Something important that the authors highlight is that the consumption of alcohol by an adolescent or his friends does not have a causal effect on the progress to the use of marijuana. But the consumption of alcohol by the young person, however, can develop a positive attitude towards the consumption of other illicit substances. These attitudes, on the other hand, are decisive in the subsequent use of marijuana.

In the same way, (Nkansah-Amankra & Minelli, 2016b) also found that gateways drugs used in early adolescence were significantly associated with marijuana use, illegal drugs, and cocaine in older adolescence, but over time these relationships were not consistent in adulthood. Complementing the above, (Fergusson et al., 2006) analyzed the association that frequent cannabis use has with other illicit drug consumption. Results suggest that the frequency of use of this substance is significantly associated with the use of other illicit drugs, which support the general causal model of the cannabis gateway hypothesis.

Nevertheless, the actual mechanisms underlying this hypothesis, and whether these causal mechanisms are direct or indirect, remains to be a subject of study.

Advancing in the analysis and considering those described in the previous paragraphs, the opponents to the legalization of the recreational use of marijuana, argue that the increase in the consumption of this substance may be the gateway to the use of illegal drugs more harmful. (Sabia et al., 2021) findings suggest strong evidence that the legalization of consumption generates an increase in the consumption of the same substance, but the impulse to the consumption of heavier drugs is almost null. On the other hand, (Anderson & Rees, 2021) considers that in theory, the legalization of marijuana should increase both its demand and supply, unambiguously leading to an increase in consumption (p:9). However, (Anderson et al., 2019) found that the legalization of marijuana for recreational use brought an 8% decrease in the probability of any use of marijuana in high school students and a 9% decrease in the probability of frequent use of it. This argument is based on the fact that it is more difficult for young people to access this substance when there are official distributors with a license for sale. In contrast, (Hollingsworth et al., 2020) found for the US that recreational laws increase past-year marijuana use by 25% among adults and by 10% among adolescents.

As mentioned, the gateway hypothesis suggests that legalizing marijuana should, in a causal sense, increase the use of other illegal harder drugs. (Hollingsworth et al., 2020) found that there is an association between the legalization of marijuana for recreational use and cocaine use. Specifically, the authors find that recreational use laws had no effect on the use of legal substances (alcohol and cigarettes). However, they do find an increase in the consumption of cocaine in adults of 10-12%. (Kelly & Rasul, 2014a) also finds that the use of marijuana leads to the consumption of other drugs that are classified as type A, among which is cocaine, suggesting that these two drugs (cocaine and marijuana) are complements.

4.2 Marijuana Price elasticity

Marijuana consumption factors have been analyzed from different areas of study, and even more during the last few decades when global consumption has been significantly increasing as mentioned before with data from the United Nations Office on Drugs and Crime (UNODC). From the economic point of view, research has been done to demonstrate how much the price factor can affect the consumption level of the substance. To measure this effect, the microeconomic concept of Elasticity of Demand is utilized to indicate in percentage levels how much consumption decreases given a one percent price increase in the substance. This concept is important to understand the effect in consumption given a legalization or decriminalization approach along with the price drop of the substance that this entails. Table 1 includes the price elasticity of Marijuana, estimated by several authors in different countries using a variety of methods and research people samples.

Table 1. Marijuana Price Elasticities

Author	Country of research	Estimated Elasticity
(Davis et al., 2016)	USA	-0.67
(Nisbet & Vakil, 1972)	USA	-0.4
(Kilmer et al., 2014)		-0.69
(van Ours & Williams, 2007)	Australia	-0.7
(Grossman, 2005)	USA	-0.26

Source: own elaboration

As mentioned by (Davis et al., 2016), estimating the elasticities for illicit goods such as Marijuana and other illegal substances, is a complex process given the nature of the data recorded for this purpose. In this order of ideas, the data collected and used in most of the studies that will be described below is gathered through surveys asking participants

about their Marijuana consumption habits. Given the latter, prevalence and probability of Marijuana use is estimated based on socioeconomic variables such as race, age, and gender more than based on policy or economic variables such as price. Also, some authors argue how the possession's decriminalization has an important effect.

