How does legalising cannabis influence the purchasing choices of cannabis consumers and the modus operandi of illicit cannabis suppliers?

Erik Cheekes

This thesis is submitted in candidature for the
Degree of Doctor of Philosophy

January 2022

Cardiff School of Social Sciences
Cardiff university

Abstract

The past decade has seen the unprecedented uptake of cannabis legalisation, a trend likely to continue. However, the consequences legalisation poses for illicit cannabis markets are currently empirically underexplored despite an often-discussed benefit of it being harming the illicit market. This thesis analyses how, and why, recreational cannabis legalisation may affect consumer purchasing decisions (i.e., their decision to buy cannabis illicitly or legally), the modus operandi of illicit cannabis suppliers, and wider cannabis trafficking flows.

This thesis uses a mixed-methods parallel databases design to answer the above questions. Qualitative research involved thematically analysing online forum conversations of self-described illicit cannabis consumers and suppliers who discussed their experiences with recreational cannabis legalisation. Key insights indicate a commercially competitive legal market may encroach upon illicit market demand while threatening the profits of local illicit cannabis sale. Consequently, suppliers experiencing difficultly described either desisting or adapting their illicit modus operandi towards supplying the under-age market, selling other illicit drugs, or trafficking. Consumers and suppliers described little impact if viewing the legal market as commercially uncompetitive.

Quantitative research involved analysing a source of self-reported longitudinal illicit cannabis price data on the United States. Descriptive statistics identified distinct price drops coinciding with Coloradoan legal sale in its neighbouring states. An interrupted time series model identified negative associations between Coloradoan legal sale beginning, and prices in neighbouring states. Similarly, a multiple linear regression model identified a negative association between the number of active Coloradoan retail licenses and prices. Potential explanations for these associations include legal cannabis diversion (by supplier or consumers) alongside illicit cannabis trafficking.

Altogether, the present research indicates a commercially competitive legal market may affect and harm the local illicit cannabis market. However, policy makers should consider the unintentional consequences of a commercially competitive legal market for displacement and public health.

Contents

List of tables

List of Figures

Acknowledgements

Introduction

Over the past decade, substantial changes in cannabis drug policy have occurred in certain countries and jurisdictions (examples including Canada, Uruguay and over a dozen states in America) who now legalise its recreational use, production, and distribution (Cerdá and Kilmer, 2017; Hall et al., 2019; NCSL, 2021). This approach is in stark contrast to the vast majority of the past century where most countries strictly prohibited any cannabis industry (Kleiman et al., 2011; Levine, 2003). The Netherlands is a notable exception however, as they have always only tolerated cannabis sale in small quantities whilst still punishing its production and large quantity sales as severely as any prohibition regime (Caulkins et al., 2015; Maccoun, 2011). In modern times, a fully privatised legal cannabis industry has only been in full operation since 2014, when Colorado began legal sale (Hall et al., 2019).

Underlying the drive to legalise cannabis are several proposed benefits including improving the economy, providing users safer access to cannabis products, and freeing up law enforcement (Caulkins et al., 2015; Dills et al., 2016; Hall et al., 2019; Kleiman and Ziskind, 2019). A fourth proposed benefit is legalisation harming, or shrinking, the illicit cannabis market (Hall et al., 2019; Kleiman and Ziskind, 2019). This thesis focuses upon the latter claim which is empirically underexplored in the academic literature. Furthering understanding in this area is not only important for expanding the literature, but also in helping jurisdictions and policy makers make more informed decisions regarding legalisation.

To better understand the consequences legalisation poses to illicit cannabis markets, this thesis empirically explores three research questions:

1. What influences a cannabis consumer to use the legal or illicit market?
2. How do illicit cannabis suppliers respond to recreational cannabis legalisation?
3. Do wider illicit trafficking flows change in response to recreational cannabis legalisation?

Altogether, these questions comprehensively consider the consequences recreational cannabis legalisation poses to illicit markets. The first question considers how a legal

market may successfully, or fail to, take demand from the illicit market through considering the factors which influence consumers to use one market over the other. The second question focuses on the reactions of illicit cannabis suppliers to legalisation, specifically whether, how and why, legalisation may influence changes in their modus operandi. Lastly, the third research question focuses attention on whether legalisation impacts wider cannabis trafficking flows (i.e., the routes in which cannabis is smuggled across borders). Thus, through exploring these questions, this thesis comprehensively considers the impacts legalisation poses to illicit markets through examining its influence on demand, supply, and on other jurisdictions.

To aid in answering the above questions, this thesis uses a theoretical framework consisting of Rational Choice Perspective (RCP), bounded rationality concepts, and Risk and Prices (R&P) theory (Caulkins and Reuter, 2010; Cornish and Clarke, 2014; Reuter and Kleiman, 1986; Selten, 2002; Simon, 1978; Wortley, 2014). The above framework is used to consider, analyse, and interpret how legalisation may influence the decisions of illicit cannabis consumers and suppliers. People comprise markets, thus, their individual decisions together constitute wider change. Therefore, analysing how the criminal involvement decisions of cannabis users and suppliers change post legalisation, may indicate wider illicit market consequences (Cornish and Clarke, 2017, 2014). For example, exploring how, and why, legalisation may influence a consumer to desist buying cannabis illicitly, indicates how this policy may harm the illicit market by taking away demand from the illicit market. Importantly, the above approach lends itself to offering practical policy advice as it empirically links specific aspects of legalisation policy to illicit market consequences. This thesis strives for its findings to be useful for jurisdictions and policy makers considering, or currently employing, legalisation.

Before outlining the structure of this thesis, some clear boundaries for the present research exist. Firstly, the thesis focuses on recreational cannabis legalisation (i.e., a policy regime which permits the use, distribution, and/or production for non-medical reasons). Thus, when the terms legalisation, legalised or legal are used, it refers to recreational cannabis policy and not medical cannabis laws unless otherwise stated. Secondly, focus is on the consequences legalisation poses for the illicit market, meaning all data and analysis pertains to the former. However, during discussion, reference is made to other related issues such as public health concerns.

The structure of this thesis is as follows. Chapter 1 reviews relevant literature. Firstly, it discusses the demand and supply of illicit drugs alongside its societal consequences. Attention then focuses on examining cannabis deregulation policy with a particular focus on recreational cannabis legalisation. A thorough exploration of literature discussing the potential consequences, and policy regime variants, of legalisation occurs. Following this, instances of legalisation implementation is identified and empirical studies regarding the consequences of legalisation is examined before discussing the research gap. Chapter 2 details, and justifies, the inclusion of RCP and R&P theory used in this thesis. Chapter 3 details the pragmaticism research paradigm and mixed methods methodology underpinning this thesis. Most of Chapter 3 is dedicated to outlining, justifying, and discussing the qualitative and quantitative portions of this thesis. Lastly, it considers the ethics of the research.

Chapters 4 and 5 constitute the empirical qualitative analysis chapters which involves thematically analysing online forum conversations of self-described illicit cannabis consumers and suppliers respectively (Braun and Clarke, 2006). Specifically, these individuals discussed their experiences with recreational cannabis legalisation and how it affected their involvement with the illicit cannabis market. These chapters offer insights into why and how, legalisation may or not, affect the key decisions of illicit cannabis market participants. Specifically, chapter 4 examines the consumer-market choice decision while chapter 5 focuses on how legalisation impacted the modus operandi decisions of illicit suppliers.

Chapters 6 and 7 are the empirical quantitative analysis chapters which contain analyses of a self-reported source of longitudinal illicit cannabis price data on the United States. These two chapters examine illicit cannabis price fluctuations occurring around instances of legal sale, which may infer illicit market responses and cannabis movement. Analysis particularly focuses on prices in jurisdictions bordering legal states to examine whether the data indicates cross-border cannabis movement. Chapter 6 includes descriptive statistics of the price data alongside a detailed discussion of the results which follows directly into the following chapter. Chapter 7 contains two statistical models used to estimate associations between illicit prices in states bordering Colorado and Coloradoan legal sale.

Chapter 8 contains the discussion of the entire thesis. The first section accomplishes three goals. Firstly, it discusses how the findings help answer the research

question underlying this thesis. Secondly, it interprets the qualitative and quantitative findings together to examine how they relate and expand understanding of the research focus. Thirdly, it specifies how the present research has supported, expanded, and/or uniquely contributed to the literature. The second section focuses on relating findings to practical policy advice for jurisdictions considering, or currently employing, legalisation. Following this, a short section on the contextual limitations associated with the present research for the purpose of advising future research occurs.

Lastly, the conclusion chapter summarises the key findings and implications of the thesis for the reader alongside identifying specific areas deserving of further research

Chapter 1: Literature Review

This chapter first discusses the demand and supply of illicit drugs. Following this, an overview of all drug policy regulation regimes occurs with special attention paid towards legalisation and its possible variations. Theoretical and hypothetical discussions regarding the potential consequences legalisation poses for the illicit market are considered before exploring the empirical research. Lastly, gaps and under researched areas of the literature are identified.

1.1   Illicit Drug Demand

Examining drug consumption statistics illustrates the large demand for illicit drugs. For instance, examining the most (at time of writing) recent UNODC (2021) report estimates that 1 in 18 people aged 15-64 (or 275 million people), worldwide, used a drug at least once in 2019. Cannabis is the most popular illicit drug of choice, with an estimated 200 million people (aged 15-64) worldwide reporting using it at least once during 2019, compared to 62 million using opioids (i.e., opiates and pharmaceutical or synthetic opioids) for non-medical purposes, and 27 million for amphetamines (UNODC, 2021). It is worth noting that these estimates come self-reported from member states, thus it is possible some countries do not always submit their data consistently, accurately, or simply offer no data profiles (UNODC, 2021). However, these estimates serve as a useful rough picture of overall trends in usage while illustrating the scale of illicit drug usage.

The large number of users is troublesome as drug consumption is linked with physical and mental health issues (Chen and Lin, 2009; Degenhardt and Hall, 2012). Harms vary depending on the drug and its effects. Cannabis is the least harmful when compared to opioids, amphetamines, and cocaine. Overdosing on cannabis is essentially impossible, while opioid and stimulant use can be fatal (Degenhardt and Hall, 2012). However, cannabis, as with opioids and stimulant use, has been linked to physical consequences such as traffic accidents, falling, and drowning (Asbridge et al., 2012; Degenhardt and Hall, 2012). Furthermore, drugs which are consumed by injection

(opioids, cocaine, and amphetamine use) risk spreading diseases and infections through the unhygienic use of contaminated needles (Degenhardt and Hall, 2012; Dolan et al., 2015).

The literature shows a correlation between mental health complications and illicit drug use. Cannabis, opioid, and stimulant use are associated with psychotic and common mental disorders (Degenhardt and Hall, 2012; Di Forti et al., 2015; Marconi et al., 2016). However, the findings linking mental disorders to illicit drug usage are limited to associations as it is difficult to identify which preceded the other. For example, existing mental disorders may predispose individuals to use illicit drugs, but equally so, illicit drug usage could lead to mental health issues (Degenhardt and Hall, 2012)

Due to these drug-related issues, it is important to understand what influences consumption. The literature identifies various risk factors for drug usage which separate into two categories, contextual factors (societal and cultural influences), and individual and interpersonal factors (Hawkins et al., 1992; Su et al., 2018). Contextual factors include the impact of laws, drug availability, socioeconomic influences (such as poverty, poor housing, and overcrowding), and neighbourhood disorganisation (Cooper et al., 2013, 2016; Hawkins et al., 1992; Wu et al., 2008).

Literature examining individual and interpersonal factors focus on adolescent drug usage (Anthony and Petronis, 1995; Newcomb et al., 1986; Su et al., 2018). Early drug usage in life strongly predicts a pattern of long-term drug usage, and consequently is the optimal time in life to prevent a long-term pattern of usage (Anthony and Petronis, 1995; Newcomb et al., 1986). Individual and interpersonal risk factors of adolescents include exposure to deviant role models (both peers and family members), parent drug use, peer drug use, displaying anti-social behaviour, low educational achievement, sensation seeking, early alcohol use and disruptive life events (Anthony and Petronis, 1995; Hawkins et al., 1992; Mayberry et al., 2009; Newcomb et al., 1986; Su et al., 2018). Overall the drug use literature does not prioritise one factor as more of a risk factor than another, rather a multi-path model of drug use is argued where different factors can result in similar levels of drug usage (Anthony and Petronis, 1995; Gorsuch and Butler, 1976; Newcomb et al., 1986).

Another major contribution for understanding drug consumption is examining how drug demand interacts with drug price (Caulkins, 2007; Caulkins and Reuter, 2010; Kilmer et al., 2015). This relationship is unanimously considered to be negative, when

drug price increases, a corresponding demand decrease follows (Caulkins, 2007; Caulkins and Reuter, 2010; Kilmer et al., 2015). The responsiveness of a demand decrease relative to a price increase is termed the price elasticity of demand (Caulkins, 2007). Calculating the price elasticity of demand involves dividing the percentage that demand changes, by the percentage change in price (Pacula and Lundberg, 2013; Parkin, 2015). A product is termed elastic if price elasticity is calculated to be over one, meaning a 1% increase in price leads to a greater than 1% decrease in demand. A product is termed inelastic if price elasticity is under 1% and therefore is less responsive to price changes (Parkin, 2015).

The literature shows illicit drugs as being inelastic with Gallet's (2014) extensive review of 42 studies (consisting of 462 price elasticities) showing the median drug elasticity being 0.33. This average indicates that overall, illicit drugs are not particularly responsive to price increases. However, this varies by drug, as a majority of studies showed the elasticity of cannabis being below the 0.33 median, while heroin and cocaine were commonly seen above the median, with some being in the elastic range (Gallet, 2014).

Overall, a large demand for drugs exist in the world (UNODC, 2021, 2017). Illicit drugs have been associated with mental and physical health complications leading many to investigate what predisposes individuals to drug usage and how drug usage may be influenced (Chen and Lin, 2009; Degenhardt and Hall, 2012). The literature describes a variety of risk factors that may increase the likelihood of an individual turning to drug use. These factors range from broad societal influences, to individual and interpersonal causes (Anthony and Petronis, 1995; Hawkins et al., 1992; Newcomb et al., 1986). The literature also points to drug price influencing demand, with a price increase corresponding to decreased usage (Caulkins, 2007; Caulkins and Reuter, 2010; Kilmer et al., 2015). However, the responsiveness of usage to a price is deemed inelastic and varies by drug type (Gallet, 2014).

1.2   Illicit Drug Supply

Illicit drug supply can be viewed as a series of trade relationships between countries or locales, who play the different market roles of production, transit, and consumer (Boivin, 2013; Naylor, 2003; Paoli et al., 2009; Reuter, 2014). Production countries are responsible for most of the illicit drug supply. Production patterns vary by drug, for

instance, in contrast to heroin and cocaine, cannabis production (alongside trafficking and consumer markets) tends to remain in smaller microcosms as countries and/or regions are more self-sufficient in supply (Boivin, 2013; UNODC, 2021). Cannabis self-sufficiency is attributed to: hydroponic growing advances (indoor cannabis cultivation) which lowers geographical bias, a softer attitude towards it, and less enforcement focus (Boivin, 2014, 2013; Bouchard, 2007; Bouchard and Dion, 2009). Nonetheless, certain countries are thought to produce far higher cannabis amounts than other jurisdictions in their same region or subregion. Mexico and the United States in North America, Paraguay in South America, and Morocco in Africa, see UNODC (2021) for more examples.

For other drugs, specific regions dominate world supply. For instance, South-West Asia (primarily Afghanistan), South East Asia (primarily Myanmar and less so, Lao People's Democratic Republic), and certain countries in Latin America (Mexico, Colombia and Guatemala primarily) produce the majority of opiates (Boivin, 2014; UNODC, 2021, 2016). The South American region is well known as the primary source of the global supply of cocaine, with Colombia, Peru and Bolivia cultivating the majority of cocaine (Boivin, 2014; UNODC, 2021, 2016).

Transit countries are nations in which illicit drugs travel through on their way to consumer markets from production countries. In a transit country, a certain proportion of the imported drugs is designated specifically to export rather than for domestic consumption (Boivin, 2014). For instance, Mexico is a well-known bridge for illicit drugs to enter North America (Kilmer et al., 2010a; Reuter, 2014; Rosen and Zepeda, 2016). Parts of Africa have recently become known as a growing transit area for cocaine to Europe, with the largest amount of cocaine seized by Cabo Verde, Gambia, Nigeria, and Ghana (Reuter, 2014; UNODC, 2016). For opiates, the famous Balkan Route begins with Afghanistan (the major opiate producer country) then proceeds through Iran, followed by Turkey to Eastern Europe, and finally resting in central and western Europe (UNODC, 2015). Recently, there has been an increased importance of the southern route, where opiates are smuggled from Pakistan and/or Iran through shipping to the Gulf region, Eastern Africa, South Asia, and less so, South-East Asia (UNODC, 2015).

Trafficking refers to the transportation of illicit commodities across borders, from its source to the drug user (Boivin, 2013; Naylor, 2003). Trafficking flows refer to the geographical configuration of routes that distribute illicit drugs. The overall structure of these drug trafficking flows indicates a conscious influence by drug traffickers. While

knowledge is limited, it is clear that trafficking routes are not random, implying that specific factors influence drug trafficker decisions (Giommoni et al., 2017; Reuter, 2014). Reuter (2014) identifies three possible factors that influence drug trafficking routes which are law enforcement, geographical proximity, and social ties between countries.

Areas with less effective law enforcement would be more attractive for drug traffickers as these jurisdictions constitute less risk than another more well-guarded route, assuming both areas shared similar economic rewards (Boivin, 2014; Caulkins and Bond, 2012; Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). Giommoni et al (2017) also shows that higher levels of corruption in a country may facilitate illicit drug trade.

Social ties between countries include the sharing of a language, similar cultural links, and a large migrant population from production countries (Giommoni et al., 2017; Reuter, 2014). It is argued that these ethnic ties aid illicit drug trade across borders through facilitating increased trust and connections (Reuter, 2014). Several studies illustrate social links influencing the illicit drug trade. For instance, Giommoni et al (2017) and Berlusconi et al (2017) showed that a common language and existence of large migrant populations from countries known for drug trafficking increased the likelihood of heroin trade occurring. Paoli and Reuter (2008) found that partial sectors of the drug market are dominated by particular ethnic groups in Western Europe. Turkish and Albanian groups control much of heroin trafficking, while Colombian groups control cocaine importing (Paoli and Reuter, 2008).

Geographical proximity refers to how close a country is to a producer or consumer country, with shorter distances increasing the likelihood of it being a transit country (Berlusconi et al., 2017; Giommoni et al., 2017; Reuter, 2014). Having to transport illicit drugs over longer distances increases transportation costs and risk of detection. The more borders a trafficker travels through generally entails higher risk of detection (Berlusconi et al., 2017; Giommoni et al., 2017; Reuter, 2014). However, Reuter (2014) points out that borders may represent differing degrees of risk, so traffickers may choose to move through more borders than physically necessary if the overall risk is less than a more direct path.

The geographical position of a country or jurisdiction within the global illicit drug network influences drug price. For instance, illicit drug purchases may be more expensive the further away they are from their production source (Caulkins and Bond, 2012; Caulkins and Reuter, 1998). Zook et al (2012) showed average cannabis price increasing

the further away the purchase was from Humboldt County in California (a major source of cannabis production) to the rest of the United States. Caulkins and Bond (2012) showed cannabis price increasing the further away the purchase took place in the United States from Mexico. Giommoni and Gunder (2018) indicates that cannabis price increases when moving from South England (the shipping entry point to England) to Scotland. Prices of heroin in France increase as one moves away from bordering Netherlands, a known entry route of heroin into Western Europe (Lahaie et al., 2016). Several studies used price data in identifying cocaine and heroin trafficking flows in Europe and the United States (Chandra et al., 2014, 2011; Chandra and Barkell, 2013; Chandra and Joba, 2015). Prices also appear lower in countries that are a transit country to larger consumer markets (Boivin, 2014).

Illicit drug supply and drug trafficking has several secondary consequences. For instance, the large profits possible from the illicit drug trade may fund transnational criminal organisations. The UNODC (2017) estimate drug sales make up one fifth to a third of their wealth. Likewise, terrorist organisations have partially funded their operations through drug trafficking, some examples include the Revolutionary Armed Forces of Colombia (FARC) who traded cocaine, the Islamic state and ISIL with captagon pills (a combination of amphetamine and caffeine), and Al-Qaida with cannabis and cocaine (UNODC, 2017).

Illicit drug supply may indirectly lead to systemic violence, a term coined by Goldstein (1985). Systemic violence results from the indirect consequences of drug trafficking operations (Boles and Miotto, 2003; Goldstein, 1985). Violence can result from territory disputes between rival groups that may spill into collateral damage (Boles and Miotto, 2003; Goldstein, 1985). Inter-organisation violence may also arise from ambitious individuals aiming to rise through the ranks (Reuter, 2009).

There has been literature examining the relationship between law enforcement and drug-related violence. Werb et al (2011) conducted a systematic review of studies, finding that increased drug law enforcement pressure on the drug market increased drug-market violence and homicide rates. Mexico illustrates the potential scale for violence when law enforcement pressures illicit drug trade organisations. For instance, (the then) Mexican president Felipe Calderón enacted a campaign against major Drug Trafficking Organisations (DTO) in 2006, leading to major conflict with cocaine-smugglers (Reuter, 2014). An estimated 50,000 to 60,000 drug-related homicides occurred during the

confrontations of the Mexican government with DTOs (Molzahn et al., 2012; Reuter, 2014).

The literature paints a clear picture of the illicit drug trade and supply. Whilst the structure of the illicit drug trade differs depending on the drug (e.g., the more self-contained cannabis markets), a common system exists that supports the illicit drug trade. Production countries cultivate illicit drugs, transit countries transport illicit drugs, and consumer countries generate the large demand for illicit drugs (Boivin, 2013; Naylor, 2003; Paoli et al., 2009; Reuter, 2014). Drug traffickers play a fundamental role as the bridging point between producers and consumers. Trafficker decisions in smuggling routes are not random, as the literature indicates that law enforcement, geographical proximity, social ties, and corruption influences trafficking decisions (Berlusconi et al., 2017; Giommoni et al., 2017; Paoli et al., 2009). Lastly, the configuration of the global illicit trade and trafficking networks incurs consequences for others beyond drug market participants. For instance, drug trade increases systemic violence, and has been shown to generate income for criminal and terrorist organisations (Boles and Miotto, 2003; Goldstein, 1985; Molzahn et al., 2012; Reuter, 2014; Werb et al., 2011).