(Nisbet & Vakil, 1972) was one of the first studies to estimate Marijuana price elasticity. They analyzed the Marijuana consumption habits using an anonymous mail questionnaire received by 926 students from UCLA. According to the data collected from this survey, 52.8 percent of the sampled claimed that they have never tried Marijuana before, classifying themselves as "non-smokers", and 47.2 percent answered they have tried Marijuana before and were classified as smokers. In addition to that, they gathered more information about the 437 "smokers" purchasing habits, from which 184 said they were purchasers and the remaining 253 claimed that they have never purchased Cannabis, and that they obtained it only from friends. Furthermore, purchaser students reported how much marijuana have they purchased at regular prices and how would their consumption vary given a random price change.

(Nisbet & Vakil, 1972) utilized Ordinary Least Squares method to estimate the Marijuana price elasticity. They employed both the logarithmic function form as well as the linear form to estimate the quantity of Marijuana demanded per month based on its price and their monthly total expenditures, as can be observed in the following models:

$$(1) \text{Log}(Q_M) = b_0 + b_1 \text{log}(P_m) + b_2 \text{Log}(E) + b_3 \text{Log}(S) + e$$

$$(2) Q_m = C_0 + C_1 P_m + C_2 E + C_3 S + d$$

Where Q_M is the quantity of Marijuana in ounce of dried Marijuana (lid) per month, P_m is the price of Marijuana in \$/Lid, E is the mean total expenditures in dollars and S is the expenditure dispersion measure. The b_s and C_s are the parameters to be estimated in the double log and linear form respectively. For model (1), the price elasticity of demand

is simply b_1 given its logarithmic form, whereas for model (2), the price elasticity of demand is estimated in the following way:

$$e_p = \frac{\partial Q_m}{\partial P_m} * \frac{P_m}{Q_m}$$

When using the mentioned Market Survey Data, both models give evidence about the inelasticity of the average demand curve for Marijuana. This price elasticities estimated in these models are -0.365 and -0.51 for the double-log and linear models respectively at a current market price of 10 dollars per ounce of dried Marijuana. The results estimated by both functional forms of the model are statistically significant at a 5% level of significance (Nisbet & Vakil, 1972).

On their end, (van Ours & Williams, 2007) studied the cannabis use habits of young people in Australia between 14 and 22 years based on data collected from the 1998 Australian National Drug Strategy's Household Survey. The authors concluded that people that make part of this age range are highly attracted by lower Cannabis prices, which means that these low prices are associated with early use and a low quit rate and/or longer duration of use.

To determine whether price impacts this initiation or quitting decisions, (van Ours & Williams, 2007) matched data from the survey mentioned above with information on the Marijuana price of each year gathered from the Australian Bureau of Criminal Intelligence, Illicit Drug Reports (AIDR), allowing them to model their consumption responsiveness to changes in the price of the substance. In addition, the authors present additional statistics on starting and quitting rates of Marijuana use. An important fact to bear in mind, is that 15.4 years is the mean age of initiation into Marijuana use. Also, they found that during the teen age years, Cannabis use increases dramatically as the individuals get older, estimating that by the age of 15, 28% of individuals have used Marijuana, 48% by the age of 18 and 52% by the age of 21.

In this order of ideas, to estimate the price elasticity of cannabis, the authors employed a Split Population (SP) model which allowed to account for the large part of the population who has never tried Marijuana before. The estimated price elasticity for the substance is -0.7, with a 10% statistic level of significance. Furthermore, to make sure that the estimated effect on consumption by the price is in fact reflecting a response in starting rates to lower prices, rather than a different social variable as Cannabis acceptance could be, a calendar time trend is included in the model and the results show a price elasticity for Cannabis of -0.5. This way, (Van Ours & Williams, 2006) conclude that Cannabis prices have a statistic significant effect on consumption starting rates.