1.3   Deregulation Policy Overview

As discussed, the illicit drug trade is extensive and may pose certain societal threats for countries. In response, countries have historically regulated certain psychoactive substances. The United Nations has enacted various international drug conventions over the past century which created the global drug prohibition system seen today (Levine, 2003). While such conventions exist, not all countries or jurisdictions have uniformly adhered to them. Variation in drug policy exists in certain countries, particularly so for cannabis. Reinarman and Levine (1997) visualised the global prohibition system as a continuum, with one end containing highly punitive and criminalised drug control in contrast to softer decriminalised regimes. Relatively recently, cannabis legalisation has occurred in several jurisdictions. This perspective of a continuum is useful in understanding the global drug regulation landscape and understanding how it has developed over time. Three main types of drug policy regimes characterise this continuum, these are prohibition, decriminalisation and legalisation (Kleiman et al., 2011). Some jurisdictions also permit certain illicit drugs (such as cannabis) for medicinal purposes.

A drug prohibition regime prohibits (with the threat of punishment) the production, consumption and distribution of illicit drugs (Kleiman et al., 2011). For the vast majority of the 20th century, a prohibition drug regime towards all illicit drugs was (almost) completely uniform barring the Netherlands (Levine, 2003). This global tough enforcement on illicit drugs can be largely attributed to the United States and their allies supporting a tough stance, with president Richard Nixon's mantra of 'War on Drugs' reflecting the overall narrative (Levine, 2003). Nonetheless, while there is certainly more variety in drug regulation seen in recent times, prohibition is still the most common drug policy witnessed (Kleiman et al., 2011).

Moving along the continuum is decriminalisation. This proposed alternative to prohibition still treats production, distribution, and selling of an illicit drug as a fully punishable criminal offence, however, in contrast to its prohibition forefather, it removes criminal penalties for use (Caulkins et al., 2015; Kleiman et al., 2011). Consuming an illicit drug in countries or jurisdictions with a decriminalisation regime may still risk state punishment through civil fines and/or being mandatorily referred to a drug treatment program (Caulkins et al., 2015; Kleiman et al., 2011).

Finally, and of key interest in this thesis, is legalisation. A legalised regime permits the recreational use, production, and/or commercial sale of a drug (Kleiman et al., 2011). Most notably, several instances of cannabis legalisation have occurred in recent times. This thesis, and the rest of this chapter, focuses on cannabis legalisation solely. It is worth acknowledging that countries have also permitted cannabis for its medicinal purposes (Hall et al., 2019). However, unless explicitly stated in this thesis, when the term legalisation or legalised is used, it refers to non-medical or recreational cannabis policy only.

1.4   Cannabis Legalisation

Legalisation is not a simple binary choice between strict prohibition and a relatively unrestricted commercial market (Caulkins et al., 2015; Caulkins and Kilmer, 2016; Kilmer, 2019). Legalisation as a policy regime and the decisions regulators can make are more complex, arguably more so than previous drug policy regimes. The most common view of legalisation that people may hold is a system akin to alcohol or tobacco market regulation (Caulkins et al., 2015). While the former is one popular choice, the literature

discusses several different legalisation policy regimes and choices a jurisdiction can make (Caulkins et al., 2015; Caulkins and Kilmer, 2016; Kilmer, 2019). Between decriminalisation and an alcohol or tobacco-based regulation system lay several middle-ground options. The following paragraphs explore all the possible approaches. However, these approaches are not mutually exclusive, the less restrictive options may incorporate elements from the more restrictive options.

The most restrictive legalisation option involves limiting cannabis production to the consumer level, for example, by allowing only adult individuals to personally grow their own cannabis (Caulkins et al., 2015). Alternatively, and relatively less restrictively, a jurisdiction may permit relatively small communal groups to collectively grow cannabis together. Known as cannabis social clubs (Caulkins et al., 2015; Decorte et al., 2017), the use of cannabis from these communal groups is restricted to only group members (Caulkins et al., 2015; Decorte et al., 2017).

Further easing of restrictions involve opening retail and/or production to government or business organisations. The most restrictive involves a jurisdiction only permitting or tolerating small quantities of cannabis sale from retail stores, while still prohibiting production and cultivation (Caulkins et al., 2015; MacCoun, 2011). Alternatively, a country or jurisdiction could permit the entirety of legal cannabis supply but only under a full government monopoly (Caulkins et al., 2015; Kleiman and Ziskind, 2019). A variant of the government monopoly approach (particularly for jurisdictions in which there are conflicting regulations between federal and local cannabis regulation) is a Public Authority model (Caulkins et al., 2015). This variant assigns an organisation to be a public authority that fully controls legal cannabis supply, which the government can then influence through choosing members or setting policy goals.

Lowering restrictiveness further invites non-government organisations to run all aspects of the legal cannabis trade (Caulkins et al., 2015; Kleiman and Ziskind, 2019). This leads to the commonly discussed for-profit alcohol or tobacco-based regulations where governments issue licenses to the private sector. Nonetheless, restrictions still exist such as age limits, quality control, restricting certain cannabis products, limiting potency, packaging requirements, single purchase quantity restrictions and/or mandatory distance away from schools (Caulkins et al., 2015; Kilmer, 2019; Pardo, 2014).

However, a government or jurisdiction may influence the direction, character and ethics of a private legal market without direct control through license distribution

decisions (Caulkins et al., 2015; Caulkins and Kilmer, 2016). A jurisdiction may license only non-profit and/or for-benefit organisations whose culture and goals better align with public benefit over commercial interests (Caulkins et al., 2015; Kilmer, 2019; Kleiman and Ziskind, 2019). Alternatively, a jurisdiction could release only a few licenses allowing the government to influence the legal market through leveraging the distribution of the few licenses available (Caulkins et al., 2015).

While many might consider a for-profit alcohol or tobacco style regulation the least restrictive, an even more laxed legal cannabis policy which entails repealing cannabis prohibition while creating no new specific regulations is hypothetically possible This means starting a cannabis business would have the same requirements as any other non-alcohol or non-tobacco business (Caulkins et al., 2015).

As demonstrated, a full spectrum of cannabis legalisation options is possible rather than a simple yes or no (Caulkins et al., 2015; Caulkins and Kilmer, 2016; Kilmer, 2019). Being aware of available choices or strategies is vital when understanding, researching, discussing, or advising on the potential consequences of legalisation. As the following section discusses, differences in legalisation implementation may likely have varying consequences. Such variations being unaccounted for risk incorrect inferences and interpretations of the potential impacts of legalisation (Caulkins et al., 2015; Caulkins and Kilmer, 2016; Kilmer, 2019). Consequently, this becomes important regardless of what area of legalisation a researcher is interested in.

1.4.1   Legalisation and Potential Consequences

The literature has hypothetically discussed possible consequences of different legalisation cannabis policy choices. Before traversing this discussion, it is worth explaining the value of these hypothetical discussions rather than solely relying on empirical research. Cannabis legalisation is (barring few exceptions) a relatively new policy regime. For instance, Colorado, the first instance of a fully privatised legal cannabis industry has only implemented legal sale since 2014 (Hall et al., 2019; NCSL, 2021). Longer term consequences of legalisation will take time to be fully observable as these fresh cannabis markets take time to mature (Dills et al., 2016; Hall et al., 2019). However, if inherent issues lie in certain legalisation policy choices then, at the time such consequences fully manifest and become empirically observable, it may be too late to reverse said policy

choices and their related consequences (Caulkins and Kilmer, 2016; Hall et al., 2019). Additionally, not every legalisation policy regime discussed in the previous section has been implemented, meaning no empirical assessment is available or possible. Hence, only informed hypothetical discussions can offer potential insights into unimplemented legalisation policy options.

Several lines of reasoning and arguments support cannabis legalisation. Firstly, with cannabis legalisation comes benefits through tax revenue and economic opportunity for the public (Caulkins et al., 2015). Secondly, as cannabis use is widespread even under prohibition, little may change if legalised, but those using cannabis may now buy it more safely from regulated sources, and have more accurate information on the cannabis they consume (Hall et al., 2019; Kleiman and Ziskind, 2019). Furthermore, when considering public health, cannabis causes far less harm than alcohol yet the latter is legal (Hall et al., 2019). Thirdly, legalisation may free up law enforcement resources from cannabis crime to target other crime (Dills et al., 2016; Hall et al., 2019; Kleiman and Ziskind, 2019; Maccoun, 2011; Williams and Bretteville-Jensen, 2014a). Lastly, legalising and having a legal cannabis market would destroy or shrink the illicit cannabis market (Hall et al., 2019; Kleiman and Ziskind, 2019).

There are serious concerns over the impact of legalisation on cannabis usage. If cannabis usage increases, then so does the associated risks and harms discussed previously in section 1.1 (Caulkins, 2019; Caulkins et al., 2015; Degenhardt and Hall, 2012; Di Forti et al., 2015; Marconi et al., 2016). The clearest link between legalisation and increased usage is greater cannabis accessibility from legal providers and thus increased likelihood for use (Caulkins et al., 2015; Hall et al., 2019). However, use may also increase when considering the cannabis price elasticity of demand also discussed in section 1.1 (Gallet, 2014; Pacula and Lundberg, 2013). If legalisation lowers cannabis price enough, it could increase cannabis usage considerably (Kleiman and Ziskind, 2019; Pardo, 2014).

An operating legal cannabis market offers the potential to sell legal cannabis at increasingly cheaper prices. Specifically, prices may lower as legal cannabis production costs decrease (Caulkins, 2010; Kilmer et al., 2010b; Kleiman, 2017). Consider cannabis being mass produced. Caulkins and Kilmer (2016) estimated, with comparisons to other common agricultural crops, that cannabis production costs per gram could theoretically range between $0.25 to $0.50, while cannabis extracts from outdoor farms could range

from $0.10 to $0.20 per gram (Caulkins and Kilmer, 2016). Under these prices, excessive cannabis users would more likely face a serious health concern before a monetary one (Kleiman and Ziskind, 2019). Secondly, prices may also theoretically lower from increased competition between legal businesses for local demand (both production and retail) as sellers and cannabis supply increases (Gale, 1955; Mankiw, 2011; Pardo, 2014).

A legalisation regime allowing large-scale production and a relatively unrestrictive commercial market would be more susceptible to the above price decreases than more restrictive regimes (Hall et al., 2019; Kilmer, 2019; Kleiman and Ziskind, 2019). Legalisation regimes lacking the control of more restrictive approaches would be unable to directly restrict cannabis cultivation or prices (Hall et al., 2019; Kilmer, 2019; Kleiman and Ziskind, 2019). Legalisation regimes not permitting commercial production (e.g., personal growing, cannabis clubs, retail sales only) would avoid, or at least, severely limit any potential price decreases as mass production remains prohibited (Caulkins et al., 2015; Caulkins and Kilmer, 2016).

Of course, a jurisdiction could use taxation to artificially inflate cannabis price, even in a locale permitting a relatively unrestricted legal cannabis trade (Kilmer, 2019). However, taxes based on the price value of the cannabis product sold (*ad valorem* taxation) may still fall if production costs lower as suppliers could afford selling at lower prices (Caulkins and Kilmer, 2016; Kilmer, 2019). Furthermore, this would result in lower tax revenue as cannabis production costs lower (Carnevale et al., 2017). A solution may be taxing THC (Tetrahydrocannabinol) content rather than cannabis price which may also discourage use of more potent cannabis. However, the feasibility of taxing THC is questioned (Kilmer, 2019; Kleiman and Ziskind, 2019).

While touched upon, the license distribution deserves further discussion. For-profit cannabis businesses are incentivised to promote cannabis use and predatorily target high consumption users to maximise profits (Caulkins, 2019; Kilmer, 2019). A direct and concentrated effort to increase cannabis use by experienced marketers and advertisers may greatly increase problematic cannabis use regardless of price decreases stemming from lowering production costs and competitive retail prices (Caulkins, 2019; Caulkins and Kilmer, 2016; Kilmer, 2019). Of course, disregarding license control, a government may directly neuter such commercial profit-oriented strategies by directly prohibiting any form of advertisement or marketing of cannabis (Hall et al., 2019; Kilmer, 2019).

There is much uncertainty regarding how cannabis legalisation may interact with the illicit market. Hopes of legalisation harming the illicit market (i.e., it shrinking or removing it) logically relies on the legal market encroaching upon illicit cannabis demand (Hall et al., 2019). The large potential price decreases discussed above may result in competitively priced cannabis that can challenge or undercut illicitly produced cannabis (Kilmer et al., 2010b; Kleiman, 2017). Further, the legal market may produce better and more varied cannabis products that the illicit market may struggle to compete with (Giommoni et al., 2020a; Kilmer et al., 2010a).

Again, the type of legalisation regime a jurisdiction implements may influence how effective it is for harming illicit cannabis markets. Cannabis social clubs may be the smallest permitted cannabis growing operation that could supplant a relatively larger proportion of an illicit cannabis market demand (Caulkins and Kilmer, 2016). While individual personal growing could encroach upon some illicit cannabis demand, it may never seize a significant market share and in particular, the non-flower cannabis market (Caulkins et al., 2015). Logically, the more unrestrictive approaches that allow commercial industries are more likely to innovate with new products and produce competitively priced cannabis than the more restrictive approaches, thus the former may threaten the illicit market more than the latter (Kleiman, 2017). Legalisation may lessen illicit cannabis trafficking to legal jurisdictions for these same reasons, as traffickers would have to compete with the legal market (Caulkins and Bond, 2012; Giommoni et al., 2020a; Kilmer et al., 2010a).

However, while cannabis legalisation may negatively impact the illicit market, there is the possibility of it inadvertently creating criminal opportunity. If legalisation entails lower cannabis prices, then it may possibly create arbitrage between non-legal jurisdictions which traffickers can capitalise on (Caulkins and Bond, 2012; Kleiman, 2017). The predictive analysis by Caulkins and Bond (2012) explored the scenario of Californian legalisation, concluding it could lower cannabis prices throughout the United States by exporting cheaper legal cannabis that undercuts illicit prices. Further, the possible increase in nationally produced cannabis may influence and lower the amount of cannabis supplied to the US by outside sources, namely Mexico and Canada (Caulkins and Bond, 2012). However, Caulkins and Bond's (2012) analysis is predictive and hypothetical, taking place several years before California officially legalised cannabis in 2016 (NCSL 2017b).

Even a legalised regime without mass production may invite some exploitation as such legal policies could lower law enforcement risk which may attract illicit cannabis suppliers (Reuter and Kleiman, 1986). For example, permitting personal growing (or cannabis social clubs) may possibly cover for illicit cannabis production from law enforcement (Caulkins and Kilmer, 2016).

Having a legalised policy regime with greater government supervision may feasibly help control diversion issues. For example, a government monopoly would give authorities complete oversight over legal cannabis products, their distribution and prices, and allow for more stringent requirements (like a registration program) for licensed suppliers and consumers (Caulkins et al., 2015). However, having such intense and tight regulation, like increasing legal cannabis price, may discourage consumers and suppliers from entering the legal market (Carnevale et al., 2017).

Overall, literature discussion warns against an unchecked for-profit commercial legalisation policy regime for fears of it increasing consumption and by extension, public health concerns (Caulkins, 2019; Pardo, 2014). Specifically, serious concerns are for-profit businesses targeting (with advertisement and marketing) heavy cannabis users and promoting use generally (Caulkins, 2019). While legalisation can occur with relative safety, low prices, higher potency and advertising could lead to problematic cannabis use and thus a legal policy regime may wish to focus on regulations, laws and choices that protect public health while minimising the consequences of a profit-driven market (Caulkins, 2019; Pardo, 2014).

However, an (at the least currently) incongruous issue arises when considering whether legalisation can effectively harm the illicit market and balance public health concerns. The discussed measures to protect public health and control possible consumption increases are at odds (Kleiman, 2017). Measures (as discussed above) to protect public health interests may weaken the ability of legalisation to shrink or remove the illicit market (Carnevale et al., 2017; Caulkins et al., 2015; Hall et al., 2019; Kleiman, 2017). Keeping legal prices high and other similar measures to discourage use may encourage users to continue using the illicit market (Carnevale et al., 2017; Caulkins et al., 2015; Hall et al., 2019; Kleiman, 2017). Likewise, employing tight monitoring (or a government monopoly) and regulation of suppliers may discourage any illicit supplier desistance (Carnevale et al., 2017).

By extension, the illicit market being relatively undisturbed by a more restrictive legalisation policy regime may (to some extent) result in a larger unlicensed cannabis market which would require more law enforcement resources to enforce (Kleiman and Ziskind, 2019). This scenario, at least partly, possibly diminishes the proposed positive of cannabis legalisation freeing up law enforcement resources (Hall et al., 2019). One suggestion involves using low taxes initially after legalisation to undercut the illicit market and raise taxes later on to deal with public health concerns (Caulkins and Kilmer, 2016). Further complicating the issue is the opportunity of cannabis diversion for illicit traffickers if it does result in low prices and more potent cannabis (Caulkins and Bond, 2012; Kleiman, 2017). The above characteristics may make diverted legal cannabis desirable for consumers in non-legal jurisdictions.

While hypothetical or theoretical discussion is necessary, so as to not legalise blindly, the sobering reality is such a relatively new policy change as cannabis legalisation will not be optimised in its first incarnation (Kleiman and Ziskind, 2019). Jurisdictions should accept that, and importantly make it possible, that any legalisation regime is open to making self-adjustments as more experience is gained and informed feedback is available (Carnevale et al., 2017; Kleiman and Ziskind, 2019). Therefore, it is important that legalised jurisdictions are thoroughly and constantly researched to understand all the potential consequences of this relatively new policy change.

1.4.2   Instances of Cannabis Legalisation

Three countries or jurisdictions (as of writing) have implemented an operating legalisation regime that permits not only consumption, possession and personal growing, but actual sale, distribution and large-scale production (i.e., a full industry). Specifically, these locales include Uruguay, Canada and certain jurisdictions in the United States.

In December 2013, Uruguay became the first country to legalise cannabis production, distribution, and use (Cerdá and Kilmer, 2017; Hall et al., 2019; Pardal et al., 2019; Pardo, 2014). Following Uruguay, Canada became the second country to legalise nonmedical cannabis across all its borders in October 2018 (Hall et al., 2019). In the United States (as of this writing), eighteen states and the District of Columbia have legalised cannabis for nonmedical use (Hall et al., 2019; NCSL, 2021). Colorado and Washington state both first legalised recreational cannabis in 2012 (Hall et al., 2019;

NCSL, 2021). Alaska, Oregon, and DC (District of Columbia) followed, legalising in 2014 (Hall et al., 2019; NCSL, 2021). In 2016, four more states voted to legalise cannabis, these being California, Maine, Massachusetts and Nevada. Michigan and Vermont legalised in 2018, with the latter notably becoming the first American state to legalise through the legislative process rather than ballot voting (NCSL, 2021). Since 2018, several other states have legalised cannabis (NCSL, 2021). An important distinction is that cannabis is only legal at the state level in the United States as federally, the plant remains prohibited (Cambron et al., 2017; Caulkins et al., 2015; Hall et al., 2019; Pardo, 2014).

Closer examination of the legal cannabis regulations reveals differences in their legalisation implementation. Uruguayan legalisation is the most restrictive out of the three (Cerdá and Kilmer, 2017; Decorte et al., 2017; Hall et al., 2019; Kilmer, 2019; Kilmer and Pacula, 2017; Pardal et al., 2019; Queirolo et al., 2016). Anyone wishing to use and/or buy cannabis must register with the state cannabis regulatory system. Only citizens or permanent residents over eighteen can register. Users can only choose, and are restricted to, one of three possible cannabis supply sources. These options include, personal cultivation, cannabis social clubs and retail sale through pharmacies (Hall et al., 2019; Pardal et al., 2019; Pardo, 2014). Uruguay created an entire new agency to regulate cannabis, the Institute of Regulation and Control of Cannabis (IRCCA) (Kilmer, 2019; Pardal et al., 2019; Pardo, 2014).

As described previously, cannabis social clubs are self-created groups of individuals who pool together resources to grow cannabis for their fellow members (Caulkins et al., 2015). Uruguay heavily restricts cannabis social clubs; they can only consist of 15-45 members with everyone limited to receiving 40 grams of cannabis per month (Decorte et al., 2017; Hall et al., 2019). Cannabis social clubs can not advertise their activities nor use a public space (Decorte et al., 2017; Pardal et al., 2019). Cultivation and storage sites must be separate, secure and not visible to the public (Pardal et al., 2019; Queirolo et al., 2016). The clubs must also provide a crop and distribution plan (Pardal et al., 2019).

From July 2017, Uruguayan residents could buy up to ten cannabis grams per week from select pharmacies which are strictly controlled by the Uruguayan government (Cerdá and Kilmer, 2017; Pardal et al., 2019). Uruguay initially restricted the pharmacy cannabis THC levels to only 2% but later raised this to 9%, and further they can only sell

cannabis flower (Kilmer, 2019). Uruguay restricts the cultivation of their large-scale cannabis producers to four metric tons per year (Kilmer, 2019; Pardo, 2014). Furthermore, Uruguay only licenses two producers to cultivate cannabis for pharmacies (Kilmer, 2019; Pardo, 2014).

While the Canadian federal government controls and licenses wholesale cannabis producers with no restrictions, provincial governments are the sole wholesale cannabis distributors at the lower market levels (Hall et al., 2019; Kilmer, 2019). Provincial governments are free to set their own regulations as they can control cannabis price, distribution, permitted products for sale, and who can sell in retail (Hall et al., 2019; Kilmer, 2019). Certain provinces only allow local government monopolies of cannabis sale, others allow privately run stores, while others have stores which are a hybrid of the two (Hall et al., 2019; Myran et al., 2019). Further regulation differences include legal age restrictions, where cannabis consumption is still prohibited (for example, if it is restricted to private residences), whether and how much cannabis plants can be self-cultivated for personal use, and tax levels (Hall et al., 2019). Canada initially disallowed edibles and waxes but later developed regulation for their allowance (Kilmer, 2019).