(Grossman, 2005), conducted a study in the USA about the demand for harmfully addictive substances, alcohol, cigarettes, cocaine, heroin, and marijuana, with an emphasis on the effect price changes have on consumption. After analyzing the annual prevalence trend of high school seniors between the years 1975 and 2003, the authors suggest that the number of young people who use this substance increases as its price falls, and users decrease and Marijuana current prices climb, as it's the case between the years 1975 and 1992, when marijuana participation fell 40% while prices increased. Moreover, when the current price level dropped, participation reached 38.5% in 1997.

To analyze the relationship between the price and substance use outcomes, including annual prevalence of marijuana, (Grossman, 2005), regresses the indicator on a measure of its real price in a time series. To estimate the Marijuana price elasticity, the author uses the annual price of Marijuana lagged one year, and the regression results in a -0.46 price elasticity for this substance. This explains how between 1975 and 1992 marijuana participation fell from 40% to 21.9%, when prices increased by almost 100% and how participation reached approximately 38.5% through 1997 when there was a 40% price drop of the substance.

(Kilmer et al., 2014) argue that to understand the most relevant factors associated with marijuana use initiation, it is imperative to analyze adolescent use. This is because the

average age of the reported marijuana initiation is below the age 18, so data from teenager marijuana consumption serve as a good study sample about marijuana initiation. Along with other factors associated with initiation such as perceived harm or disapproval, monetary price represents a particularly key factor when analyzing trends of use over time. (Pacula et al., 2001), using national and repeated cross-sectional data from Monitor The Future (MTF) and cannabis price data from IDPRR, examined how changes in purity-adjusted price affected the use trends in youth annual and monthly rates, from 1982 to 1998. They estimated a price elasticity of -0.30 for both annual and monthly prevalence.

To estimate a full demand elasticity, (Davis et al., 2016) used crowd-sourced transaction data from a cross section of the USA, which included more than 31,000 actual marijuana transactions, which recorded price, quantity, and quality for each. The data was collected from a website called “ThePriceofWeed.com”, which the creators set to be a “Crowd-Source” data, collecting information from consumers about their marijuana transactions, including factors such as price, quantity, quality, city, state and country. After organizing their own data base by eliminating useless entries such as the ones with prices above \$100/gram and prices of zero, and focusing only in the United States, (Davis et al., 2016) were left with approximately 23,611 observations that were used to estimate a price elasticity equal to -0.689 (Davis et al., 2016) , which indicates the inelasticity of the demand for this substance and goes in line with previous elasticity estimations cited above.

4.3 Cocaine and other stronger drugs price elasticity

Regarding elasticities, (Saffer & Chaloupka, 1999), analyze the effects of alcohol prices, marijuana liberalization, cocaine, and other substances prices on the demand of these substances. In this study, after estimating the price elasticity for other illicit substances, they found that cocaine had one of -0.28, and predicted that a decriminalization of this substance might lead to 26,000 new users. Although they did not estimate the price

elasticity of recreational cannabis, according to the authors, marijuana liberalization can lead the probability of marijuana utilization by 8% (see Table 2).

Table 2 Cocaine elasticities

Author	Country	Elasticity
(DeSimone & Farrelly, 2003)	USA	-0.41
(Saffer & Chaloupka, 1999)	USA	-0.28
(Grossman & Chaloupka, 1998a)	USA	-0.7
(Crane & Rivolo, 1997)	USA	-0.42
(Saffer & Dave, 2005a)	USA	-0.57

Source: own elaboration.