Canada employs several restrictions on cannabis advertising regardless of what provincial governments may wish to do. The Canadian Cannabis Act prohibits any advertisement or promotion that aims to increase cannabis consumption (Rup et al., 2020). Traditional forms of advertisement such as TV or print, lifestyle advertising, and any advertising that could appeal to youths is prohibited (Rup et al., 2020). Cannabis packaging must be plain and contain warnings, which are comparable to common tobacco regulation (Kilmer, 2019; Rup et al., 2020).

The legal jurisdictions within the United States also differ. Some, like Vermont and the District of Columbia, legalised possession and personal cannabis cultivation only but not commercial sale (Hall et al., 2019; Kilmer, 2019; Lancione et al., 2020). Most employ cannabis regulations modelled after alcohol with licenses given to for-profit businesses (Caulkins, 2017; Hall et al., 2019; Kilmer, 2019; Lancione et al., 2020). Legalisation polices also vary on whether personal cultivation is allowed. For instance, Washington state and Illinois prohibit personal cannabis cultivation, while Nevada restricts it for anyone living within a 25-mile radius of a state-licensed dispensary, though most permit personal growing (Hall et al., 2019; Lancione et al., 2020). Taxes amongst states also vary (Boesen, 2020; Cammenga, 2020; Hall et al., 2019). Anyone 21 or over

can buy legal cannabis in jurisdictions that legally sell and the purchaser can be a non-resident or non-citizen (Kilmer and Pacula, 2017; Lancione et al., 2020).

Technically, the first instance of cannabis legalisation in the United States (when considering the middle ground options described in section 1.4) actually occurred in 1975 when the Alaskan US state permitted adults to personally grow and have their own cannabis plants (Caulkins et al., 2015). This policy was in place barring 1990-2003, it was revoked but then later defended and reaffirmed (Caulkins et al., 2015).

The above three countries contain instances of formal legalisation (e.g. passed through regulation or popular vote), however instances of legalisation emerging in a grey area rather than a clear and direct policy change exist (Caulkins et al., 2015; Caulkins and Kilmer, 2016; Kilmer, 2019; Kilmer and Pacula, 2017). The most popular example being Netherlands Dutch Coffee shops, which is a retail sales only legalisation model (Caulkins et al., 2015; MacCoun, 2011). The Netherlands punishes production, distribution, and selling large quantities of cannabis as severely as prohibition regimes do (Caulkins et al., 2015; Maccoun, 2011). However, selling small amounts of cannabis from coffee shops has been tolerated since 1976 (Maccoun, 2011). Thus despite cannabis entering the coffee shop illegally, it is sold legally to retail consumers (Caulkins et al., 2015). The regulation of these coffee shops is left to local governments. The reasoning behind this approach was harm reduction as Netherlands believed removing cannabis use entirely was impossible and that separating cannabis users from using the illicit market (and by extension from those selling harder drugs) is beneficial (Caulkins et al., 2015; De Kort and Cramer, 1999; MacCoun and Reuter, 1997).

There has also been the existence of cannabis social clubs in the grey area of the law throughout Europe, notably in Spain, Belgium, the United Kingdom and France (Caulkins et al., 2015; Decorte et al., 2017). Likewise, more recently, certain countries such as Mexico, South Africa and Georgia have legalised possession, consumption and/or cultivation but not legal sale. However, for the purposes of this thesis, further discussion only covers Uruguay, Canada, United States and the Netherlands, as they have permitted relatively less restrictive legalised regimes and importantly, have done so over a longer period of time.

1.5   *Legalisation Studies*

The literature has explored consequences of cannabis legalisation for both demand and supply. The following sections examine this literature for the Netherlands, Uruguay, United States, and Canada.

1.5.1 Netherlands

Studies examining the impacts of legalisation the Netherlands implemented on cannabis usage have compared Dutch consumption rates to other countries, and/or how usage varies depending on the number of coffee shops in operation. Simons-Morton et al (2010) examined Dutch adolescent use finding that its rates did not differ from Canada or America, barring Dutch girls being slightly less likely to consume cannabis. Both Korf (2002) and MacCoun (2011) observe modest correlations between cannabis usage rates as coffee shop numbers increased or declined. However, both studies found that cannabis use developed similarly to other European countries during the same period (Korf, 2002; Maccoun, 2011). Wouters et al (2012) found that spatial proximity to a coffee shop was not linked to increased prevalence or intensity of use. Overall, studies examining the legalisation regime of the Netherlands and their coffee shops indicate a limited impact on cannabis usage and user behaviour.

Furthermore, the drug policy model of the Netherlands was successful in separating soft-drug cannabis users from the harder drug markets, who now could obtain cannabis through coffee shops rather than interact with illicit suppliers who may also sell harder drugs (Caulkins et al., 2015; MacCoun and Reuter, 2001). However, the Netherlands has had to contend (alongside neighbouring countries) with drug tourism as its relaxed stance attracts people from jurisdictions with stricter cannabis policy (Caulkins et al., 2015; Grobe and Lüer, 2011; van Loon and Rouwendal, 2017).

Van Ooyen-houben et al (2016) examined the consequences of coffee shop restrictions the Dutch government placed in 2012. These restrictions involved only allowing cannabis sale to residents and those whose names the coffee shop recorded in a verifiable members list. Restrictions correlated with decreases in coffee shop usage and an increase in illicit market size. These restrictions when later repealed coincided with coffee shop usage gradually increasing (though not to pre-restriction levels) while the illicit market size started to decrease (van Ooyen-Houben et al., 2016). Consequently, this indicates that the Netherlands tolerating (small quantities of) legal cannabis sale to the

public may encroach upon a proportion of the illicit retail cannabis market. However, as cannabis legally sold to consumers in the Netherlands still originates from illicit production, this approach can not directly impact illicit suppliers operating at higher market levels (Caulkins et al., 2015).

1.5.2 Uruguay

Literature on cannabis usage in Uruguay has focused on non-adult usage rates. Boidi et al (2016) surveyed 294 Montevideo students in 2014 between November and December, examining current and planned adherence to legalisation restrictions. Note, this period excludes pharmacy sales (being only the first year after legalisation) but users could personally grow or join cannabis social clubs. The majority used multiple supply options for cannabis rather than the permitted single choice and reported still obtaining cannabis from illicit sources (Boidi et al., 2016). Boidi et al (2016) also questioned respondents on their intentions to register giving insight into user compliance within a more restrictive legalisation regime. Only 1% of respondents had registered at the time of the survey, 40% described themselves as not planning to register or doubtful that they would (with an equal split). Common reasons for not registering involved confidentiality fears regarding security of their personal information, and the potential corresponding consequences if this information leaked to authorities or employers (Boidi et al., 2016).

Laqueur et al (2020) examined biennial student self-reported survey data from the Uruguayan capital city, Montevideo, and interior regions in Uruguay after legalisation. Further, they contrasted Uruguay with 15 comparable control regions in Chile. Results indicated no impact on cannabis usage or perceived risk of use, while the perceptions of Uruguayan students regarding cannabis availability increased when compared to a synthetic control (58% to 51%). Laqueur et al (2020) argue that the more restrictive Uruguayan approach limited any consequence from legalisation for increasing adolescent usage. However, only one year of this study 2017-2018 occurred when the most popular pharmacy supply option became available in July 2017 (Cerdá and Kilmer, 2017).

1.5.3 United States

Numerous studies have explored the association between American states legalising cannabis and its use.

Several studies have compared usage rates in legalised and non-legalised states. Bae and Kerr (2019) examined 834,274 college students (aged 18-26). The 234,669 students living in legalised states showed a higher trend increase in past 30-day use compared with those in non-legal states. (Bae and Kerr, 2019). Cerdá et al (2017) examined 253,902 United States students in 8th, 10th, and 12th grades between 2010-2015, and compared Washington alongside Coloradoan usage with non-legal states. Washington 8th and 10th graders showed increases in cannabis consumption and a decrease in perceived harmfulness of its use than non-legal states but not for 12th graders, while Coloradoan students showed no differential change in either category.

Cerdá et al (2020) examined and compared marijuana usage alongside cannabis use disorder (CUD) of 505,796 residents living in legal and non-legal states. During 2012 to 2015, an increase in reported adolescent (aged 12-17) CUD and past-month cannabis use occurred following legalisation enactment. Adults 26 or older, also saw increases in past-month frequent cannabis use and past-year CUD following legalisation enactment. Those aged 18-25 saw no associated differences in cannabis usage measures.

Coley et al (2021) examined data that covered 47 American states and 1,077,938 individuals aged between 14 to 18. Through a quasi-experimental difference-in-differences design, they found no significant association between cannabis legalisation and increased chances of cannabis use. Rather, a small significant decline in cannabis use arose (Coley et al., 2021).

Other studies have focused on specific legal states, namely Colorado, Washington, and Oregon. In Colorado, Parnes et al (2018) examined 5,241 college students between spring 2013 to fall 2015, finding cannabis use increased for all students while it increased the most for those older than 21. Brooks-Russell et al (2019) analysed a repeated cross-sectional survey data on Coloradoan adolescent high school students between 2013-2015. A significant decrease in perception of cannabis harm occurred, but no significant effects were observed in lifetime use, past 30-day use, or perceived ease of access in the post-legal sale period (Brooks-Russell et al., 2019). Jones et al (2018) compared four survey waves (between October 2013 and March 2015) of 1,431 Coloradoan college students to the national average estimates for the United States.

Students reporting to have tried cannabis, and to be daily or near daily users, was higher than the national average estimates (Jones et al., 2018).

In Washington, Miller et al (2017) analysed undergraduate student cannabis use rates between 2005 to 2015 from 13,335 observations, and found a significant increase in cannabis usage after legalisation that was larger than national trends. Kerr et al (2018) surveyed 3,451 respondents between 2014-2015, requiring them to report their current use and a retrospective account of pre-legal sale usage. They observed a statistically insignificant 1.2% increase in past year prevalence.

Everson et al (2019) compared usage changes in 85,135 adult cannabis users in Washington before and after legalisation changes (both enactment and legal sale implementation). They also examined the relationship between usage and proximity to a legal store. No significant change in use occurred immediately after legalisation but it did significantly rise as more legal stores opened and expanded. Furthermore these changes in use occurred for those within 18 miles of a store, and in particular those within 0.8 miles (Everson et al., 2019).

Similarly, Ambrose et al (2021) explored the possible relationship between adult use and local access to legal cannabis in Washington. Examining survey data from the Behavioural Risk Factor Surveillance System, they found that the number of cannabis users, alongside frequency of use, increased as stores opened nearer. Specifically, a 33% reduction in travel time was associated with a 0.54% and 0.2% probability increase in using cannabis and heavy use respectively (Ambrose et al., 2021). Effects were concentrated for young adults aged between 18 to 26, women and rural residents (Ambrose et al., 2021).

Burgard et al (2019) conducted a novel method to examine cannabis consumption rates in Washington, by analysing raw wastewater samples for THC-COOH (tetrahydrocannabinol carboxylic acid) which can indicate cannabis consumption levels. In total, 387 samples over a three-year period (between 2013 to 2016) came from two wastewater treatment plants that served roughly 200,000 people. THC-COOH levels increased by 9% per quarter indicating cannabis consumption doubled over this period (Burgard et al., 2019). Burgard et al (2019) notes that most of the increase occurred later in the dataset timeline.

In Oregon, Kerr et al (2017) compared student cannabis use rates (10,924 students in total) in one Oregon university and six other universities in non-legal US states between

2012-2016. Past 30-day cannabis use increased in six universities, while use in Oregon was significantly greater, but for only self-reported heavy alcohol drinkers, who constituted 55% of the dataset (Kerr et al., 2017). Rusby et al (2018) examined two cohorts of Oregon 9th graders finding that legalisation was only associated with an increase in consumption for students who had already used cannabis pre-legalisation.

Paschall and Grube (2020) explored Oregon youth cannabis usage (specifically, 6th, 8th, and 11th graders) but also accounted for legal store availability. Their data came from 247,403 students from 35 Oregon counties (of which, 15 disallowed legal cannabis at the time). Paschall and Grube (2020) found a state-wide increase in cannabis usage and perceived availability in 2015, but counties allowing recreational cannabis sales and those with a higher density of legal cannabis stores were associated with higher cannabis usage and perceived availability (Paschall and Grube, 2020).

Hao and Cowan (2020) examined the NSDUH (National Survey on Drug Use and Health) data at the state level for those 18 and older who reported using cannabis at least once in the past year. Regarding timeframe, Hao and Cowan (2020) compared years 2009-2012 (as pre-treatment groups) with 2013-2014 (as post-treatment groups). They found that usage increased relatively more in jurisdictions bordering Colorado and Washington than other states. However, as their post-treatment group ends at the start of 2014, this analysis does not consider the impacts of legal sale on use (as Colorado began legal sale in January 2014, while Washington started in July of the same year) (NCSL, 2021).

Doran et al (2021) analysed 563 Californian adults (aged between 18 and 24) partaking in a longitudinal study. They found no significant association between use frequency and legalisation, though women showed an increase while men did not. Another longitudinal study by Epstein et al (2020), contrasted cannabis use between 668 parents participating in a longitudinal panel study, finding that those living in legalised, and non-legalised, jurisdictions both showed frequency use increasing. New users primarily drove this increase (Epstein et al., 2020).

Analysis of the first wave (August to October 2018) of the International Cannabis Policy Study (ICPS) compared cannabis consumption between legal US states, non-legal US states, and Canada (Goodman et al., 2020; Hammond et al., 2020). Daily, weekly, and monthly cannabis usage prevalence rates in legal US states and Canada were higher than non-legal US states. Furthermore, US legal states had higher usage rates than Canada

(Goodman et al., 2020). Note, Canada only legalised in October 2018 meaning during the examined period in the above study, only the US contained locales with legal sale implemented.

Several studies have specifically examined the consequences of legalisation for the illicit market, with a large proportion focusing on Washington.

Kilmer et al (2019) examined the Washington cannabis market between July 2016 and June 2017. They estimated that by the third year following legal sale implementation, between 40-60% of THC Washington residents bought came from legal stores, thus indicating the legal market took illicit demand. However, this also means that much of the THC bought (again 40-60%, though a proportion would also include medical sources) likely still came through the illicit market (Kilmer et al., 2019).

Caulkins et al (2019) estimated the Washington cannabis market using a self-report survey, general population surveys and official legal sales tracking system data between July 2016 and July 2017. Washington sale records show $1.17 billion across all products (equivalent to 120-150 metric tons of cannabis flower), while survey responses indicate approximately $1.66 billion (above 200 metric tons of cannabis). Contrasting these two approximate figures indicate a substantial amount of cannabis consumed and supplied in Washington came outside of licensed legal sale (Caulkins et al., 2019).

Burgard et al (2019) wastewater analysis (discussed previously) also indicates the ability of the legal market to displace a proportion of the illicit market. The increase in wastewater THC-COOH levels was lower than expected if the 60% increase in legal sales stemmed from new cannabis users. Consequently, this indicates a sizable proportional increase of these sales came from illicit users (Burgard et al., 2019). However, keep in mind testing cannabis amounts from wastewater is known to possibly overestimate consumption (Bijlsma et al., 2020).

Hansen et al (2020) examined legal cannabis sales data from Washington before, and after, bordering Oregon legalised themselves in 2015. Specifically, sales records of legal stores in Washington counties that bordered Oregon. A 36% drop in sales coincided with Oregon starting legal sale. A possible explanation for this drop are Oregonians, who previously used Washington stores, ceased using these stores as they could now legally purchase it in Oregon (Hansen et al., 2020).

Hansen et al (2020) also examined recent Google reviews for stores in border counties of US states in Washington, Oregon and Massachusetts. They found 38.2% of

reviews for Washington stores came outside the state from Idaho (24%), Montana (4.9%), Oregon (1.8%) and other locations (7.6%). Along the Oregon-Idaho border, 81% of Google reviews for cannabis stores come from Idaho, 10% from Oregon and 9% from other locations. The authors attribute the large proportion from Idaho to its state capital, Boise, being near the Oregon border. In Massachusetts, 54.5% of recent Google reviewers for cannabis stores in border counties came from out of state (barring other locations, this percentage breakdown is New York 14.9%, Connecticut 10.5%, New Hampshire 9.1% and Rhode Island 4.7%). Overall, Hansen et al (2020) indicates drug tourism and cross-border movement of cannabis by consumers (at least between locales neighbouring legal jurisdictions) likely occurs.

Wadsworth and Hammond (2020) examined the likelihood of out-of-state purchases occurring within the United States using data from the International Cannabis Policy Study (ICPS), first wave (August-October 2018). Specifically, from 4,320 US participants who reported past 12-month use. Only 15% reported buying cannabis out of state, with those living in recreationally legalised jurisdictions being less likely to than those in non-legal states (Wadsworth and Hammond, 2020). However, the ICPS first wave asked no specific information on where out-of-state purchases took place, and whether the purchases were illicit or legal (Wadsworth and Hammond, 2020).

Prestemon et al (2019) examined changes in reports of cannabis cultivation grow sites in 111 national US forests between 2004 and 2016. They found a significant association between legalised recreational cannabis and fewer reported illicit grow sites. Furthermore, if a non-legal state bordered a legalised jurisdiction, then illicit grows in the national forests of the former also decreased, indicating that legalisation may reduce illicit production in locales outside its own border. Also, legal states with higher cannabis taxes were associated with smaller decreases in reported grow sites (Prestemon et al., 2019).

Klassen and Anthony (2019) also examined reported cannabis grows in national forests, though focused only on Washington and Oregon. Legalising cannabis was associated with reduced illicit cultivation in national forests of Oregon but not Washington. Klassen and Anthony (2019) account for these differing results to differences in legalisation policy. Specifically, Washington employed a far higher 37% tax on commercial cannabis sales than Oregon which taxed 17% (Hansen et al., 2017; Klassen and Anthony, 2019).

Meinhofer and Rubli (2021) analysed pooled self-reported price data for the United States. They estimated associations between states with legalisation laws and those without using a difference-in-differences model to compare changes in certain outcomes. The former was associated with illicit cannabis prices decreasing by 9.2% (this decrease was driven primarily by cannabis described as low quality, with no significant association seen for cannabis described as higher quality). Additional findings include, larger price decreases being associated with states with higher licensed dispensaries per capita and lowered costs for buying commercial sale licenses. Meinhofer and Rubli (2021) are that more stringent regulation may limit the ability of legalisation to remove local illicit cannabis markets.

1.5.4   Canada

Rotermann (2020) examined the voluntary Canadian National Cannabis Survey (NCS), in total, analysing 17,683 respondents in the pre-legalisation (all of 2018 barring the last quarter) and 11,866 respondents in the post legalisation periods in 2019. Past 3-month use increased from 14.9% to 16.8%, though the percentage of Canadians reporting daily, or almost daily use, remained unchanged at 6% (Rotermann, 2020). Rotermann (2020) also examined the source of cannabis finding that in the first year of legalisation, users self-reporting buying illicit cannabis lowered from roughly 52% to 40%.

Zuckermann et al (2021) using a quasi-experimental design compared cannabis usage among high school students in Alberta, British Columbia, Ontario and Québec, before and after legalisation. Analysing the cross-sectional sample found that cannabis use in the year following legalisation was significantly higher than the previous year. However, the authors conclude that such increases aligned with previous trends alongside it, indicating increased experimentation which did not evolve into regular use (Zuckermann et al., 2021).

Turna et al (2021) examined a cohort of community adults in Ontario, finding small significant changes in cannabis use. Interestingly, they found that those reporting cannabis use in the six months prior to legalisation showed decreases in use, while those reporting no use during the same period showed increases (Turna et al., 2021).

Several studies have specifically examined the consequences of legalisation for the illicit market in Canada. Preliminary reports between the third and fourth quarter of

2018 from Statistics Canada indicate cannabis bought illegally fell from 90% to 79% (Bahji and Stephenson, 2019). Reports indicate that average illicit cannabis price is far lower than average legal prices, $6.37 and $10 per gram respectively (Bahji and Stephenson, 2019).

Goodhart and Ashworth (2019) offer another indicator of Canadian legalisation encroaching upon illicit demand. Within the same month of legalisation, and in particular the week before and after legal sale implementation, material cash circulation fell in contrast with observed rises in previous years. Goodhart and Ashworth (2019) argue a possible cause for this being ex-illicit cannabis consumers using electronic payments at legal stores opposed to using physical currency with illicit suppliers.

Wadsworth et al (2021) explored whether legal cannabis retail availability influenced demand for legal and illicit cannabis. They examined data from the International Cannabis Policy Study (ICPS) for Canadian respondents, specifically those reporting purchasing dried flower in the previous year (amounting to 2,506 participants). Wadsworth et al (2021) found an increased likelihood of buying dried flower was greater for those closer to retail stores (those living within 3km compared to those above 10km) and those with shorter reported travel time (below 5 minutes compared to above 15 minutes).

Mahamad et al (2020) compared online illicit retail prices with legal prices in a two-month period after Canadian legalisation. They used both online directory sites and government retail sites. In total, 185 legal retailers were identified (22 online, 163 physical stores, 65 government run stores and 120 private stores), and 944 illicit retailers (791 delivery only and 157 stores). They found illicit cannabis herb was significantly lower in price and had higher potency. Also, legal private store prices were significantly higher than government run stores (Mahamad et al., 2020).

1.6 *Cannabis Consumer Market Choice Decision*

While the previously discussed literature indicates legalisation can affect and take consumer demand, of key importance is understanding what factors a consumer considers when deciding to use the illicit or legal market. A small body of literature has specifically explored cannabis user purchasing decisions by giving participants hypothetical decision-based scenarios.