In line with the above, “The canonical value of the price elasticity of demand for cocaine that is commonly used in the literature seems to be about -0.5, based on extrapolated knowledge from other drugs such as alcohol and tobacco” (Crane & Rivolo, 1997, p:46). The authors argue that in the illegal cocaine market, the costs associated with security, risk and distribution are greater than the costs of the raw material. Price stability over time shows that the product has low elasticity. The research finds that after making estimates with four indicators of indirect use, the elasticity found is consistent with the canonical value of price elasticity of demand of -0.5, averaged over the entire user function.

As documented in Table 2, (Grossman & Chaloupka, 1998) estimated a price elasticity of -0.7. However, under a rational addiction model on cocaine demand, these authors found a long-term elasticity of -1.35. This result suggests a greater response to changes in prices in the long run, given that in this model the possibility that consumers are rational and foresee future consequences exists. For this reason, it might be that legalization of this, or similar substances imply a substantial increase in cocaine consumption as an effect of the price reduction this conveys (Grossman & Chaloupka, 1998b).

On their end, (DeSimone, J., Farrelly, 2003) focus on an alternative approach that considers both cocaine prices and the possibility of being arrested for illicit substance possession, which results in a price elasticity of -0.41 . The authors concluded that the demand for cocaine is price sensitive, but that its elasticity is also influenced by factors such as age of the consumers, and that a high probability of being arrested reduces the probability of consuming this substance. In addition, by incorporating the effect of mental illnesses caused by consumption in the demand for cocaine, a price elasticity of -0.57 was found by (Saffer & Dave, 2005b). In this regard, (DiNardo, 1993) finds no effect between changes in the price of cocaine and the amount consumed.

4.4 Cross elasticities between Marijuana and harder substances

Most studies agree that some people who use marijuana also use drugs considered more harmful such as cocaine, heroin, methamphetamines, and controlled medications (opioids and benzodiazepines). (Jofre-Bonet & Petry, 2008) states illicit drug users consume different types of drugs. In this regard, illicit drug users consume different types of drugs. For example, 69% of heroin addicts consume marijuana, 50% alcohol, 47% cocaine and 33% benzodiazepines. As for the price, although the evidence from studies suggests that cocaine and heroin use respond negatively to price, there is little consensus on the magnitudes of the price elasticity of demand for these illegal substances (Dave, 2006).

Starting with (Thies & Register, 1993) findings, in the 1980s, when cocaine was a hot drug, in states where marijuana was decriminalized, cocaine use increased. Again, it would be evidence that marijuana opens the door for more dangerous drugs. However, it is found that for those people who used cocaine, the frequency of use decreased. In this case, it could be assumed that cocaine users were able to substitute marijuana.

In contrast to the above, (Kelly & Rasul, 2014b) suggest that their results determine that cannabis and class A drugs (such as cocaine and heroin) have a negative cross-price

elasticity, thus being complements, and then “the use of cannabis leads through some mechanism to the later use of harder illicit drugs” (p: 99). In addition, the relationship between alcohol and marijuana cannot be forgotten, this being a complementary relationship according to (Williams et al., 2004).

For the UK, (Sumnall et al., 2004) affirm that for the estimated model it could be predicted that multiple drug users alter their consumption behavior in function of the purchase price of available drugs. In addition, they find “The asymmetrical relationship between cocaine and alcohol was interesting with cocaine acting as a complement for alcohol but alcohol acting as a substitute for cocaine” (p: 6). However, when cocaine gets expensive, alcohol acts like a substitute, which also does for amphetamines and ectasis. Cocaine and ectasis are substitutes to each other, which indicates that they both share the same function and work as “social facilitators” and enhance a positive mood in people.