Amlung et al (2019) and Amlung and Mackillop (2019) both used a marijuana purchase task (MPT) which asked participants how many grams of illicit and/or legal cannabis they would hypothetically buy at differing prices. Amlung et al (2019) recruited online, 724 participants (who resided in a legalised US state) to explore the substitutability of legal cannabis for illicit cannabis. Responses indicate an asymmetric substitutability, where legal cannabis, if cheaper, comparable or somewhat higher, may substantially decrease illicit cannabis demand. Similarly, Amlung and Mackillop (2019) conducted a MPT on a sample of 287 Canadians from Hamilton Ontario which also found a comparable (to the previous study) asymmetric substitutability between legal and illicit cannabis. However, both studies found if legal cannabis prices were excessively high, any substitutability effect for illicit demand became limited (Amlung et al., 2019; Amlung and MacKillop, 2019).

Zhu et al (2020) surveyed online 817 adults living in US legal states. Participants took part in a best-worst scaling experiment of 20 cannabis relevant attributes where they selected their most and least important attributes. These attributes were in broad categories of product characteristics, quality, packaging, prices and store characteristics. The most popular choices include quality, strain type, price, THC and pesticide use. The least popular being package, label instructions, store hours, label warning and whether public use was permitted. However, Zhu et al (2020) focused solely on consumer purchasing decisions between legal stores rather than the consumer choice between the illicit or legal market.

Other relevant research on consumers in legalised locales have occurred. Fataar et al (2021) surveyed and statistically analysed consumer perceptions of illicit and legal market cannabis quality, price, convenience, safety of use and safety of purchasing. More consumer respondents perceived legal cannabis as safer to buy, safer to use and as being of greater or equal in quality and convenience, while more respondents viewed legal cannabis products as being more expensive than illicit. However, as Fataar et al (2021) point out themselves, their study did not examine whether certain perceptions were associated with actual consumer behaviour.

1.7   *Research Gap*

Cannabis legalisation represents a new and significant drug policy change. As discussed above, in the past several years, literature on the consequences of cannabis legalisation for consumption and illicit markets has grown. However, there are empirical gaps and underexplored issues within the literature regarding the consequences legalisation poses the illicit market, despite this being an often-claimed benefit (Hall et al., 2019).

For instance, as seen in section 1.5, literature examining the influence of legalisation on consumers focuses on prevalence of use or quantitative indicators of them switching to legal markets. However, this literature does not explain or identify the specific reasons for why a consumer desists or continues using the illicit market. While a small set of studies have examined decisions and identified certain important factors (Amlung et al., 2019; Amlung and MacKillop, 2019; Zhu et al., 2020), these have only occurred under hypothetical scenarios, are quantitative analyses and lack deeper qualitative elaboration. Additionally, these studies either focused entirely on price or factors influencing purchasing decisions amongst legal stores only (which does not consider unique factors for illicit purchasing nor the consumer decision between the illicit and legal markets). Therefore, researching the consumer-market choice decision will add to the criminological literature by offering rich qualitative insights which complement the quantitative research into consumer responses. Similarly, there is a relative dearth of literature on how, and why, illicit cannabis suppliers may react to legalisation. Thus, researching supplier reactions will expand the criminological literature on how illicit drug suppliers may react to legalisation.

Gaining qualitative insight into the reactions of illicit cannabis market participants to legalisation is valuable for both policy makers and law enforcement. Qualitative research can give us an explanation for why legalisation impacts the behaviour of illicit cannabis consumers and suppliers, rather than solely estimating or identifying its prevalence. Thus, policy makers may better understand how certain aspects of legalisation influence certain behaviours of interest. For example, understanding how certain policy choices may encourage, or dissuade, consumers from buying legal cannabis are useful for a policy maker considering the value of legalisation in harming the illicit market. Similarly, how illicit cannabis suppliers react to legalisation may be of particular interest to law enforcement who may otherwise be unaware of certain changes in current or ex-illicit cannabis supplier strategies. Furthermore, knowledge of such possible

changes may be useful for law enforcement in structuring their cannabis strategy accordingly in a legalisation context.

Another underexplored area in the literature involves cross-border cannabis movement from a legal jurisdiction into non-legal locales and its impact on other illicit cannabis markets. A few studies have explored this area, however, they do not specify where this cannabis moved from, focus exclusively on retail drug tourism rather than illicit suppliers, and/or focus on the Washington-Oregon border (Hansen et al., 2020; Wadsworth and Hammond, 2020). No empirical academic research has examined the potential impacts of legalisation on cannabis supplier trafficking flows, despite the possible incentive and opportunity to do so for suppliers by legalisation lowering prices (Caulkins et al., 2019; Caulkins and Bond, 2012; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017). For instance, does cannabis trafficking outwards from a legalised state possibly increase, or begin, after legalisation and why? Researching the above will add to the academic literature on the potential consequences of legalisation for drug trafficking.

Knowledge on the above may be of interest to policy makers considering cannabis legalisation and law enforcement. Policy makers may wish to understand the potential risks creating a legal market poses for encouraging cannabis diversion and trafficking from their jurisdiction. Consequently, more informed policy makers in non-legal locales may be better placed to enact policy for dealing with the potential repercussions of cannabis diversion into their jurisdiction. Similarly, any increased understanding on activities of cross-border cannabis movement from legalised locales may help law enforcement better respond to changing illicit cannabis flow dynamics in a post-legal era.

Overall, research into these gaps and underexplored areas of the literature will provide valuable insight into how, and why, cannabis legalisation may impact the illicit cannabis market. Improving the understanding of the relationship of the consequences legalisation potentially poses to the illicit market is of importance to academics, policy makers and law enforcement.

1.7.1 Aim, Objectives, and Research Questions

This thesis aims to analyse why, and how, recreational cannabis legalisation may affect consumer purchasing decisions (i.e., their decision to buy cannabis illicitly or legally),

the modus operandi of illicit cannabis suppliers and wider cannabis trafficking flows. Specifically, for consumers, 'how' refers to whether they continue using the illicit market or cease in favour of using legal suppliers. For suppliers, 'how' refers to whether they stop, continue, or change their illicit strategies in response to legalisation. The 'why' for suppliers and consumers considers the possible underlying reasons for these previously discussed decisions and behaviours.

Achieving this aim involves the following objectives:

- Analyse online forum conversation of self-reported illicit cannabis consumers to understand why a cannabis consumer may, or may not, choose to buy legal cannabis.
- Analyse online forum conversations of self-reported illicit cannabis suppliers to identify and understand their reaction (specifically pertaining to their illicit operations) to cannabis legalisation.
- Examine illicit cannabis price variation in and nearby legalised jurisdictions, in periods before and after cannabis legalisation, to indicate possible shifts in wider illicit cannabis trafficking flows.

Three research questions guide this thesis:

1. What influences a cannabis consumer to use the legal or illicit cannabis market?
2. How do illicit cannabis suppliers respond to recreational cannabis legalisation?
3. Do wider illicit cannabis trafficking flows change in response to recreational cannabis legalisation?

Answering the above three research questions will provide a comprehensive understanding of the possible impact legalisation poses to illicit cannabis markets. Together, the questions give insight into the two key components of any market, demand and supply, alongside considering possible consequences for other nearby jurisdictions.

Chapter 2: Theoretical Framework

This thesis uses Rational Choice Perspective (RCP) and Risk and Prices (R&P) theory to aid in answering its research questions. The following sections discusses these theories and concepts alongside their application to illicit drug market studies.

2.1   Rational Choice Perspective

RCP traces its roots to Jeremy Bentham who discussed rational decision making as a process in which individuals select options that provide them with the most perceived utility (Bentham, 1998). Utility is defined as how much an action creates pleasure or pain, specifically, the resultant sum of pleasure minus pain (Bentham, 1998). RCP views criminal behaviour as purposive and committed with the intention of self-benefitting the criminal in some way (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014). Benefits involve gratifying human motives and desires. RCP argues that criminal decision-making uses the same cognitive strategies as non-criminal decisions where individuals evaluate opportunities, rewards and risk before offending. Committing a crime for self-benefit implies rationality as the offender must go through a decision-making process to make a choice, however simplistic that choice appears.

RCP views crime as a highly diverse set of behaviour with differing motivations, purposes and perceived benefits (Cornish and Clarke, 2017; Kubrin et al., 2009; Leclerc and Wortley, 2014). Likewise, criminals and their decision-making involve differing motivations alongside consideration of different factors for their specific intended crime. Hence, if attempting to understand criminal action, one must consider the contextual nature of the specific crime examined (Cornish and Clarke, 2017, 2014; Leclerc and Wortley, 2014). Thus, the goals and decision-making of illicit cannabis consumers and suppliers will differ from each other.

RCP separates criminal decision making into two categories, involvement and event decisions (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014). Involvement decisions revolve around the criminal career of an individual and may extend over longer time periods (Cornish and Clarke, 2017). Involvement decisions refer to initiation (first involvement with crime), habituation

(continued involvement with crime) and desistance (the cessation of crime) decisions (Cornish and Clarke, 2014).

Factors influencing the initiation, habituation and desistance decisions for a specific crime may differ (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009). For example, factors influencing the initiation decision may include background factors (such as personality and upbringing), current circumstances (such as the lifestyle, needs, motives and perceived opportunities of the individual), and prior experience of committing other crime. Factors encouraging the habituation decision largely lay in repeated success of a crime act, while continued failures influence a desistance decision. Besides failures in crime commission, other external factors (i.e. not directly linked to their criminal activity) such as marriage, divorce, family member death and so on, may influence transitions between the criminal involvement decisions (Cornish and Clarke, 2017).

Conversely, crime event decisions involve the practical preparation, implementation, and completion of a specific crime commission (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014). Event decisions are temporally shorter than involvement decisions, lasting only until the offender completes their crime. Unlike involvement decisions, only immediate circumstantial and situational factors influence crime event decisions (Cornish and Clarke, 2017, 2014).

Both criminal event and involvement decisions may be visually modelled using flow diagrams to identify key decision points and identify influential factors (Cornish and Clarke, 2017, 2014, 2011). For example, a flow diagram of a drug dealer desistance decision would map the key factors contributing to illicit sale becoming less successful (for example, lowered profitability, inability to obtain demand, unable to compete against other dealers or the legal market, etc) and/or circumstantial factors (such as recently married, a traumatic event, increased family responsibilities or legalisation).

Contrastingly, modelling a criminal event decision for a specific drug deal (thus, the decision to sell has already been made), would mainly map out the situational and circumstantial factors affecting the successful completion of an illicit sale. For example, firstly obtaining drugs to sell (i.e., producing or buying it themselves from another supplier) and the actual act of selling (i.e., locating customers, choosing a method of delivery or location, and actions taken to lower law enforcement risk).

Considering the aims of this thesis, theoretical focus is placed on criminal involvement decisions over crime event decisions, and specifically, how legalisation may influence the criminal involvement decisions of illicit cannabis market participants. Recall that legalisation harming or disrupting the illicit market relies on it taking demand away from the illicit market (Hall et al., 2019). Thus, when viewed through the lens of RCP, harming the illicit market constitutes illicit cannabis consumers choosing the desistance involvement decision (Cornish and Clarke, 2017). Conversely, consumers continuing to choose habituation reflects little to no harm.

Likewise, differing supplier criminal involvement decisions reflect differing consequences and harms that legalisation poses for illicit markets. A supplier choosing desistance reflects harm towards the illicit cannabis market (i.e., it possibly shrinking) while habituation reflects little to no harm nor consequences. The initiation decision may invite more complicated interpretation, as it may entail illicit market harm whilst also indicating displacement. Displacement refers to crime being shifted in form, location or time, and can be classified into different types such as temporal, tactical, target, territorial and functional (Reppetto, 1976; Windle and Farrell, 2012). For instance, a supplier ceasing illicit cannabis sale in favour of trying a new crime indicates illicit cannabis market harm, but functional displacement has occurred. Displacement is an issue as it means crime has not decreased but has merely changed form in some way. Additionally, the initiation decision may entail legalisation benefitting the illicit market, for example, if the illicit cannabis supplier experiences opportunity to conduct new types of profitable cannabis crime previously unavailable, such as legal cannabis diversion.

Thus, considering how legalisation may influence the criminal involvement decisions of cannabis users and suppliers is a useful framework for understanding how, and why, legalisation may harm or impact the illicit cannabis market. People comprise markets, thus, their individual decisions together indicate and constitute wider change.

An important facet of RCP is the emphasis placed on the individual and situational interactions (Cornish and Clarke, 2017; Wortley, 2013). RCP views crime as the resultant output of the interaction between a motivated offender and criminal opportunity. This focus on the situational causes of crime directly contradicts dispositional criminological theories that argue a "root cause" for crime (Cornish and Clarke, 2017, 2014). Here RCP terms these root causes as 'distal' causes, and situational influences as proximal causes (Cornish and Clarke, 2014; Ekblom, 1994). RCP does not completely ignore these distal

causes but views them as performing an orientation role (Cornish and Clarke, 2017, 1985). Distal causes influence firstly, the perceptions of individuals on the viability and attractiveness of criminal activity, and secondly, their material circumstances alongside exposure to problems and opportunities.

This emphasis on the proximal or situational causes of crime reflects the aim of RCP to understand, prevent and disrupt criminal action through policy (Cornish and Clarke, 2017, 2014). As action and opportunity result in criminal action, RCP focuses on understanding this area where an offender must interact with their environment to achieve their goal. Thus RCP argues that influencing the proximal or situational causes of crime is a feasible and realistic way to tangibly influence crime (Cornish and Clarke, 2017, 2014, 2011). By understanding opportunity, situational influences, choices and decision-making processes, RCP aims to identify ways to reduce offending through manipulating these factors (Cornish and Clarke, 2017). This emphasis is in keeping with the focus of this thesis on understanding how cannabis legalisation as a policy (and a situational change) influences the actions of illicit cannabis market participants.

2.1.1 Bounded Rationality

RCP differs from other rational choice or conventional economic theories of human behaviour through not assuming an infallible mythical offender with perfect rationality who makes optimal decisions (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014). For example, perfect rationality dictates a drug dealer would flawlessly make decisions regarding illicit sale which maximise their profit, whilst faultlessly limiting any law enforcement risk. Decisions would stem from the dealer having perfect knowledge of their situation and circumstance (such as law enforcement strategies, market prices and drug quality). Furthermore, such a drug dealer would never allow irrational emotions to influence (even slightly) their choices.

Contrastingly, RCP adopts a different view of rationality (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978, 1955). The concept of bounded rationality (originally coined by Herbert Simon), is known as a descriptive decision-making model which aims to identify how people actually think, and importantly account for deviation from optimisation (Wortley, 2014). Furthermore, bounded rationality models aim to explain

how judgements and decisions are reached rather than assessing only their end outcomes (Selten, 2002).

Bounded rationality argues that human decision making occurs under imperfect conditions (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978, 1955). Human decision making is bounded by both individual limitations and by environmental structures that constrains individual experiences (Selten, 2002; Wortley, 2014). Herbert Simon used a metaphor of scissors to describe this duality, "Human rational behaviour (and the rational behaviour of all physical symbol systems) is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor" (Simon, 1990 p.7). As a scissors requires two blades to work, to fully understand human behaviour requires acknowledging the influences of both the individual and their environmental influences (Gigerenzer and Selten, 2002; Lockton, 2012). More specifically, decision making may be limited by time (i.e. generally some deadline exists for choosing an alternative decision so the decision maker must do the best they can within their, often unknown, deadline), information available (which is constrained and affected by environmental structures), and the personal experiences of the individual (influenced by environment) alongside their thinking capacity (i.e., cognitive limitations or individual influences) (Selten, 2002; Simon, 1978, 1955; Wortley, 2014).

Thus, how well a drug dealer succeeds in selling may depend on, for example, their own business acumen, people skills, drug production skills, self-discipline, knowledge of law enforcement strategies, and/or natural intelligence (i.e., individual differences). Equally however, environmental influences may affect illicit sale success in several ways. For instance, past life experiences of the drug dealer may influence their aforementioned skills and knowledge, i.e., their acquirement, improvement, and/or degradation. Further, these life experiences may shape their interpretation of relevant information (such as law enforcement strategies, market prices, drug quality, competitor activity, etc) and how well the drug dealer can capitalise on it. For example, a drug dealer who underwent a business degree (past experiences), may find greater success in generating profit as their education taught them relevant skills and knowledge which may transfer to a successful illicit cannabis drug operation.

Importantly, using bounded rationality accounts for the possibility of individual choices being non-optimally made, while not entirely excluding rationality from the decision-making process (Cornish and Clarke, 2014; Selten, 2002; Simon, 1955; Wortley,

2014). As Selten (2002 p.15) points out "… behaviour should not be called irrational simply because it fails to conform to the norms of full rationality". To apply a simple rational choice model (i.e., one where the drug seller or consumer has perfect information and flawlessly maximises utility from all the relevant information) would be dubious when considering literature that indicates illicit drug market participants do not necessarily always conform to such simple rational models (Caulkins and MacCoun, 2003; Levitt and Venkatesh, 2000; Sandberg, 2008). Hence, RCP, with its adoption of bounded rationality, is well situated, and suited, to explaining illicit cannabis market participant behaviour which does not necessarily conform to full rationality (Caulkins and MacCoun, 2003; Cornish and Clarke, 2014; Levitt and Venkatesh, 2000; Sandberg, 2008; Selten, 2002; Simon, 1955; Wortley, 2014).

The original incarnation of bounded rationality by Herbert Simon views the decision-making process as defined by several features, these being aspiration levels, search for alternatives and satisficing (Selten, 2002, 1998; Simon, 1957; Wortley, 2014). An aspiration level is the value of a goal that the individual wants to fulfil or surpass. Aspiration levels guide the decision-making search process. For example, a drug dealer may desire making a certain amount of profit, hence profit is the goal, while how much profit is the aspiration level set on that goal.

Search for alternatives means individuals are seeking different means to satisfy their goal, which importantly, must be found as the individual is not assumed to know (Selten, 2002, 1998; Wortley, 2014). To better understand this, a distinction must be made between familiar and unfamiliar problems (Selten, 2002). The former refers to problems the decision maker knows the optimal way to solve, which may occur if trained to deal with a specific problem or if the solution is obvious due to its simplicity. The latter refers to problems where the decision maker is unaware of the solution and thus must discover one (Selten, 2002). In real life, many problems are generally unfamiliar. An offender may not necessarily be aware of what crime may best fulfil their profit goal aspiration level and thus must search for it. For example, a drug dealer may find their current product no longer provides satisfactory profits. However, they do not necessarily have knowledge of whether another drug market or different strategy can satisfy their goals. Thus, the dealer must discover an alternative option themselves which may invite non-optimised behaviour as they experiment with options.

Once the individual finds a satisfactory decision alternative that fulfils or surpasses their aspiration level, said decision takes place, with this process termed satisficing (Selten, 2002, 1998; Wortley, 2014). The use of the word satisficing (and variants such as satisfactory, satisfy, etc) goes beyond semantics and reinforces the view that individuals are not optimisers maximising utility. Rather than infallible optimisers, individuals are satisfiers who seek a solution until a satisfactory outcome is reached, i.e., meets or surpasses their aspirational level for a particular goal (Selten, 2002; Simon, 1978, 1955). However, due to individual and environmental differences, their choice is rarely optimised (Cornish and Clarke, 2014; Selten, 2002; Simon, 1955; Wortley, 2014). For example, an individual may discover trafficking cannabis to a nearby jurisdiction can satisfy their profit goal and settle on that, while a more profitable strategy, such as selling cocaine, may never have been considered as they lack access to it.

Further, aspiration levels can change (termed aspirational adaptation), within the search for alternatives process as an individual examines alternative decisions through adjustment steps (Selten, 2002, 1998; Simon, 1978, 1955). For instance, if no satisfying choice emerges, then the goal aspiration level may move downwards until an available choice can satisfy said goal. Likewise, aspiration levels may increase for a goal variable if finding satisfactory alternatives prove easy in an upward adjustment step. Less than optimal decisions may also occur if an aspiration level is met too quickly, and the individual loses any reason to search for a better option. Lastly, an aspiration level for a goal variable may remain steady, neither decreasing nor increasing.

2.1.2   Rational Choice Perspective Applied

Several studies have applied a rational choice perspective onto illicit drug market participants. Jacques et al (2014) used a rationality perspective to understand why illicit drug dealers did not take advantage of every customer (i.e., overcharge the buyer). By analysing qualitative data from interviews with incarcerated illicit drug sellers, the study identified several rational reasonings behind the decision to rip off a buyer or not (Jacques et al., 2014). Jacques and Bernasco (2014) used RCP to conduct crime script analysis of drug dealing in the Amsterdam Red Light District. The constructed crime script for these drug dealers showed that each step in their modus operandi stemmed from a rational and/or opportunistic reasoning (Jacques and Bernasco, 2014).

Jacques and Wright (2011) applied RCP and RAT (Routine Activities Theory) to explore the influence of informal control (i.e., measures of control that drug suppliers place on other drug suppliers, such as negotiation, avoidance, retaliation and tolerance) on drug sale frequency and prices. Analysing interviews of drug suppliers showed that forms of informal control affected drug sale prices and frequency, with Jacques and Wright (2011) concluding these effects stemmed from rationality and opportunity.

Other studies have examined drug traffickers specifically. Decker and Chapman (2008) administered questionnaires to federally incarcerated drug traffickers. The study concluded that these inmates began this activity because they personally viewed drug trafficking as offering more rewards than the risk and pain of being caught (Decker and Chapman, 2008). While Toth and Mitchell (2018) analysed qualitative data from the DEA (the Drug Enforcement Administration in the United States) consisting of interviews with informants operating in international drug trafficking organisations alongside other DEA sources of information, they aimed to investigate whether the responses of drug traffickers to international drug interdictions was in keeping with RCP. The study concluded that drug trafficking organisations adjust their operations to international drug interdiction interventions to ensure their product reaches consumers, in a manner that aligns with RCP (Toth and Mitchell, 2018).

Aldridge and Askew (2017) aimed to explore how drug sellers and buyers on cryptomarkets perceive and minimise risks of detection and arrest through analysing Silk Road (an ex-cryptomarket) vendor transactions and user-archived forum conversations. The study concluded that the use of cryptomarkets gave sellers and suppliers more information than they would have otherwise. This greater access to information lessened informational constraints on Silk Road participants and allowed these users to more accurately assess, and better reduce risks of apprehension and arrest (Aldridge and Askew, 2017).

Some literature has qualitatively examined the decision-making process of cannabis users from a rationality choice perspective. Shukla (2005) found cannabis consumers desisted using cannabis when judging the associated risks as exceeding any benefits, with risk constituting whether cannabis use threatened other aspects of their life. Shukla (2006) examined cannabis use patterns of individuals with roles in conventional society (i.e., the interviewees held jobs and these ties meant these individuals had much to lose if caught). These cannabis users indicated an underlying cost-benefit assessment

as they described making rational decisions regarding whether to use cannabis or not. They considered how much cannabis to consume, how much spare time they had and whether other tasks currently needed doing (Shukla, 2006).

Osborne and Fogel (2008) concluded their interviews of cannabis users supported a rational choice view of drug use. They found that their interviewees did not use cannabis compulsively and generally used it only in recreational time (Osborne and Fogel, 2008). The interviewees held rational goals for using cannabis, specifically its enhancement of relaxation and concentration during leisure activities (Osborne and Fogel, 2008). Further, their interviewees reported no dependency or addiction problems, though Osborne and Fogel (2008) note this may stem from their middle-class background and immediate social environment. Moreover, the cannabis use of their interviewees appeared solely for recreational purposes rather than a method of escape from social or psychological issues (Osborne and Fogel, 2008).

Shukla and Kelley (2007) found that the decision making process of drug users (cannabis and non-cannabis) changed as these individuals gained more experience in drug use. Their decision-making processes became more sophisticated, and drug specific factors related to their first-hand experiences began influencing their decisions. Comparatively, their decisions in the pre-initiation and pre-experiment phase contained far more uncertainty and was based on external information, i.e., parents, peers, drug prevention programs and media (Shukla and Kelley, 2007).

Parker et al (1998) use of surveys and interviews found youth decisions, of whether to use drugs or not, stemmed from them weighing up the benefits of costs in a decision-making process covering several factors, such as their income, drug use risks and being caught.

A relevant example of illicit market participants dealing with limited information (and thus this impacting their decision-making) stems from illicit drug sellers and buyers possibly having imprecise information regarding the quality of drugs they sell and buy respectively (Caulkins, 2007; Decorte, 2011; Reuter and Caulkins, 2004). Thus, their decisions (such as whether a purchase is a good deal or not) were constrained by their available information (Cornish and Clarke, 2014; Selten, 2002; Simon, 1955; Wortley, 2014).

Overall, these studies indicate that a rationality perspective is well suited to understanding, analysing and interpreting the decisions illicit cannabis consumers and suppliers make in response to legalisation.

2.2   *Risk and Prices*

Reuter and Kleiman first discussed the relationship between illicit drug prices and risk (Reuter and Kleiman, 1986). Reuter and Kleiman (1986) took an economic approach towards understanding the participation of illicit drug sellers, who they argued were primarily motivated by earning money rather than a pathological or ideological reason (Caulkins and MacCoun, 2003; Reuter and Kleiman, 1986).

A key point of Risk and Prices (R&P) theory is that risks associated with illicit drug sale explains the high prices of illicit drugs, as conventional production costs for illicit drugs do not explain its high prices (Caulkins and MacCoun, 2003; Caulkins and Reuter, 1998; Reuter and Kleiman, 1986). If illicit drugs were cultivated or produced under legal settings (comparable to that seen for legal products such as coffee), prices would be far lower (Caulkins and Reuter, 1998). More recently, this point has become relevant for those fearing potential price drops for cannabis produced under a legalised and commercialised setting (Caulkins, 2010; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017).

Reuter and Kleiman (1986) discussed risk increasing illicit drug prices in three main ways. Firstly, successful law enforcement supply-side interventions such as drug seizures remove product from the market which the supplier must replace (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). Secondly, additional costs may emerge from illicit drug suppliers having to operate inefficiently and/or invest in strategies to lower the chance of detection (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). Lastly, working in the illicit drug trade requires some level of compensation to justify the associated risks of working in an illicit market. These risks include law enforcement but also the potential violence from other illicit drug market participants (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986).

Thus, law enforcement can be viewed as informally taxing illicit drug suppliers (Caulkins and MacCoun, 2003; Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). However, as R&P view illicit drug suppliers as primarily motivated by money, they pass

these incurred costs onto the consumer by raising retail prices (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). Hence, higher risk should theoretically increase prices (Caulkins and MacCoun, 2003; Reuter and Kleiman, 1986).

However, R&P may over-assume an optimised rationality in illicit drug suppliers. R&P assumes that illicit drug suppliers are making purely rational assessments of risk based on accurate information with calculated probabilities (Caulkins and MacCoun, 2003). While illicit drug sellers likely respond to incentives and disincentives, this does not support said suppliers as being optimisers who are maximising utility (Caulkins and MacCoun, 2003). As previously discussed, a view of optimised rationality is not adopted in this thesis nor RCP, but rather a bounded view of rationality is taken (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014). This view of bounded rationality accounts for suppliers responding to risk in ways that do not necessarily conform to full rationality.

Legalising cannabis may feasibly affect law enforcement risk for illicit suppliers. For example, law enforcement must now distinguish between legal and illicit cannabis when working out which may be exploitable. For instance, concealing illicit operations and operating more efficiently may prove easier in a legalised locale. Likewise, if post-legal punishment for the illicit (or rather unlicensed) cannabis sale is less than the pre-legal period, suppliers may require less risk compensation. Further, if legalisation does reduce law enforcement risk, then R&P theory indicates illicit suppliers may experience cost reductions as informal law enforcement tax reduces (Reuter and Kleiman, 1986). Consequently, this may have important implications for illicit cannabis supplier criminal involvement decisions (Cornish and Clarke, 2014). Thus, incorporating R&P theory is useful for understanding how, and why, changes in law enforcement risk (from legalisation) may affect supplier-decision making processes.

2.3   Summary

This thesis applies an RCP and R&P framework to empirically examine the consequences legalisation poses to the illicit cannabis market and its participants (Cornish and Clarke, 2017, 2014; Reuter and Kleiman, 1986). This framework is suited to satisfying the objectives of this thesis alongside answering its research questions. Recreational cannabis legalisation constitutes a situational change in the environment for illicit cannabis market

participants, which may feasibly impact their decision-making processes and criminal involvement decisions. Legalisation presents consumers with a new option for legally obtaining cannabis which simultaneously constitutes a possible desistance choice. For illicit cannabis suppliers, they are now operating amidst a new legal competitor which may threaten their demand. Consequently, suppliers may feel inclined to cease operations (desistance) or explore new options (initiation). Alternatively, consumers and suppliers may choose habituation. Understanding the underlying reasoning underpinning these criminal involvement decisions offers valuable insights and interpretation of how legalisation may influence the illicit market. People constitute markets; thus, how illicit cannabis consumers and suppliers react to legalisation is indicative of potential wider illicit market responses to legalisation.

Chapter 3: Methodology

This chapter discusses and details the methodology underpinning this thesis. Accomplishing the aim of this thesis involved employing a mixed methods approach utilising both quantitative and qualitative methods on novel data sources. The following sections detail the research process of this thesis, its limitations, and the reasoning for key methodological decisions.

3.1   Research Paradigm

Kuhn (2012) described paradigms as consisting of generalisations, beliefs and values of a community. Underpinning this research project is the pragmatism paradigm which holds several philosophical assumptions (Creswell, 2008; Creswell and Clark, 2017; Tashakkori and Teddlie, 2010; Teddlie and Tashakkori, 2008; Yvonne Feilzer, 2010). Ontologically, pragmatism views reality as consisting of both singular and multiple versions. Epistemologically, the researcher collects any data that can suitably answer their research questions. Methodologically, both qualitative and quantitative approaches should be combined to examine these different layers of reality.

Mixed methods research constitutes an alternative methodological choice to using only qualitative or quantitative approaches. Mixed methods involve the researcher utilising both qualitative and quantitative data to answer their research questions or test hypotheses. Importantly, mixed methods should, in some way, combine together both types of data and their results during the research project (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008; Yvonne Feilzer, 2010). The use of a pragmatism paradigm stemmed from the belief that answering the research questions of this thesis required a mixed methods approach. Thus pragmatism, being a philosophical partner to the mixed methods approach, made it a natural choice for incorporating both qualitative and quantitative methods (Denscombe, 2008; Tashakkori and Teddlie, 2010; Yvonne Feilzer, 2010). Two reasons justified a mixed methods approach.

Firstly, the population of interest (i.e., illicit drug market participants) is a 'hard-to-reach' or hidden population (Duncan et al., 2003; Shaghaghi et al., 2011). No national survey consistently asking operating illicit cannabis suppliers and cannabis users on their illicit market involvement in a legalised context exists, nor do official records of market

transactions (later sections fully discuss these accessibility difficulties). Therefore, potential data on this population are scarce and early on, the possibility always loomed that suitable data sources were non-existent. Therefore, restricting the present project to solely quantitative or qualitative data threatened to limit the scope of this research.

Secondly, the legalisation of a large-scale commercial cannabis market and industry is a relatively recent phenomenon (Caulkins et al., 2015; Kilmer et al., 2019; Pardo, 2014). Little to no literature (at least at the start of this research process) existed exploring consumer and supplier reactions to cannabis legalisation (in the context of their continued interaction with the illicit market). Hence, exploring this specific phenomenon with a mixed methods approach offered a more comprehensive and corroborated view than relying on one source. Furthermore, using data derived from qualitative and quantitative methods provided a richer understanding from looking at legalisation through different perspectives and layers (Creswell and Clark, 2017). Ultimately, interpretating both quantitative and qualitative data together helped produce a more comprehensive understanding of the present research focus than relying solely on one would (Creswell and Clark, 2017; Denscombe, 2008; Jick, 1979; Yvonne Feilzer, 2010).

This thesis uses a mixed methods convergent design and specifically, a parallel-databases variant which involves three main steps (Creswell and Clark, 2017). Firstly, the researcher gathered relevant quantitative and qualitative data that could indicate potential impacts of cannabis legalisation on the illicit cannabis market. Secondly, the researcher separately and independently examined both datasets using appropriate analysis methods. [1] Importantly, both types of data offered independent findings (i.e., results from one does not rely on the other) and aid in answering research questions. Lastly, the researcher interpreted how both sets of results converge, relate, and/or combined to better understand how legalisation may impact illicit cannabis markets. Overall, by using different data which complemented each other, the present research could better achieve the aim of this thesis (Creswell and Clark, 2017; Morse, 1991; Teddlie and Tashakkori, 2008).

---

[1] In practice, exceptions were made in referencing qualitative findings during the quantitative analysis chapters, as they improved interpretation of results in a more coherent and reader friendly manner. Nonetheless, the initial planning and carrying out of the quantitative analyses occurred independently.

3.2   Reddit Analysis

The qualitative part of this thesis involved analysing online forum conversations from the popular social media website Reddit. [2] This section details the methodology behind the Reddit analysis. Firstly, it discusses what Reddit is, the data it offers, and how to collect it. Secondly, it discusses the value of, limitations of, and considerations required when using online social media data such as Reddit. Lastly, the thematic analysis method used to analyse the Reddit data is covered.

An ever increasing proportion of human life occurs online (such as social media or online purchasing of products) which leaves digital traces that constitute naturally occurring data (Décary-Hétu and Aldridge, 2015; Enghoff and Aldridge, 2019). One example of this digital data are online forum discussions, which occur on social media platforms such as Reddit which encourage collective community discussions (Caplan and Purser, 2019; Medvedev et al., 2017). Reddit offers opportunity for researchers to explore a vast and rich array of collectively discussed experiences.

3.2.1   Reddit Description

Reddit aggregates news, offers an online content rating system and provides digital discussion space (Medvedev et al., 2017). In January 2020, Reddit (2020) described receiving over 52 million daily users, 50 billion daily views and having 100,000 unique online communities. Alexa (2021), a web traffic analysis company, ranked Reddit as the 19th most popular internet website.

The structure of Reddit is unique and requires some explanation, it consists of numerous 'subreddits' containing discussions and posts under an overarching theme or topic (Caplan and Purser, 2019; Medvedev et al., 2017). For example, a gardening subreddit only permits posts on gardening, the football subreddit only contains posts on football and so on. [3] Any registered user can post a link, a title or their own content, which others can reply to (though non-registered users may still view any content) within

---

[2] The URL for Reddit is https://www.reddit.com/.

[3] Subreddit moderators serve the role of removing irrelevant comments and keeping posts aligned with the overarching theme.

subreddits. Users may formally follow subreddits which is also a requirement to post in a specific subreddit. Every subreddit post may have one or more parent comments replying directly to the initial post, while child comments reply to the parent. Likewise, users may reply to child comments and so on.

The voting system of Reddit is a key feature where registered users can either upvote or downvote a post or comment once. Thus, every comment and post hold a numerical score (which Reddit terms karma). Downvotes lower this score by 1 while upvotes increase it by 1. Higher voted posts become more visible for other Reddit users, though over time newer content replaces said post regardless of the votes amassed (Medvedev et al., 2017).

3.2.2   Using Reddit

The researcher first considered using Reddit while personally coming across a Reddit post asking illicit cannabis dealers about their experiences with recreational legalisation. Initial skim reading indicated the qualitative analytical potential of using Reddit as data for answering the research questions. Following this, the researcher discovered other academic literature that also used Reddit and comparable online data sources, which reinforced the initial impression that Reddit could become a valuable data source (Caplan et al., 2017; Davey et al., 2012; Ladegaard, 2019; Literat and van den Berg, 2019; Mitchell et al., 2016; Record et al., 2018; Sharma et al., 2017; Toth and Mitchell, 2018; Wang et al., 2015).

Thus, in 2018-2019, using the inbuilt Reddit search function, the researcher identified six posts from the period 2014-2018 querying illicit cannabis dealers on their actions and reactions to recreational cannabis legalisation. These six Reddit posts were chosen as they explicitly asked how recreational cannabis legalisation impacted illicit cannabis dealer activities with no ambiguous wording. AskReddit is a popular subreddit that focuses on textual user generated discussions (Caplan and Purser, 2019). The subreddit only permits open-ended questions and aims to foster wider community discussion. At the time of writing, the subreddit notes under its 'about community' section that it has roughly 32 million Reddit users following (AskReddit, 2021).

Data collection simply involved copying and pasting the Reddit post contents into Word documents. Following this, the documents were imported into Nvivo 12 for further

analysis (Jackson and Bazeley, 2019). In total, roughly 14,000 comments came from the six AskReddit threads whose dates ranged between 2014-2018. While using an API to gather Reddit user comments is possible, it has a 1,000 comment limit. [4] As three of the AskReddit posts contained over 1,000 comments, an API risked missing valuable and insightful comments.

Preliminary reading indicated many parent comments (and their subsequent child comments) discussed consumer experiences with recreational cannabis legalisation. Of particular interest were those discussing their reasoning for continued illicit cannabis buying or shifting to legal purchases. Qualitatively exploring the reaction of both the demand (consumers) and supply (dealers) to recreational cannabis legalisation, offers a more comprehensive perspective into the impacts of legalisation for the illicit cannabis market. Furthermore, these two perspectives explicitly link, as consumers switching to the legal market would impact the dealers who supplied them. Thus, exploring both perspectives could identify an overarching online narrative.

A methodological choice emerged of whether to include the Reddit comment vote score system into analysis. Other studies have used the upvote system to identify specific comment threads for analysis (Caplan and Purser, 2019). Ultimately, the researcher ignored this voting system for several reasons. Underlying voter intentions are unclear as there is no strict enforceable requirement for an upvote to reflect the accuracy of a comment or post, nor can the initial commenter challenge a downvote or identify which user voted. Voting only, at best, indicates a Reddit user likes or dislikes a post or comment but not why. For example, perhaps a post received downvotes for inaccuracy but equally so, another possibility may be other users finding their own anecdotal experiences disagree. Even so, a user may feasibly upvote a post they dislike, for instance to increase its visibility so others can chastise the commenter.

Secondly, research indicates the amount of upvotes a comment receives may also depend on factors unrelated to its content (Weninger, 2014). For instance, comment replies occurring within 90 minutes of the initial post may receive more upvotes. Similarly, as higher scoring comments become more visible (i.e., they appear first),

---

[4] As clearly stated on the Reddit website itself, see https://www.reddit.com/dev/api. API stands for Application Programming Interface and, in this context, is a means to obtain data from Reddit posts.

Reddit users may post on these comments regardless of whether it is topical in order to increase the visibility of their own comment by proxy (and thus gain more upvotes themselves). Ultimately, the researcher concluded that using the voting system as an indicator of user comment accuracy was not reliable for the purposes of this thesis. Furthermore, using vote score to select comments risked losing potentially insightful comments. Thus, the researcher focused solely on the contents and descriptive meaning of the comments rather than inferring any characteristics from comment scores.

3.2.3   Reddit Data Considerations

There are several strengths and limitations of using online data such as Reddit user discussions, this section first discusses the former before acknowledging the latter. One advantage of using online data is accessing certain populations. Conventional data collection methods may suffer from several limitations if researching difficult-to-reach populations, such as requiring a contact, geographical constraints, and gatekeepers restricting access (Aldridge and Bouchard, 2019; Enghoff and Aldridge, 2019; Miller and Sønderlund, 2010). Thus, data from online platforms such as Reddit offer a new reach that conventional methods may lack. The present research clearly demonstrates this strength in practice. Firstly, illicit cannabis users and dealers are a traditionally difficult-to-reach population (Duncan et al., 2003; Shaghaghi et al., 2011). Secondly, as the research involves recreational cannabis legalisation impacts, analysis required participants residing in or near a jurisdiction that had legalised (whilst the researcher resided in the UK). Yet, despite these serious obstacles, through Reddit, the researcher accessed posts on relevant topics about a distant location.

A second advantage involves potentially accessing illicit cannabis market participants who avoided law enforcement detection. Research into offline illicit drug markets primarily originates from samples associated with law enforcement (Enghoff and Aldridge, 2019). For example, data associated with law enforcement activities (such as drug seizures, fake drug buys and so on) or from researchers interviewing already arrested or incarcerated drug suppliers (Barratt and Aldridge, 2016). Such methods primarily give insights into drug sellers who law enforcement know, and/or caught, while drug suppliers who remained undetected, remain undiscovered (Enghoff and Aldridge, 2019). Using

Reddit forum data means possibly gaining insights from illicit cannabis suppliers and users who avoided law enforcement detection.

Furthermore, the above becomes particularly important when considering the present research interests focus on recreational cannabis legalisation and not law enforcement (though the latter remains an important factor). Through Reddit data, analysis can identify and examine illicit cannabis market participant experiences and choices which legalisation primarily influenced. For example, only through using information from a dealer untouched by law enforcement could analysis gain insight into how legalisation encouraged desistance. If police arrested and/or punished said dealer, their reasoning for desisting (if they did) may arise (at least partly) from law enforcement rather than legalisation.

Thirdly, online data is unimpacted by researcher effects (Enghoff and Aldridge, 2019; Hewson et al., 2016; Robinson, 2001). While Reddit users explicitly know their discussions are publicly visible, they are unaware that researchers can retrospectively analyse their comments. Therefore, Reddit users are unlikely to change their behaviour (i.e., their Reddit conversations) as they are unaware of being researched (potential ethical issues of this are discussed later in section 3.4).

Similarly, online data may potentially offer unique access into stigmatised or illegal behaviour that people may be reluctant to discuss. Internet-granted anonymity may increase the willingness to discuss sensitive and stigmatising topics such as illicit cannabis sale (Caplan and Purser, 2019; Enghoff and Aldridge, 2019). Several studies have utilised online social media, like Reddit, as data sources to qualitatively explore stigmatised behaviour such as smoking, violence and bullying (Calvin et al., 2015; Chou et al., 2011; Kim et al., 2018; Patton et al., 2014; Struik and Baskerville, 2014). Similarly, Reddit offered the researcher an opportunity to explore descriptive conversations of stigmatised behaviour, i.e., illicit cannabis sale and use. Reddit offers such anonymity as account creation requires no self-identifiable information nor is it viewable when looking at a Reddit user profile. Thus, such anonymity may encourage illicit cannabis market participants to discuss their experiences more truthfully with less self-censoring.

Lastly, there are clear practical benefits of collecting online data as less resources are typically used. For example, gathering online data entails no travel costs nor time investment in transcribing verbal communications (as user accounts are already in text format). Hence, collecting online digital data can result in a, relatively, far larger scale

dataset at a cheaper cost (Enghoff and Aldridge, 2019; Kozinets, 2002). The present research demonstrates this, as the researcher gathered thousands of potentially useful comments from Reddit posts. As a sole PHD researcher, obtaining a comparable amount of information through conventional methods such as an online survey would be infeasible.

There are also clear limitations of using data from online platforms such as Reddit. Firstly, validity issues may arise from the anonymity that Reddit grants, as users may easily lie or distort the truth in their comments (Enghoff and Aldridge, 2019). Importantly, it is not possible to directly verify whether Reddit user comments accurately reflect their lived experiences and behaviours. Likewise, social desirability bias may influence social media conversations (Caplan and Purser, 2019). For instance, Reddit users may comment inauthentically to garner more upvotes (Weninger, 2014). While the researcher strived to be unbiased during data collection and later selection of key comments, the researcher acknowledges that unconsciously, information and confirmation biases may have partly influenced their decisions (Casad, 2007). However, through transparent reporting of methodology, decisions, and analysis limitations, any such biases (if they exist), will reveal themselves to the reader.

Secondly, a limitation stems from the lack of primary data collection. Comments arise entirely from what the user chose to discuss, meaning important details relating to research questions may remain unanswered (Enghoff and Aldridge, 2019). Furthermore, the researcher was unable to ask follow-up, or clarification, questions of Reddit users. Alternatively, Solymosi et al (2018) argues that without the researcher reigning online users to certain discussions, their topics reflect what they subjectively consider as most important. Thus, while the researcher did not specifically question Reddit users, their discussions may organically reflect their most important views and experiences (Solymosi et al., 2018).