4.5 Marijuana liberalization socioeconomic effects

(Hajizadeh, 2016), provides an overview of the potential economic, social, and public health effects that marijuana legalization in Canada may have. From a fiscal point of view, tax revenue could increase by adding marijuana products to the legal market, and legalization will also save some Government public expenditure by decreasing money spent into cannabis prohibition enforcement. In addition, a social advantage of this policy is to remove the criminal element from the marijuana market, increasing public safety by limiting exposure to criminal individuals or groups. However, the author emphasizes that this measure might bring serious public health consequences, provoked by the imminent increase in the substance consumption, for which he states that is especially important to apply effective strategies to prevent minor use and to increase public awareness on the harmful effects of marijuana.

(Reuter, 2010) analyzes the effects of Marijuana legalization in other countries like the Netherlands and Australia, and the risks associated with this. He affirms that the motion to legalize this substance was done under the recommendation of the Baan and Huilsman

Commissions, who had the hypothesis that the liberalization for Cannabis distribution would help to separate the market of soft and hard drugs (Reuter, 2010). It is important to highlight the Policy precautions the Netherlands took, for which a significant one is that the Dutch never allowed the production of Marijuana, this way they left production and trafficking concerns to the regular laws and policies applied in the western nations.

According to (Hall & Weier, 2015), policy analysts disagree about how much Cannabis recreational use rates increased after its legalization in the Netherlands' market. They argue that the effect was not that much different for the US states that "*facto*" legalized Cannabis supply for medical use. However, they affirm that where recreational marijuana use will be legalized, it is likely to increase the number of new users among young adults, as they compared this to the effect that the liberal alcohol policies had on this part of the population at those times. In addition to this, as it is explained by (Parey & Rasul, 2021), younger cohorts have a significantly greater prevalence for marijuana usage, as they affirm that according to (UNODC, 2011), among US High School Senior year, annual prevalence was estimated to be 35% in 2010.

As mentioned before, marijuana legalization is a wide debate among policy makers all around the world, in which those in favor advocate that with its legalization, there would be fewer underground-economy transactions, which can be very threatening for public safety as they involve many risks mentioned before. (Miron & Zwiebel, 1995) after observing study cases where cannabis has been legalized such as in states as Colorado and Washington, concluded taxation and revenue generation have become one of the principal political and economic arguments for legalizing Marijuana. However, although taxation to different sections of the supply chain of this substance can represent high government revenues, states with legal markets have established a wide range of tax rates ranging between 3.75% to 37%, which indicates that policy makers use taxes differently to control and regulate this market, as where some states such as Washington is inclined into collecting profits from this by taxing all areas of the supply chain by 37%, other states

such as Massachusetts may be inclined to keep their tax rate low to 3.75% (Hansen et al., 2017).

Another mechanism used to regulate cannabis legal and similar markets, apart from regular taxation to various levels of the supply chain, is by applying license quotas. According to (Thomas, 2019), license quotas are commonly used by states to restrict entry into retail markets of “sin goods”, such as tobacco products, alcohol and marijuana. From an industrial organization point of view, license quotas limit competition, which increases the licensed firms’ markups as an effect of the higher prices allowed by the lower competition and therefore, reducing consumption or their offered goods.

When diving into the effects that marijuana liberalization policies have on crime rates in different places, there are significant contrasts between findings. (Makin et al., 2019), affirm that legalization helps to improve police effectiveness, by redirecting their resources, time, and attention from marijuana prohibition to other serious offenses such as violent and property crimes. Using 2010-Uniform Crime Reports data to conduct a time-series analysis for Colorado and Washington states, findings suggest that marijuana legalization measures had no negative effects on crime clearance rates. Also, (Lu et al., 2021), also conducted a time series study of crime rates in Washington and Colorado, finding no statistically significant long-term effects on violent and property crime rates.

Furthermore, (Maier et al., 2017), conducted research that involved comparing states who applied marijuana liberalization policies between 2010 and 2014 to states where it remained to be prohibited, and had results indicating that trends for property and violent crimes rates were higher in states where marijuana remains to be illegal, but the result is not statistically significant. This way, they conclude that the legal status of marijuana in states failed to significantly predict variations in property or violent crimes in 2014. In addition, (Dragone et al., 2019) using a combined county-level difference-in-differences and partial regression discontinuity model, found that the legalization policy of

Washington had a significant reduction in rapes and property crimes, relative to pre-legalization levels in the years 2010-2012.