Lastly, online research is limited as it rarely allows for demographic generalisability. Firstly, only participants of said online communities are represented, meaning those who sell or use illicit cannabis but do not use Reddit are unrepresented. Furthermore, people using online communities may differ on socio-economic factors such as age, sex, wealth, location, education and drug use or supply patterns (Caplan et al., 2017; Enghoff and Aldridge, 2019). Thus, only the experiences of the certain demographic that use Reddit are visible in this research. Additionally, online data may

offer poor demographic information on its users (Caplan and Purser, 2019; Enghoff and Aldridge, 2019). This is true for Reddit which does not offer demographic data on its users nor does it require such information during account creation. Consequently, it is impossible to know how representative (or non-representative) the examined Reddit users are of cannabis users or suppliers. [5]

However, in practice, the researcher was able to glean key geographical information from 'reading between the lines' of Reddit user comments. Importantly, the researcher could identify if Reddit users resided in, or near, legalised locales. For instance, all the chosen Reddit posts specifically directed their questions to those living in, or near, legalised jurisdictions. Thus, posters of parent comments (i.e., ones directly replying to the initial question) could be inferred as living in, or near, legalised locales. Furthermore, as chosen comments all discussed legalisation and the legal cannabis market in a relevant way, by definition, the commenter implies they have directly experienced it. However, the specific legalised locale for each commenter was not always knowable, though many did specifically discuss locations. Of course, the above all assumes the Reddit users examined for this research are being truthful.

In summary, Reddit shows clear strengths and limitations for qualitative inquiry, and is a valuable source of data for the present research as it offers potential insights on all three research questions underlying this thesis. Table 1 below summarises the above discussion.

Table 1. Strengths and limitations of using Reddit.

Strengths	Limitations
Access to difficult-to-reach populations	Users may lie or distort the truth
Access to those who avoided law enforcement	Social desirability bias
Unimpacted by researcher effects	Lack of primary data collection
Unique access into stigmatised or illegal behaviour	Represents only online Reddit users
Practical	Lack of demographic information

---

[5] The Pew Research Centre, which conducts representative surveys on American internet users (Auxier and Anderson, 2021; Duggan and Smith, 2013), found males, younger individuals and non-rural residents were more represented on Reddit. However, this pertains to Reddit users in general, rather than AskReddit subreddit users specifically.

3.2.4   Thematic Analysis

The following section details the thematic analysis method applied to the Reddit data. Thematic analysis is a qualitative method that identifies, analyses and reports patterns or themes within data (Bailey, 2017; Braun and Clarke, 2006; Hawkins, 2017; Patton, 2002). As the research questions were crafted within a pragmatic paradigm, interest was in the experiences of illicit cannabis users and suppliers (Bailey, 2017; Braun and Clarke, 2006). In line with this approach, the researcher identified themes at the semantic level, thus they emerged from the explicit or surface meaning of Reddit user discussions (Bailey, 2017; Braun and Clarke, 2006).

Regarding the exact analytical process, the researcher followed the five steps Braun and Clarke (2006) describe, while utilising the qualitative analysis software Nvivo v12 (Jackson and Bazeley, 2019).

The first step involved data familiarisation (Braun and Clarke, 2006). Familiarisation involved lengthy reading of the Reddit comment threads. Two key points became apparent from this initial reading. Firstly, relevant and insightful comments relating to the research questions existed. However, secondly, many more comments deviated into topics unrelated to the research questions. For example, a comment thread may initially discuss the reaction of a cannabis supplier to legalisation, but subsequent replies strayed into off-topic areas such as favourite films or political discussion. Similarly, other comments discussed cannabis related topics unrelated to the research questions. For instance, discussions of favourite foods to eat while intoxicated on cannabis. Irrelevant comments to the research questions were not unexpected given the nature of social media platforms like Reddit (Caplan and Purser, 2019; Enghoff and Aldridge, 2019).

Nonetheless, irrelevant comments presented an issue that the researcher dealt with in the following thematic phase, creating initial codes (Braun and Clarke, 2006). The initial codes phase split into two parts. First, all collected Reddit comments were re-read while identifying only those explicitly relating to the research questions of this thesis. Thus, the researcher only included comments which directly discussed topics that explicitly related to the research questions of this thesis, and which gave insight into the criminal involvement decisions of illicit cannabis consumers and suppliers (Cornish and

57

Clarke, 2017, 2014; Wortley, 2014). Figure 1 visually summarises the screening and selection process.
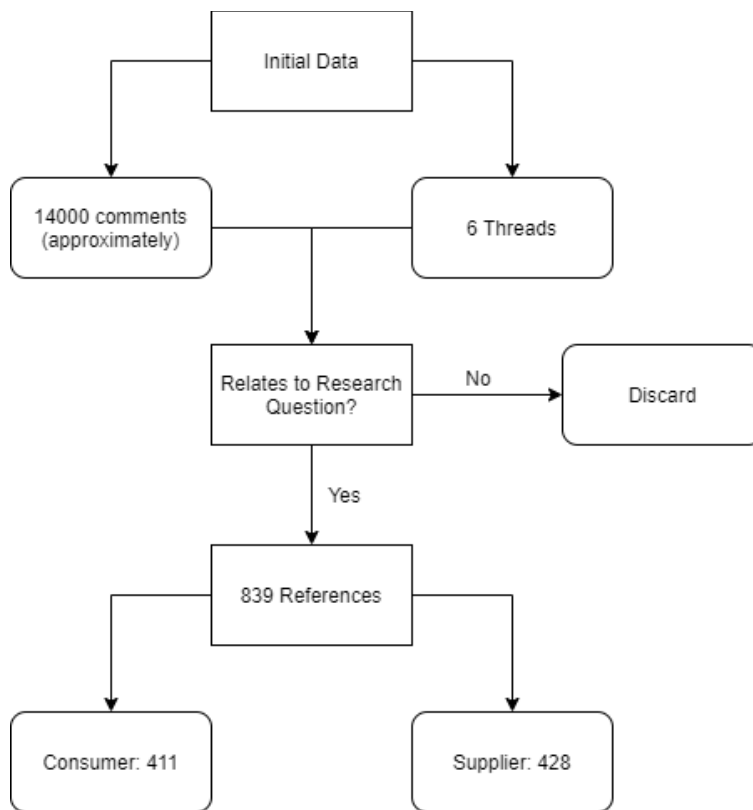
Figure 1. Reddit comment screening process visualised

The last step depicted in Figure 1 involved separating references into the consumer or supplier category. This separation was a natural choice which reflected that the research questions of this thesis focused on consumers or suppliers. What designated a reference as belonging in the consumer or supplier category was whether it discussed supplier or consumer activity, regardless of the possible market role (as indicated by the comment) of the Reddit user. For example, if a Reddit user who self-described themselves as a cannabis consumer commented on the activities or decisions of their supplier, this entered as a reference into the supplier category.

The majority of references placed in the consumer category came from Reddit users who were cannabis users. Likewise, most comments in the supplier category came from Reddit users who were (or had been) cannabis suppliers, however, some came from two other sources. Firstly, from consumers discussing the activities of their current or ex-illicit cannabis suppliers. Secondly, from Reddit users referring to someone they knew as a supplier, such as a 'friend' or 'brother'. Ultimately, these latter two sources can only be

considered as second-hand accounts of supplier activities. [6] Nonetheless, these comments still gave relevant insights regarding supplier activities, and being a purchaser or close to a supplier gives credibility to their accounts. Furthermore, accounts from Reddit users who were, or are, cannabis suppliers can reinforce these second-hand accounts.

Indicating the market role of the Reddit user was possible in three ways. [7] First, some users self-identified themselves as a consumer or supplier. Second, the contents of the comment clearly indicated the market role of the Reddit user. For example, a Reddit user describing having to lower their own cannabis prices to maintain demand explicitly indicates a supplier role. Third, market roles may be inferable by considering the context available from examining the comment, or initial post, the Reddit user replied to. A simple example would be an initial comment stating that, "As a cannabis user, legal prices are too high to warrant buying it" and a reply stating, "Yeah, I feel the same way". The context given by the initial comment infers the replier as also being a cannabis consumer (and sharing the same perspective of legal prices being too expensive). [8]

For certain collected comments that offered relevant insights, it was impossible to clearly indicate a market role. However, the content of these comments indicated these Reddit users had knowledge and experience with the illicit market in some way, despite how and why being unclear. Nonetheless, the content of these comments still related to other comments (with known market roles), while giving useful perspectives that help answer the research questions of this thesis.

The second part of the initial codes phase involved the researcher closely re-reading the selected comments from the data familiarisation stage. The researcher opted to use an open coding approach during this stage, where codes emerged and changed

---

[6] As much as it is tempting to interpret Reddit user descriptions of an anonymised person as a possible method for suppliers to discuss their own activities in a more deceptive, though safer, way, it would be inappropriate to do so. Indeed, some of these comments placed quotations around the word they used to refer to the 'supplier' they knew, which may indicate this being true for some.

[7] Of course, in keeping with discussions of limitations in section 3.2.3, these methods all assume Reddit users are being truthful in the first place.

[8] However, it proved impractical to translate this wider context and inter-connectedness of Reddit user discussions into a written thematic analysis chapter. Hence, efforts were made to choose excerpts in which the market-role of the Reddit user would be more self-evident for the reader.

throughout this process. The previous deductive screening process ensured most emergent codes or themes related to the research questions.

The following thematic analysis stages involved identifying and reviewing themes originating from the coded data. Themes identified a significant, or revealed an interesting aspect, of the data which related to the research questions. The first stage involved searching for candidate themes arising from the codes rather than the raw data, and identifying differing hierarchal levels, i.e., some played an overarching role while others became subthemes of the former.

Secondly, the researcher reviewed candidate themes at two levels. Level one involved reviewing the data extracts constituting each theme to ensure they supported them. Level two entailed a similar process but applied at a larger scale, i.e., reviewing whether the themes (as a whole) accurately reflected the data. These reviews resulted in removing certain themes, combining others into single themes and breaking up others (Braun and Clarke, 2006).

Following this, Braun and Clarke (2006) discuss identifying the essence of each theme, and then the themes as a collective. Each individual theme was analysed in detail alongside acknowledging its 'story'. Further, the researcher considered how each theme, and subtheme, fit into the overarching story of the data in relation to the research questions (Braun and Clarke, 2006).

The final stage, producing the report, involved telling the story of the Reddit analysis and conveying its value (Braun and Clarke, 2006). This last stage constitutes the two chapters which focus on consumer and supplier conversations respectively, while the discussion chapter focuses on demonstrating its value.

3.2.5 Reflection

While Reddit, and other comparable mediums, demonstrate great potential as data sources for research, it remains relatively unused in academic research compared to more traditional data sources, such as surveys, field studies, experiments, reports, interviews, etc (Enghoff and Aldridge, 2019; Giglietto et al., 2012; Jürgens, 2012). Some researchers may possibly disregard such data as it is unfamiliar despite it potentially offering unique opportunities for research. After using Reddit, the researcher found it offers great potential for qualitative research, as do other studies using it indicate (Caplan et al., 2017;

Davey et al., 2012; Ladegaard, 2019; Literat and van den Berg, 2019; Mitchell et al., 2016; Record et al., 2018; Sharma et al., 2017; Toth and Mitchell, 2018; Wang et al., 2015). Reddit permits discussions on almost everything, and unique subreddits exist for an extraordinarily large number of topics. Thus, Reddit proves a flexible data source that may offer unique research opportunity for numerous interests besides, and including, illicit drug research.

For those considering using Reddit, the present researcher offers some practical advice from their own experiences. Firstly, some papers exist that specifically describe what Reddit is and how it functions (Medvedev et al., 2017; Weninger, 2014). Particularly, Caplan and Purser (2019) do a fantastic job of explaining Reddit alongside demonstrating how they used it for their own qualitative study. Enghoff and Aldridge (2019) also focus on unsolicited online data specifically in the context of illicit drug research. Secondly, reading other studies using Reddit, or comparable platforms, for various research (some of which are referenced in the previous paragraph) may aid a researcher in devising their own approach. Thirdly, and a personal suggestion, one should simply use the website as a regular user, even if briefly. Reddit is free to use and while the above studies (and this chapter) formally explain the website, using it personally gives an intuitive understanding. Thus, armed with more formal academic introductions, alongside an intuitive grasp of Reddit, one can judge whether it is suitable for their own specific research interests and constraints.

Lastly, it is worth discussing the value of using sources such as Reddit in a post-COVID-19 world for research. At the time of writing, countries are suffering difficulties associated with COVID-19 which may particularly cause issues for qualitative researchers who traditionally use face-to-face methods. While several fortunate countries may have access to large quantities of vaccines (such as the United Kingdom, United States and Israel to name a few), which may make conducting face-to-face research more feasible, others may not be so fortunate. Thus, utilising online social media resources such as Reddit may become a valuable, or even a necessary option, for researchers contending with unpredictable physical restrictions.

3.3 Price Data

The quantitative part of this thesis involved analysing illicit cannabis price data which can offer insights into illicit drug markets (Caulkins and Reuter, 1998). For instance, research on drug prices and consumption indicate that lower prices may coincide with more consumption, and vice versa (Caulkins, 2007; Gallet, 2014; Kilmer et al., 2015; Olmstead et al., 2015; Pacula and Lundberg, 2013). Illicit price fluctuations can also indicate effectiveness of law enforcement interventions on traffickers and illicit markets (Caulkins and Reuter, 2010; Kuziemko and Levitt, 2004; Reuter and Kleiman, 1986). Other researchers have used price data to research and identify drug trafficking flows (Caulkins and Bond, 2012; Chandra et al., 2014, 2011; Chandra and Barkell, 2013; Chandra and Joba, 2015; Giommoni and Gundur, 2018; Lahaie et al., 2016; Zook et al., 2012).

The price analysis discussed here reflects this third use and focuses on the third research question of this thesis, which asks whether recreational cannabis legalisation impacted wider illicit cannabis trafficking flows. [9] The researcher used illicit cannabis price data to explore whether drug trafficking flows changed in the United States following legalisation. Before discussing the data source and methods used, it is important to understand exactly how price fluctuations may indicate trafficking flow changes from legal cannabis sale.

Firstly, as discussed in section 1.2 of the literature chapter, research indicates illicit drug prices are lower when sold nearer its production source (Caulkins and Bond, 2012; Chandra et al., 2014, 2011; Chandra and Barkell, 2013; Chandra and Joba, 2015; Giommoni and Gundur, 2018; Lahaie et al., 2016; Reuter, 2014; Zook et al., 2012). For example, Giommoni and Gundur (2018) showed UK city cannabis prices decreased the further south one goes, thus indicating imported cannabis enters from the south. Importantly, this empirical literature highlights that, if trafficking is occurring from a legal state to a nearby non-legal jurisdiction, the data should show the former as having a lower average cannabis price.

---

[9] Nonetheless, analysis of price data has some relevance for the other two research questions when considering the likelihood of suppliers and consumers considering cannabis price when making their criminal involvement decisions (Cornish and Clarke, 2017).

Secondly, as discussed in section 1.4.1 of the literature chapter, mass-produced cannabis under a legalised setting may entail cheaper production costs per plant (compared to illicit operations), enough that retail sold legal cannabis could feasibly undercut illicit market prices despite taxation and other regulatory costs (Caulkins, 2010; Caulkins and Bond, 2012; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019). Consequently, a profitable opportunity arises for individuals to traffic diverted legal cannabis into illicit markets in other jurisdictions. Hence, the diverted cannabis may depress illicit prices as some illegal suppliers may have to lower their own prices to compete and maintain demand (Gale, 1955; Mankiw, 2011). Thus, if jurisdictions bordering the legal state experience a price decrease (i.e., a drop and/or a decreasing trend), then this may infer wider trafficking flow changes from traffickers diverting legal cannabis into non-legal locales.

Of course, such a price drop may reflect other possibilities besides supplier-based diversion. For instance, if consumers in nearby non-legal locales begin satisfying their own demand through diverting legal cannabis themselves, local suppliers may similarly be forced to lower their own prices in attempts to maintain lost demand (Gale, 1955; Mankiw, 2011). Equally, the legal market may inadvertently create, or greaten, arbitrage opportunity for traffickers if it lowers local illicit prices (i.e., local illicit suppliers lowering their own prices, in response to legal market competition and prices, to maintain demand). Thus, a price decrease in nearby non-legal jurisdictions may stem from suppliers trafficking cheaper illicitly produced cannabis (i.e., not diverted legal cannabis) from the legalised locale.

Nonetheless, all these possibilities indicate some influence of a legal cannabis market on other non-legal jurisdictions. Importantly, any price drop and/or change in trend must coincide with legal sale implementation to support it being associated with legalisation policy. Of course, other factors may also affect illicit drug price, thus the researcher accounts and controls for these other influences (where possible) during analysis (which is elaborated on in subsequent sections).

3.3.1 Searching for Price Data

To accomplish the research goals, price data was required with three key characteristics. First, the data must cover illicit prices so to capture illicit market trends. Second, it must

pertain to a relevant location, for instance, English illicit cannabis price data is impractical for exploring legal market diversion, as no nearby jurisdiction permits a largescale legal commercial market.[10] Furthermore, price data was needed which covered jurisdictions within the same geographical region that contained both legalised and non-legalised locales for exploring trafficking flow changes. Third, the price data must be longitudinal, covering enough time before and after legalisation occurs, allowing for a comparison of illicit price trends preceding and following legal sale.

Illicit cannabis price data are relatively scarce as illicit cannabis suppliers and users constitute hidden populations (Duncan et al., 2003; Shaghaghi et al., 2011). Therefore, these three data requirements presented a challenge as it created a small set of suitable data sources. This section discusses the data search to demonstrate the consideration of various illicit drug price sources.

The United States has several organisations that historically offered illicit drug price data. For example, the U.S. Department of Justice's (DOJ) National Drug Intelligence Center (NDIC) released yearly drug market analyses reports containing illicit cannabis price data for numerous regions within the United States.[11] Similarly, other government agencies such as the DEA STRIDE (system to retrieve drug information from evidence) and Illegal Drug Price/Purity Reports (IDPPR) have offered drug price data (Caulkins, 2007). Unfortunately, these sources only offer data for periods before any jurisdiction in the United States started commercially selling cannabis recreationally. Thus, the above sources failed the time requirement.

With official government data discounted, the researcher turned towards more novel sources utilising voluntary submissions. Narcotic News is a website that focuses on illicit drug enforcement (Bond and Caulkins, 2010).[12] The website posts articles on drug busts, cash seizures and illicit drug concealment methods. Importantly, Narcotic News displays illicit cannabis prices for various drugs including cannabis for the United States. While Bond and Caulkins (2010) discussed Narcotic News as encouraging only

---

[10] The Netherlands employs an informal retail sales only policy, not a largescale commercial production and sale (Caulkins et al., 2015; MacCoun, 2011). Furthermore, no price data was collected when, or before, the Netherlands first introduced this policy.

[11] See https://www.justice.gov/archive/ndic/topics/dmas.htm

[12] See www.narcoticnews.com.

self-report by law enforcement agencies, the website now appears to allow anyone to submit prices. Narcotic News reports cannabis at pound quantities for each state within a price range. For some states they note the cannabis quality, for example, as high or low grade, however for others no such description is provided. Some states have price submissions specific to cities though never more than four in one state. Unfortunately, Narcotic News fails to report price submission dates, thus determining whether a submission occurred before or after legalisation is impossible.

A second self-reported source is the website PriceOfWeed.com (POW) that crowdsources illicit cannabis price data (Caulkins and Bond, 2012; Giommoni and Gundur, 2018). Crowdsourcing invites the general public to voluntarily participate in online activity to complete a task (Estellés-Arolas and González-Ladrón-de-Guevara, 2012). The task for POW users involves reporting their cannabis purchase characteristics. POW offers key transaction measures of illicit cannabis price by quantity at set amounts ranging between 1-28 grams, by location, a self-reported quality measure (low, medium, and high quality are the only available options), and cannabis strain name. Unfortunately, POW offers no historical records of past user submissions, only those submitted relatively recently.

Lastly, High Times is a longstanding, monthly-releasing magazine covering cannabis and related topics since 1975 (Bond and Caulkins, 2010; Caulkins and Bond, 2012). The magazine contains a 'Trans-High Market Quotations' (THMQ) section that reports illicit cannabis prices voluntarily submitted by High Times readers. Readers submit three pieces of information: prices at the ounce level (28 grams), their cannabis strain name and purchase location. Price submissions primarily cover the United States, offering data at the state level and a sub-state location (such as a city). Furthermore, as the magazine has run for decades, the THMQ offers prices across a large time period before and after instances of legalisation in the United States. Of these known available data sources, High Times best satisfies all three requirements by having accessible illicit cannabis price data at geographically relevant locations (i.e., in the United States) and across a suitable timescale.

3.3.2   Assessing High Times

While High Times offers unique opportunity for research, it has several clear limitations:

- It only offers cannabis transaction prices at the ounce level, possible price differences in transactions emerging from quantity discounts remain hidden (Caulkins, 2007; Doyle, 2016).

- High Times only offers prices on cannabis bud (Green, 2009) so prices on other related products (such as edibles, oils, waxes, hash, etc) are unrepresented.

- They also irregularly report jurisdictional prices, thus some states and cities are more represented than others while many sub-state locations are unrepresented.

- High Times generally reports price submissions for larger cities in each state meaning rural and suburban illicit cannabis transactions are underrepresented.

- High Times offers no information on quality, thus price increases or decreases occurring from quality fluctuations are unaccounted (Caulkins, 2007).

Various limitations of the High Times data also stem from it being self-reported. For instance, always possible are individuals reporting false information intentionally or accidentally. Unfortunately, there is no way to validate price submission accuracy. Likewise, there is an assumed trust that High Times reported the price transactions accurately. However, the researcher saw no clear incentive for the magazine to intentionally deceive their readers. Arguably, High Times would desire to accurately report illicit cannabis price information so readers (who relied on it for illicit price information) would continue buying their magazines.

Regarding cannabis quality, even if the organisation requested some description of quality or potency from their readers, such a measure would likely be subjectively based. The literature indicates that consumers are generally unaware of the quality of drugs bought from offline illicit cannabis markets (Best et al., 2004; Decorte, 2011; Evrard et al., 2010). Likewise, literature shows that illicit drug suppliers themselves often have imperfect knowledge of the quality of their own product if buying from a larger distributer (Caulkins, 2007; Reuter and Caulkins, 2004).

Moreover, being self-reported, High Times offers a convenient, rather than random, sample as readers voluntarily participate (Battaglia, 2008; Spiegelhalter, 2020). High Times also offers no demographic information on those submitting price transactions. Thus, this limits the generalisability of any possible findings from the High Times data as it is unclear whether the prices observed are representative of retail illicit cannabis price transactions (Spiegelhalter, 2020). Therefore, any findings only apply to the High Times sample itself. While unfortunate, using a nonprobability sample when

researching a hard-to-reach population such as illicit drug market participants is not unexpected, and is considered more acceptable (Phua, 2004; Spiegelhalter, 2020). Numerous studies using illicit drug price data to research trafficking flows have used non-random samples from sources as relevant data is relatively scarce (Caulkins and Bond, 2012; Chandra et al., 2014, 2011; Chandra and Barkell, 2013; Chandra and Joba, 2015; Giommoni and Gundur, 2018; Lahaie et al., 2016; Zook et al., 2012).

However, even assuming obtaining a random sample of willing illicit cannabis consumers and/or suppliers was possible, this approach would suffer from its own methodological issues. For example, it would be assuming these consumers and participants could accurately recall purchases stretching back years at regular intervals (recall, the third data requirement). This becomes amusingly preposterous when considering that cannabis intoxication can affect memory recall (Nadia and Robert, 2007). An individual reporting purchased cannabis price (presumably) around the time of purchasing to an organisation for recording, is undeniably more accurate than relying on naturally faulty human memory.

Thus, the only feasible option for a longitudinal illicit cannabis price data source, for the purposes of the present research, is from a pre-existing organisation that systematically recorded prices as High Times did.

3.3.3   Data Collection

Conveniently, High Times in recent years began uploading current and past magazines digitally. Thus, the researcher accessed these magazines and the THMQ data online. However, the price data was not in an easily accessible format such as an Excel spreadsheet or Word document. High Times uploaded scanned pages of each magazine and uploaded them as an image. Therefore, the researcher could not simply copy and paste the information into an Excel spreadsheet. Further, the researcher had to locate the page number with the price data.

Transcribing the actual data into Excel proved time-consuming. Initially, the researcher successfully used a program that converted the image-based text into a format which could directly enter an Excel spreadsheet. This process itself was time consuming as it required visual checks to ensure the accuracy of the converted text as errors were possible. Unfortunately, the visual quality of earlier magazines deteriorated sufficiently

(around year 2014) that manually typing of the data became the only option. The researcher then typed out the data while rechecking the information after recording it for each month. In total, 184 magazine issues stretching between January 2005 to April 2020 were collected.

3.3.4   Descriptive Statistics Procedure

Descriptively analysing High Times splits into two parts, the first overviews the entire dataset, whilst the second focuses on smaller sub-regional groupings. Both sections include price data summary stats (such as the count, mean, median, standard deviation, minimum and maximum values), alongside scatterplot, boxplot and histogram graphs (Witte and Witte, 2016). The analyses were conducting using R package, with some data preparation occurring in Excel (Grolemund and Wickham, 2016). Before any price analysis occurred, ounce prices were converted into gram prices.

Besides giving an initial picture of the dataset, the overview analysis examines cannabis prices for the entire United States under different contexts. Firstly, how prices changed overtime. Secondly, whether prices differed if submissions occurred under differing regulation contexts which include, recreationally legalised, medically legalised (which splits into two further categories), or neither. The researcher specifically considered medical cannabis regulation as literature, and research indicates it may influence illicit prices (Pacula et al., 2015; Zook et al., 2012).

Lastly, it was important to analyse whether prices differed by proximity to locales with legal sale. Proximity consists of three categories constituting whether submissions occurred in a jurisdiction with legal sale, bordering a jurisdiction with legal sale or neither. Similarly, the researcher considered the medical regulation context in this proximity analysis. Overall, this overview analysis indicated whether High Times cannabis prices were comparatively lower in, or near, recreationally legalised states compared to other contexts.

However, entirely possible are sub-regional differences in illicit prices which the overview analysis may miss. For example, prices may have decreased more in, or near, one legal state than another, thus, the researcher analysed the data subregional levels to explore such possibilities. Subregional groupings contained a single legal state and their immediate bordering neighbours. These legalised jurisdictions are Colorado,

Washington, Oregon, California and Nevada. [13] Here, analysis compared prices between the pre-legal and post-legal sale periods of each subregional group. Through summary statistics and scatterplot graphs, the researcher identified whether clear price fluctuations coincided with legal sale beginning for each subregional group.

Certain rules applied for this sub-regional analysis. Firstly, analysis only included sub-state locations (i.e., cities) that contained at least one price submission before and after the relevant legal sale start date. Hence, analysis always contrasted post-legal sale prices against pre-legal prices for the substate locations. Secondly, in scenarios where a bordering jurisdiction later legalised themselves, analysis only used pre-legal prices from said jurisdiction. For example, Washington borders Oregon and has legal sale for (roughly) a year before Oregon, so analysis only used Oregon price submissions occurring in this year period for the Washington subregional analysis. The reason being, after Oregon implements legal sale, it becomes impossible to differentiate the impact of Washington (which represents a potential cross-border impact from legal sale) from Oregon (which represents a potential impact from local legal sale), and from one another on Oregonian illicit prices.

Lastly, in cases where a non-legal state borders two other states, both of which implemented legal sale during the High Times dataset timeline, analysis placed the non-legal state in the subregional group which first started legal sale, as this represents a clearly defined intervention point that constitutes bordering a state with legal sale for the first time. For example, both Washington and Oregon border Idaho, but Washington implemented legal sale first, thus, analysis placed Idaho in the Washington subregional group.

Ultimately, this subregional analysis identified which groups experienced a clear illicit cannabis price drop coinciding with legal sale starting, which as explained in section 3.3, may infer cross-border cannabis movement. Therefore, while acknowledging the limitations of High Times discussed in section 3.3.2, groups showing these drops may deserve further analysis. Conversely, groups not showing such price drops indicate a lack of impact.

---

[13] Other legal states implemented legal sale too late to establish a post-legal sale price trend to compare with pre-legal sale prices.

3.3.5   Interrupted Time Series Design

Following descriptive analysis, the researcher statistically modelled the neighbouring jurisdictions in any subregional group which showed clear price drops coinciding with legal sale. Specifically, the researcher conducted two statistical analyses. Firstly, an interrupted time series design using segmented regression, and secondly, a multiple linear regression. This section first discusses the interrupted time series analysis, while the following covers the multiple linear regression. Again, these analyses were conducting using R package (Grolemund and Wickham, 2016).

Time series data constitutes a continuous sequence of observations from a population taken repeatedly over time (Bernal et al., 2017; Wagner et al., 2002). In an interrupted time series analysis, the time series data covers a period with a known intervention that may conceivably affect the outcome of interest (Bernal et al., 2017; McDowall, 2004; Wagner et al., 2002). In the present case, legal sale starting represents the intervention, while price constitutes the outcome of interest.

Segmented regression is one appropriate method for an interrupted time series design. It separates the outcome of interest into two or more segments which contain their own regression line, using the intervention date to separate data segments, i.e., before and after cannabis legal sale implementation (Bernal et al., 2017; Wagner et al., 2002). Each segment contains two parameters of interest: level and trend (Wagner et al., 2002). The beginning value of any time interval (such as the y-intercept for the first segment and the first value immediately following any new segment) constitutes the level. The slope (or rate of change) of the measure constitutes the trend (i.e., the change in cannabis price over time, each month).

The analysis involves comparing the level and/or trend changes between the different segments (Wagner et al., 2002). A clear level change indicates a sudden impact or association with the outcome of interest by the intervention. If the slope increases or decreases in the segment following the intervention, this indicates a gradual impact or association on the outcome of interest. Using segmented regression, the researcher formally estimated the possible association of legal sale on illicit cannabis prices.

There are several assumptions to consider when selecting interrupted time series as an analysis technique (Bernal et al., 2017; Schober and Vetter, 2021; Wagner et al., 2002). First, the intervention must occur during an explicit point of time. Second, there must be an intervention that can clearly distinguish between the pre-intervention and post-

intervention period. Third, the data should be in count, continuous or binary format, and preferably be averages. Fourth, the data must be sequential and occur either side of the intervention over a sufficient period.

Besides the above, no hard limits exist for the number of data points needed, with the statistical power depending on various factors such as data point distribution in the segments, data variability, confounder effects and strength of effect (Bernal et al., 2017). Power may increase if more data exists on either side of the intervention, however, if the period considered is too wide, it risks masking the current underlying trend with past historical events. Also, an equal distribution of data points before and after the intervention improves power.

Any time series analysis should account for seasonality. Seasonality refers to possible regular and recurrent patterns in time series data that occur each year which can bias results. Having sufficient data either side of the intervention (i.e., that covers at least a year or more) allows for identifying and accounting of any possible seasonal patterns in the outcome of interest (Bernal et al., 2017; Schober and Vetter, 2021; Wagner et al., 2002).

The High Times price data met all the required assumptions and requirements for statistical power. Legal cannabis sale implementation in the United States occurred at known dates that clearly defined a pre-intervention and post-intervention period. The price data is sequential (recorded monthly) and occurs either side of recreational cannabis legal sale implementation across several jurisdictions in the United States. The collected data also stretches across fifteen years offering ample time to identify any possible seasonal effects.

As the price data variable (outcome of interest) is continuous, the researcher used segmented least squares regression analysis, which is expressed as:

$$Y_t = B_0 + B_1 X_t + B_2 X_i + B_3 X_{ti} + e_t$$

Where (Bernal et al., 2017; Schober and Vetter, 2021; Wagner et al., 2002):

- Y_t is the mean cannabis price reported at a specific period of time, in this case, month.

- X_t is a continuous variable that counts each unit increase from the beginning of the dataset. Thus, B_1X_t estimates the change in outcome given a unit increase in time and represents the baseline trend. In this context, B_1X_t measures the average cannabis price change per increase in month, which establishes the underlying trend.

- X_i is a dummy variable indicating whether the cannabis price submission occurs before or after legal sale implementation (pre-intervention coded as 0 and post-intervention coded as 1). Thus, B_2X_i measures the level change in mean cannabis prices immediately following the intervention.

- X_t counts the months since the intervention occurred, while months before is coded as 0. Therefore, B_3X_{ti} represents the trend change in monthly cannabis prices in the post-intervention period compared to the pre-intervention period. Note, B_3X_{ti} is an interaction between time and the intervention.

- e_t refers to the error term.

3.3.6   Multiple Linear Regression

Alongside the segmented least squares regression, the researcher built a separate multiple linear regression to account for the possible impact of independent variables on the price data (Aiken, 2004; Tarling, 2009; Uyanık and Güler, 2013). A range of factors are likely to influence prices across the examined period. For example, as R&P indicates, illicit cannabis prices may have fluctuated from changes in law enforcement risk rather than commercial legal cannabis stores opening (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). The specified model controlled for these observable variables:

$$Y = B_0 + B_1X_1 + B_2X_2\ldots + B_nX_n + e$$

Where (Tarling, 2009; Uyanık and Güler, 2013; Witte and Witte, 2016):

- Y refers to the predicted value of the dependent variable. Specifically, this is cannabis price at a specific location.

- B_1X_1 and B_2X_2 correspond to the first and second independent variables respectively. B_nX_n refers to any potential independent variables.
- e refers to the error term.
- B_0 is the value of Y when all independent variables equal zero.

Variable selection was based on the literature and the theoretical framework underpinning this thesis. The following paragraphs detail these independent variables and the reasoning for including them in the model. [14] The researcher conducted appropriate bivariate analysis on all independent variables and the dependent variable (i.e., price) to determine whether any potential correlation or relationship existed between them. Variables showing a potential correlation or relationship were included in the multiple linear regression model.

Independent Predictor Variable

Active recreational cannabis store licenses are used to proxy legal market size and the opportunity for retail legal cannabis diversion. Only once legal stores were operating could the legal market impact illicit cannabis markets and make diversion an easy opportunity for consumers or suppliers to satisfy their personal goals and desires. The hypothesis for this variable is as follows:

Active recreational cannabis store licences will be negatively associated with illicit cannabis prices.

Illicit prices lowering as stores increase is in line with RCP (Cornish and Clarke, 2017, 2014; Wortley, 2014). A larger retail market would increase legal cannabis

---

[14] Descriptive analysis showed not all subregional groups were suitable for further statistical modelling. Hence, description of independent variables here focuses solely on the underlying reasoning for model inclusion but does not state specific data sources. During the statistical modelling chapter, data sources used are appropriately discussed.

accessibility for residents in legal states, including those willing to divert it. Similarly, residents of nearby non-legal states (both suppliers and drug tourists) would experience easier access as more stores open closer to their shared borders. Furthermore, while legalised jurisdictions in the United States generally restrict single purchases from stores above an ounce, no system exists linking purchases to specific individuals such as Uruguay employs (Boidi et al., 2016; Hall et al., 2019). Thus, more stores mean individuals can theoretically purchase larger quantities of legal cannabis in a single day through using multiple stores. Therefore, as stores increase, greater diversion may follow and by extension, its impact on prices in neighbouring jurisdictions.

Independent control variables

The following variables are included in the model to control for their potential effects on cannabis price.

Law Enforcement

As discussed previously in section 2.2 in the previous chapter, literature and R&P theory link increased law enforcement risk with illicit drug prices (Boivin, 2014; Caulkins and MacCoun, 2003; Caulkins and Reuter, 2010, 1998; Reuter and Kleiman, 1986). Concisely put, increased law enforcement-imposed risk on drug suppliers is associated with higher drug prices, and vice versa, meaning any price changes, in jurisdictions neighbouring legalised states, may conceivably (or at least partly) stem from law enforcement strategies changing and their imposed risk increasing or decreasing.

The researcher considered three variables to operationalise law enforcement risk, these being arrest statistics for illicit cannabis supply (i.e., sale and production), possession and number of police employed. Arrest data is calculated at a rate per 100,000 capita to account for population sizes varying by locale. Logically, proportionally more arrests per capita may reflect greater risk for illicit cannabis market participants and law enforcement focusing more on cannabis crime. Similarly, locations with relatively more police officers may increase detection risk.

Medical regulation

Research has linked American medical cannabis laws with cheaper illicit prices (Zook et al., 2012). Medical cannabis product may also feasibly divert into the illicit market and thus affect illicit prices (Pacula et al., 2015). Therefore, the model includes medical regulation status in each state as dummy variables. Specifically, the United States National Conference of State Legislature divide medical cannabis laws into three categories which are used to categorise medical regulation (NCSL, 2019a). Firstly, a comprehensive medical cannabis program (CMCP) which provides access to cannabis with enough THC content to cause psychoactive effects. Secondly, a limited medical cannabis program (LMCP) which only provides low THC or CBD cannabis. Lastly, there are states that have passed no medical cannabis laws, which are referred to as the 'neither' category in this thesis.

Distance from legalised locale

A third possible confounder variable is distance from the legalised locale. As discussed, literature indicates illicit drug prices increase as one moves further from its source (Caulkins and Bond, 2012; Chandra et al., 2014, 2011; Chandra and Barkell, 2013; Chandra and Joba, 2015; Giommoni and Gundur, 2018; Lahaie et al., 2016; Reuter, 2014; Zook et al., 2012). Therefore, if diverted legal cannabis supplants illicit sources, recorded High Times prices should theoretically be lower in cities physically closer to the legalised state. The geographical centre of the legal state is used to measure the distance of legal states from cities in bordering jurisdictions.

Economic development and individual spending and population

Yearly median household income is used to proxy economic development and individual spending power of locales. Population estimates are used to measure potential consumer demand.

Time

The model includes a time variable that counts each subsequent month from the start of the dataset to the end, this accounts for any underlying variation in prices resulting from price submissions occurring at different points in time.

Missing variables

Ideally, the researcher would have considered other important variables, however adequate data sources for them unfortunately did not exist.

Firstly, city level cannabis usage rates would directly control consumer demand changes. Economics dictate that demand fluctuations influence price, i.e., prices increase as demand rises, and vice versa (Gale, 1955; Mankiw, 2011). Unfortunately, longitudinal cannabis usage data at the relevant geographical level is simply unavailable. The most useful source is SAMHDA (Substance Abuse and Mental Health Services Administration) that conducts the National Survey on Drug Use and Health (NSDUH) in the United States. SAMHDA publicly provides statistics from NSDUH on United States drug use indicators, including cannabis. [15]

SAMHDA offers yearly statistics at the state level, and biannually at the sub-state. Specifically, sub-state levels constitute groupings of counties within each state rather than cities. Unfortunately, the SAMHDA data measures were too imprecise for model inclusion. Usage rates at the state level may be erroneously different to the cities examined. While the sub-state levels improve on geographical relevance (though it remains an issue), with its data being bi-annual, it veers into cross-sectional data rather than longitudinal (Tarling, 2009). Nonetheless, the SAMHDA data proves useful in offering contextual information on cannabis usage in the examined jurisdictions during discussion of results.

Secondly, the model would ideally include accurate information on the potency of each reported cannabis transaction (Caulkins, 2007; Doyle, 2016). Unfortunately, as previously discussed, High Times offers no such data. Moreover, no other data source exists that contains some measure of cannabis potency (such as THC content) at geographically relevant locations (for the present research). The University of Mississippi

---

[15] See https://pdas.samhsa.gov/saes/state for state data and https://pdas.samhsa.gov/saes/substate for sub-state data. Accessed 15/07/2020.

has, for decades, regularly examined cannabis potency from plants confiscated by the United States federal and state law enforcement agencies, which offers some information regarding cannabis THC levels across time. Overall, this data shows illicit cannabis THC levels as generally increasing during the timeline of the High Times dataset (Chandra et al., 2019a, 2019b; ElSohly et al., 2016; Potency Monitoring Program, 2019). Thus, some illicit cannabis price increases may conceivably stem from potency increasing.

3.3.7 Modelling Limitations

When aiming to obtain valid inferences in statistical modelling, data should (for both the segmented and multiple linear regression) satisfy the underlying linear regression assumptions. These assumptions include a linear relationship between the dependent and independent variables, a normal distribution of residuals, homoscedasticity of residual variance and the independence of residuals error terms (or lack of autocorrelation) (Osborne and Waters, 2002; Tarling, 2009). [16] When interpreting the models, the researcher acknowledges (as discussed previously in section 3.3.2) the data comes from a non-probability sample (i.e., High Times readers self-reporting their purchases), which means it is not possible to infer results to a general population of illicit cannabis prices (Battaglia, 2008; Spiegelhalter, 2020). Thus, inferential statistics (standard errors, confidence intervals and p-values) have been removed from all reporting, and the researcher focuses only on effect sizes (beta) and direction (i.e., whether there was a negative or positive association) when interpretating the models.

Specifically for the multiple linear regression model, certain independent variables lacked data throughout the dataset. In response, listwise deletion is employed, meaning, if a case (i.e., a price submission) lacks data for any variable, the model excludes the case entirely (Allison, 2001; Bryman, 2004a). As listwise deletion of cases could potentially bias the results from losing price submission data for certain locales, several multiple linear regression models are constructed to ensure any association between legal stores and prices remained consistent (i.e., in direction and effect size) despite any instances of missing cases.

---

[16] Nonetheless these assumptions are checked in the statistical cannabis modelling chapter.

3.4   Ethics

Before conducting research, the researcher received ethical approval for both the Reddit and High Times analysis from the School of Social Sciences Research Ethics Committee of Cardiff University. Nonetheless, this section discusses potential ethical issues of the Reddit and price analyses.

Regarding Reddit, one potential ethical issue is lack of informed consent as personally obtaining it directly remained infeasible. It would be extremely difficult, if not impossible, to obtain consent due to the number of comments, the long timeframe, and the inactivity of many accounts. However, legally speaking, consent is implied when a user signs up and posts to Reddit as one must willingly create an account, accept the terms and conditions of the platform and then actively choose to contribute to a known public forum.

Regardless of what is legally permissible, social science research ethics provide enhanced protections to research participants. Some risk exists for Reddit users in this research as many are discussing illicit activities. However, the chances of a comment directly jeopardising a Reddit user are slim as it would require them to disclose their real-life identity, and Reddit requires zero personal information when creating an account. However, in the event a user did disclose their identity, the researcher took steps to minimise risk by excluding any Reddit user account names and any words or sentences deemed too revealing.

Further potential harm for participants may arise if quoting their comments exactly (Enghoff and Aldridge, 2019). Placing a comment in an online search engine, verbatim, may identify the Reddit thread, upon which the searcher can easily locate the specific comment and then the account name of the Reddit user. If an individual knows a Reddit account name, they can access all the past post and comment history of the Reddit user. Consequently, the identity of a Reddit user may become knowable through piecing together information disclosed from their entire comment history. Therefore, excerpts used in the thematic analysis chapters are paraphrased and reworded to remove this potential for harm (Enghoff and Aldridge, 2019; Wilkinson and Thelwall, 2011).

Regarding High Times, obtaining direct consent of those submitting price data to the magazine is impossible. However, these individuals willingly submitted their information to High Times with the explicit knowledge that the magazine may report it in their THMQ section. Regarding High Times itself, during the initial search for this

price data, the researcher contacted the (then) vice president of High Times, Jon Cappetta, and transparently asked whether the researcher could obtain said data for the present academic research. In his email response, Jon directed the researcher to the High Times online magazine service. Furthermore, there is no risk for the High Times magazine contributors as there is no possible way to link a price submission to an individual.

3.5   Summary

This chapter detailed the methodology underpinning the research. The researcher first discussed the pragmatism paradigm underpinning this thesis and the mixed methods approach used (a parallel-databases convergent design) (Creswell and Clark, 2017). Secondly, the researcher discussed the methodology underpinning the qualitative and quantitative analyses respectively, with each section identifying a data source to use alongside their methodological strengths and weaknesses. Lastly, the researcher discussed relevant ethical considerations for this thesis.