5. Concluding Remarks

Marijuana liberalization approach is a trending debate around the globe, as seventy countries have applied some sort of marijuana liberalization measure. Policy makers need to consider all the potential negative consequences, as well as the positive outcomes this can bring in economic and social terms. Those in favor of cannabis legalization or decriminalization, argue that this would shrink the cannabis illegal market, and will increase public safety by annulling cannabis derived interaction with criminal groups or individuals. In addition to this, marijuana regulated distribution and retail markets represent a new source for tax revenue, which can be used by the government to address other pressing issues, such as education and health and reallocation of public safety funds.

On the other hand, among the negative effects marijuana legalization and/or decriminalization bring, authors cited above agree that countries that have done so and that are planning to do have to accept an imminent increase in cannabis consumption, both for medical and recreational purposes. This can bring along several public health and social consequences, such as accidents and health problems caused by marijuana secondary effects and an increased consumption by minors, given that the mean initiation-use age is 15 years. For this reason, fomenting public awareness of the consequences of marijuana use and preventing minor use are key measures to put in place when liberalizing cannabis use and possession, to counter these adversities.

In line with the above, the Gateway hypothesis validated above represents another significant risk factor associated to marijuana liberalization policies. The information presented before suggests how individuals progress from consuming legal substances like alcohol and cigarettes to using stronger illicit drugs such as cocaine, heroin and

methamphetamines, and show how the use of substances, perceived as less risky such as cannabis become a crucial step into the use of these stronger illegal substances. Finally, there is consistent evidence that the use of marijuana almost precedes the use of other illicit drugs.

Regarding the estimation of elasticities for illicit substances, such as marijuana and cocaine, authors argue that models are not easy to create and run given the nature of the data used for these purposes, which is mostly collected through anonymous surveys about illegal drug consumption habits, meaning that there is no official record about regular monetary transactions. Given the latter, many studies about marijuana prevalence and probability of use are based on easier information to collect, taking more into account variables such as age, gender, and race more than economic variables like its price.

When compiling the elasticities other authors have estimated for marijuana and other drugs further up in the Gateway diagram, mostly inelastic results were found. This led this literature review to conclude that even at high prices, users of these substances will only decrease their demand in minimum amounts, even under illegal scenarios. Also,

The literature review allows us to conclude that there is no consensus on whether marijuana is complementary or a substitute for other harder drugs. Some empirical studies analyzed find that they are complementary but others that they are substitutes. This is the cultural, temporal, and spatial differences of the population studied. Other elasticities found are those of the decriminalization of marijuana. That is, how the consumption of marijuana, cocaine, alcohol, heroine, etc., reacts to the non-penalty of having small amounts of marijuana. On the other hand, there are studies that analyze the effect of decriminalization with the increase in overdose events treated in emergency rooms and/or hospitalizations for abuse in consumption.

Other factors that are considered in research is the influence of peers. The peer effect is found to be a strong predictor of marijuana and other drug use. In addition, peers have a

greater influence than parents, who try to reinforce values in adolescence to prevent consumption.

As it can be evidenced throughout this literature review, there is not a final consensus weather in terms of public policy it is desirable or not to legalize marijuana consumption, or even of its market liberalization, including both supply and demand. It remains clear that given the addiction component these illicit substances have; they tend to be inelastic and that cannabis can be the doorway to consumption of stronger drugs. In addition, there isn't common consent about the complementarity or substitutivity of marijuana among with more harmful substances, but it is certain that decriminalization of cannabis can cause an increase in emergency rooms and hospitalizations. All in all, to support this debate, it is important to continue exploring using empirical research that takes into account the different cultures and contexts found in each country.

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