Chapter 4: Consumer Reddit Analysis

This chapter explores how cannabis consumers reacted to legalisation. Specifically, whether legalisation influenced their decision to continue (habituation), or cease (desistance), illicit market use (Cornish and Clarke, 2017, 2014; Wortley, 2014). Accomplishing this involved thematically analysing online forum conversations from self-claimed (ex or current) illicit cannabis consumers from the popular social media website Reddit (Bailey, 2017; Braun and Clarke, 2006; Hawkins, 2017; Patton, 2002). Thematic themes were interpreted through the lens of Rational Choice Perspective (RCP) and specific use of Bounded Rationality concepts (Cornish and Clarke, 2017, 2014; Gigerenzer and Selten, 2002; Kubrin et al., 2009; Leclerc and Wortley, 2014; Lockton, 2012; Selten, 2002; Simon, 1990, 1978, 1955; Wortley, 2014). Section 2.1 in chapter two details the theoretical framework used. Understanding this consumer market-choice is key, as legalisation harming the illicit market logically relies on it attracting consumers away from illegal suppliers (Hall et al., 2019).

4.1   Thematic Themes Overview

In total, 411 relevant references emerged from analysing the consumer comments. [17] These users discussed their experiences with cannabis legalisation and importantly, explicitly described their end market-choice. Several themes surfaced from these comments, of which Figure 2 depicts. Themes split into two hierarchal levels. First level themes identify the consumer market-choice and criminal involvement decision, i.e., whether they continued illicit market use (habituation) or ceased in favour of new legal options (desistance). Second level themes constitute the underlying reasoning consumers gave regarding their market-choices. Naturally, analysis focuses on the latter which offers potential explanations and gives insights into why legalisation may fail or succeed in encroaching upon illicit demand.

---

[17] Relevant referring to comments which explicitly discussed topics that related to the first research question of this thesis, i.e., what influences a consumer to choose the legal or illicit cannabis market.
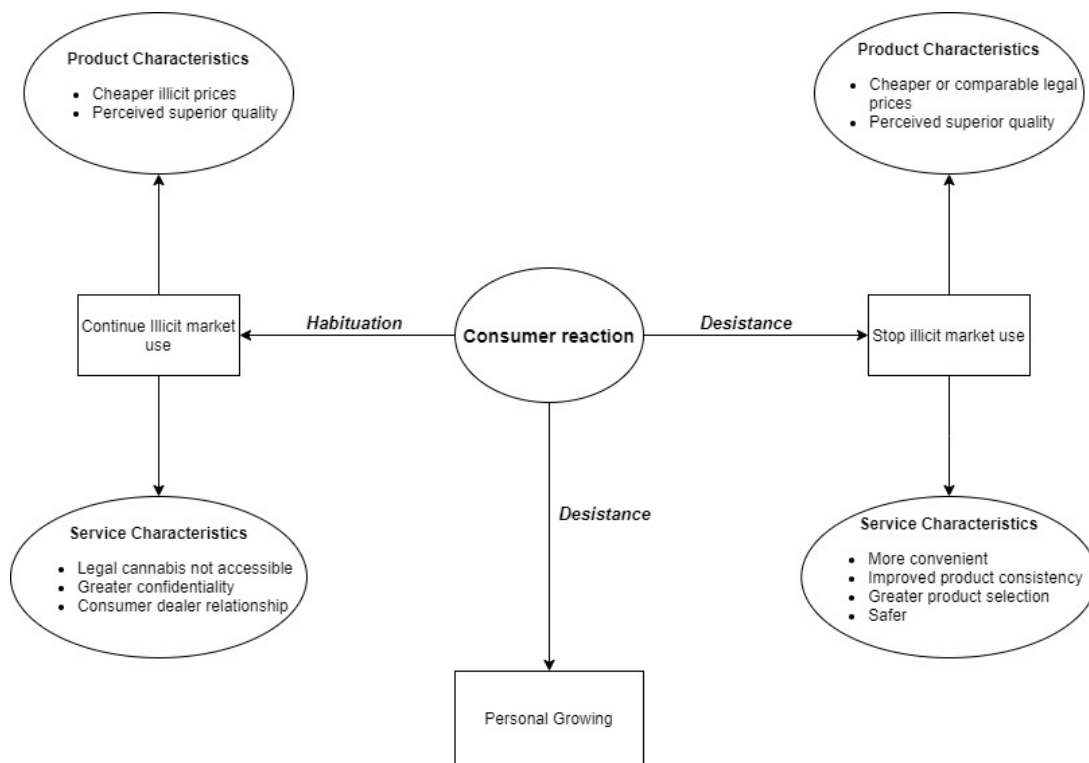
Figure 2. Consumer Thematic Theme Overview

Overall, user comments demonstrated rational reasoning behind their decisions, in which they ultimately chose the market which best satisfied their personal goals and associated aspiration levels (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978). Constituting these goals were product and service characteristics of each market. Furthermore, interpreting the data indicates situational and individual differences amongst users which helped make sense of their contradictory viewpoints on both markets. The following sections discuss and detail the structure depicted in Figure 2, alongside relating findings to the literature where possible.

4.2   Product Characteristics

Product characteristics refer to cannabis price or quality, both emerged as subthemes for the habituation and desistance consumer criminal involvement decisions.

4.2.1   Price

User comments discussed price more than any other characteristic, with it constituting roughly half of all the selected consumer references. Unsurprisingly, users generally described favouring the market with cheaper prices which is termed in this analysis as a cost-saving goal. Some described the illicit market as better satisfying their cost-saving goal, as these two comments demonstrate:

> I Still choose my illicit dealer here in Washington, much cheaper.

> I get quarter ounces for $30-40 dollars from my dude while local stores sell that at $100.

Some users intended to make the desistance decision once, or if, legal prices lowered enough to satisfy the aspiration level of their cost saving goal:

> I will continue buying from my guy until legal prices lower, I get an ounce for 240 or under while an eight costs 75 dollars in stores.

> Weed went recreational here recently but will buy it illicitly for years until legal prices lower.

Contrastingly, others described legal cannabis as better satisfying their cost-savings goal, as these two comments demonstrate:

> In Washington while I lived there, weed was legalised and I started using a store as the prices were lower than the local dealer.

> Legal weed is affordable, while dealers charge 10 or 15 per gram, a 1/8oz goes for 15 from the store.

The above comments are in accordance with quantitative research which examined hypothetical market-choice decisions, which similarly found that cheaper, comparative or slightly above legal prices may incentivise consumers to buy legal, over illicit, cannabis (Amlung et al., 2019; Amlung and MacKillop, 2019).

Literature comparing legal and illicit cannabis prices in legalised locales showed the former being more expensive (Hunt and Pacula, 2017; Mahamad et al., 2020). However, these studies only examined short periods following legal sale (i.e., five months

or less), thus longer-term trends are unclear. Additionally, a survey exploring cannabis consumer perceptions in the United States found respondents were far more likely to perceive illicit, rather than legal, cannabis as cheaper (Fataar et al., 2021). The former survey was conducted in 2018, thus these perceptions constitute a longer period. However, the Reddit user experiences of cheaper legal cannabis remain valid viewpoints, Fataar et al (2021) also noted a proportion of surveyed perceived legal cannabis as cheaper (up to 15% depending on the state).

Considering RCP, theoretical explanations for these contradictory perceptions may stem from differing situations, i.e., whether legal or illicit suppliers (available to the cannabis user) happened to sell at cheaper prices. The former also demonstrates how environmental structures (i.e., price levels) constrain and direct individual decision-making (Gigerenzer and Selten, 2002; Lockton, 2012; Simon, 1990). Costs of production, distribution, risk (for illicit supply) and regulatory requirements (for legal supply) largely dictate market prices, not the consumer. While buyers can freely choose their seller, the supplier desire to profit (in combination with the above cost factors) inherently restricts what prices a consumer can realistically expect to pay for cannabis. Thus, while the consumer can choose the more affordable market, factors beyond their control partly dictates which market is offering cheaper prices in the first place.

Some specific examples of environmental influences on legal prices emerged from the comments. Several specifically blamed taxes for artificially inflating and keeping legal prices above illicit rates, as these two comments demonstrate:

Because of taxes, an eight from a dealer is a fraction of what a legal store would charge.

Taxes can be really high in certain locations and here where I live, it is a high 30% for recreational legal cannabis.

Retail cannabis taxes vary by locale, and are largely outside the direct control of cannabis users (Boesen, 2020; Cammenga, 2020; Hall et al., 2019). [18] However, when considering the key importance of price for the market-choice decision, taxes may play an important role in depicting the legal market as more, or less, attractive to cannabis

---

[18] There is an argument to be made that in democratic societies (like the United States), cannabis users can express some minimal control through voting in politicians who support lower taxes.

users who desire cheaper prices. Thus, the present analysis supports concerns in the literature, that using taxes to increase price may hinder the threat a legal market poses to illicit suppliers (Carnevale et al., 2017; Caulkins et al., 2015; Hall et al., 2019; Kleiman, 2017).

Another situational difference comes from comments discussing legal cannabis price lowering over time, as this comment demonstrates:

> A lot of time did have to pass until recreational prices lowered enough to be competitive enough to attract everyone rather than only tourists.

The above perspective is supported by other research which found significant positive associations between how long recreational legalisation had been in place, and the likelihood of a consumer perceiving legal prices as cheaper than illicit (Fataar et al., 2021). Therefore, the situation of consumers, and their experience, with legal prices may differ depending on how long the legal market has operated for in their home jurisdictions.

The potential link between the length of legal sale operating and legal cannabis price becoming lower and/or undercutting illicit prices is explorable from the Reddit data. The Reddit forum threads used in this thesis stretch between 2014 and 2018 (note, no relevant 2017 thread was identified). Importantly, if considering the price subtheme comments that explicitly discussed a specific legal state, then the length of time between the comment being posted and legal sale beginning becomes identifiable. The most suitable way to explore this possibility with these comments involves conducting some simple descriptive statistics. [19]

Table 2 presents the total amount of relevant comments by time elapsed since legal sale began in each specific state by year. For example, the zero represents Reddit comments occurring in the same calendar year as legal sale started in the specific state the Reddit user discussed. Table 2 also displays the percentage of consumer comments

---

[19] Placing dates alongside each excerpt was considered. However, it became apparent that doing so may produce a biased perspective as comments presented in this analysis were chosen for their exemplification of the price subtheme, not to give a fair representation of comments that explicitly discussed a location.

which discussed illicit or legal price as being lower. Percentages, rather than simple counts, are used as different years had differing amounts of Reddit threads and comments.

A clear trend is visible in Table 2, where the percentage of comments discussing illicit price as being lower was higher when legal sale was more recent. Conversely, the percentage of comments discussing legal price as being lower increased as legal sale was in operation for longer. Therefore, Table 2 supports the possibility that contradictory accounts of illicit price levels relative to legal prices (and vice versa) may partly stem from differences in how long legal sale had been operating.

Table 2. Percentage of relevant consumer price subtheme references

Year from legal sale	Relevant references	Illicit price lower	Legal price lower
0	38	97%	3%
1	6	83%	17%
2	21	43%	57%
4	12	8%	92%

Importantly, one must keep in mind the limitations of these simple statistics. [20] Given the requirement for the comment to explicitly state or indicate a legalised state, the above data only represents a proportion of the consumer price comments while others go unrepresented. Further, the data in Table 2 must not be interpreted as a representative estimation of consumer perceptions or experiences with legal and illicit cannabis prices. These simple statistics only serve the purpose of offering a potential partial explanation from the data itself, for the contradictory viewpoints on price witnessed in this section. Nonetheless, the trends seen in Table 2 are in keeping with comments discussing that it takes time for legal prices to lower, literature discussions regarding legal price lowering over time, and empirical literature surveying consumer perceptions (Caulkins, 2010; Fataar et al., 2021; Kilmer et al., 2010b; Kleiman, 2017).

The concept of legal prices undercutting illicit prices may appear unrealistic at first, when considering illicit suppliers avoid paying taxes or any other regulatory costs (like license fees). However, illicit suppliers may shoulder other costs which legal sellers

---

[20] Also key is to recall the focus of this thematic analysis was on exploring what may influence consumer decisions, not to transform the Reddit data into a suitable format for rigorous statistical analysis.

avoid, as R&P theory indicates high illicit drug prices may stem from illicit suppliers having to deal with, and compensate for, law enforcement risk (Caulkins and Kilmer, 2016; Caulkins and MacCoun, 2003; Caulkins and Reuter, 1998; Reuter and Kleiman, 1986). Hence, operating legally removes any informal law enforcement costs. Further, while new costs arise from operating legally (such as taxes and licenses), production costs may substantially lower as legalised cultivation and distribution becomes increasingly efficient (Caulkins, 2010; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019). Thus, legal cannabis prices undercutting the illicit prices of some illegal suppliers is entirely feasible and may become more likely as time progresses.

Overall, consumer comments on price is in keeping with discussions of the importance of price in attracting consumers away from illicit markets (Carnevale et al., 2017; Caulkins et al., 2015; Hall et al., 2019; Kilmer et al., 2010b; Kleiman, 2017). Price matters, and more specifically, whether the price is relatively cheaper than the alternative competing market. However, price does not necessarily always overshadow other factors. For instance, some described using the illicit market predominately, but buying legal cannabis if their supplier was unavailable or out of stock:

> I buy small quantities from the store only if my dealer is not available and just to hold myself over.

> If my dealer is unavailable for four hours while I am completely out, I will spend $5 more at a store to get it now.

Furthermore, as later explored throughout the chapter, many chose the market with higher prices as it better satisfied an alternative goal aspiration level (Cornish and Clarke, 2017; Selten, 2002).

4.2.2   Quality

Consumers also discussed cannabis quality as influencing their market-choice, with some describing the illicit market as offering higher quality cannabis than legal sellers, as these three comments demonstrate:

The illicit market offers the best deals and product.

I buy cannabis, and legal weed is not the best quality so I will continue using the black market.

I wanted to participate in the event, so I bought on the 17th, crappy weed, so I still use my dealer.

Others described the legal market offering better quality cannabis, as these comments described:

Weed offered by my local dispensary was higher and a more consistent quality than what my dealer offered.

Shops are prevalent and have good weed that is a lot better that what I got from dealers in the past.

Weed from the dispensary is far better.

It is worth noting that comments discussing quality often also described price. Several described their preferred market as better satisfying both goals, as these comments demonstrate for the illicit market:

The dispensaries have higher prices and lower quality than what my dealers' offer.

My dealer grows his own product which is cheaper and generally better so he hasn't lost any business.

I will buy for years until legal prices have lowered. People continue buying it illicitly as the product is better quality and better priced.

While these comments demonstrate the same for the legal market:

My illicit supplier could not compete with the local store. The store had lower prices alongside loyalty rewards with better and more reliable quality.

The streets offer worse quality and higher cost in Washington.

Shops sell high quality for 25 dollars while dealers sold at 30 dollars, legal shops are unbeatable.

In other cases, the market better satisfied one goal whilst the other was comparably satisfied by either market, as these comments demonstrate below:

My preference is still with my dealer as their prices, without fail, are cheaper while offering comparable quality.

Bought non-dispensary weed, it was cheaper and the quality was equally good.

Prices in legal shops now match street prices whilst offering better quality, I was going to continue using my guys but not now that the prices are similar.

Certain comments showed consumers choosing to satisfy a higher aspiration level of price or quality at the expense of the other. For instance, this consumer described accepting lower quality illicit cannabis for its far cheaper cost:

While quality is poorer, its price amounts to half of what recreational shops sell at.

Contrastingly, this consumer described willingly paying more for legal cannabis as it was higher quality:

For $50-$100 you can get quality ounces of weed. While dispensary prices are possibly more expensive than your dealer prices, legal prices are still not high, so I buy legally.

The above comments are in keeping with discussions of the importance of cannabis quality for attracting users from the illicit market (Giommoni et al., 2020b; Kilmer et al., 2010b). When considering other literature, it appears legal cannabis may be of higher quality in general, as a survey of cannabis users in the United States found consumers were more likely to report legal cannabis as being superior to illicit (Fataar et al., 2021).

However, issues exist in interpreting quality descriptions from the present data (and self-report in general). Unlike price, defining what cannabis quality means to a consumer is difficult. Literature shows consumers are uncertain of the quality of drugs bought in offline markets (Best et al., 2004; Decorte, 2011; Evrard et al., 2010). Furthermore, literature indicates that those selling to consumers may have imperfect knowledge of their own product if they bought from a larger distributor (Caulkins, 2007; Reuter and Caulkins, 2004). Lab tests are time intensive (with little reward) and drug transactions are often rushed (Caulkins, 2007; Reuter and Caulkins, 2004). Research into illicit cannabis growers indicate most lack exact knowledge of the average THC content of their cannabis (Decorte, 2011). Rather, growers roughly estimate quality based on imprecise measures such as crystal quantity on cannabis leaves or subjective consumer opinions (Decorte, 2011). Therefore, user assessment of illicit cannabis quality may be subjective and uncertain.

The situations legal cannabis consumers find themselves in likely differ. Locales that have implemented legal sale have required accurate information of cannabis products for consumers, while illicit sellers experience no formally imposed regulations (Hall et al., 2019). Hence, legal buyers may generally have better access to more accurate information (such as THC content) regarding their purchases (a theme discussed in a later section). Therefore, user reports of legal cannabis may be more accurate than those of illicit buyers. However, consumers rating legal cannabis as being relatively superior remains partially subjective, as they are comparing it with past, or current (likely) subjective evaluations of illicit cannabis (Best et al., 2004; Decorte, 2011, 2011; Evrard et al., 2010).

Further, what someone classes as high-quality cannabis may differ. One assumption may be consumers always desiring higher THC content for stronger psychoactive effects. However, some consumers may prefer less potent cannabis strains, for example, cannabis consumers in the Netherlands have criticised Dutch coffee shop cannabis for having too high THC content (Decorte, 2011). Indeed, Gould et al (2019) showed cannabis consumers having differing preferences for different types of cannabis (i.e., indica, sativa or hybrid) and for intensity of psychoactive effects.

Therefore, from the examined data, it is uncertain what specifically constitutes higher quality cannabis for each Reddit user, what is only certain is they have some subjective definition of quality. That this analysis can only consider these self-reported

comments on cannabis quality as subjective is a limitation of the data. Nonetheless, these subjective perceptions of quality, and their need to satisfy it, clearly influenced the market-choice decision of these cannabis users (Cornish and Clarke, 2014; Selten, 2002).

Differing subjective definitions of cannabis quality may help explain contradictory user opinions on legal and illicit cannabis quality. Likewise, situational differences for consumers may also partly explain dissimilar perspectives of cannabis quality. Cannabis strength and psychoactive effects depend on several factors which consumers can not directly control (Brunt et al., 2014; de la Fuente et al., 2020; Green, 2009; Piomelli and Russo, 2016; Wall et al., 2019). While consumers are free to choose their supplier, it is partly circumstance whether available sellers (legal or illicit) offer cannabis which suits their subjective definition of what high-quality cannabis means.

Several reddit users described different reasoning for viewing legal or illicit market cannabis as superior. Specifically, they criticised cannabis production methods from either market, namely cannabis curing and trimming, as demonstrated in the comments below (Green, 2009): [21]

> A home grower is much more likely to hand trim all of their buds a legal op will most likely use a bud trimming machine. The end result is no way near as good as hand trimmed buds.

> While a legal operation probably uses bud trimming machines, a home grower probably hand-trims their buds so their end result is better than machine trimmed buds.

> Dealers do a poor job at trimming product.

Contradictory perspectives on legal and illicit cannabis market production may reflect differing past experiences (Cornish and Clarke, 2017, 2014; Selten, 2002). For instance, a consumer may have often received poorly trimmed or cured cannabis from illicit suppliers in the past which creates a negative view of illicit market production (as the first comment below demonstrates). Alternatively, the user may have access, or

---

[21] Curing protects cannabis from pathogens and is thought to improve quality, while trimming involves cutting off undesirable parts of the plant, see Green (2009) for more detail.

believe a particular piece of incriminatory information on a market (as the second comment below describes):

> I understand what cured and wet weed is. In the black market it's a 50% chance of getting well cured cannabis while stores have always given me well cured cannabis.

> Massive demand means dispensary suppliers cure for just two weeks while it should be four to six weeks.

Nonetheless, while consumer criticisms of either market are untenable and likely anecdotal, they still influenced them towards preferring one cannabis market over the other.

4.3   Service Characteristics

Service characteristics refer to aspects of the cannabis obtainment process for the consumer. Service characteristics differed between those choosing habituation and desistance.

4.3.1   Habituation Consumers

Some consumer comments discussed poor accessibility dissuading them from using the legal market. Users simply deemed their nearest legal cannabis suppliers as too far to reasonably use. Moreover, travelling further distances seems even less desirable when considering the consumer would have access to their, tried and tested, local illicit suppliers:

> For years I've been using my guy who delivers. Travelling to a weed store is further away and inconvenient.

> I understand the attractiveness of purchasing in a store, but other factors are important. Not one store exists remotely near me.

When considering the potential extra cost and effort of travelling further distances to obtain legal cannabis, the rationale behind continuing to use local illicit suppliers becomes clear, as the situation of this user demonstrates:

> I can simply drive down to the street and also get to have a beer with a local or drive an hour and a half to some store for cannabis and pay $60 for an 1/8, it is not a difficult choice to make.

Firstly, there is an extra time investment involved, a three-hour round trip. Furthermore, travelling far distances increases the overall price for obtaining cannabis when considering transportation costs (such as car fuel or public transportation). Hence, travelling further to buy legal cannabis may make using the legal market worse for satisfying (the previously discussed) cost savings goal.

A possible implication of this accessibility subtheme is that areas with fewer, or no, legal cannabis suppliers may experience less consumer desistance due to poor accessibility. This comment discussed this very possibility occurring in rural areas (though they refer to rural areas with the slang term 'sticks'):

> The black market thrives in the sticks but it is generally crappy product other than if you happen to know a good grower. The alternate is driving over 100 miles to our closest store.

The above interpretation is in keeping with literature regarding cannabis use and proximity to retail legal cannabis sellers. Quantitative analysis of survey respondents found that cannabis users were more likely to buy dried flower legally if residing closer to retail stores, and if their self-reported travel distance from it was lower (Wadsworth et al., 2021). Further support comes from research finding positive associations between legal store proximity or higher density and increased rates of cannabis use (Ambrose et al., 2021; Everson et al., 2019; Paschall and Grube, 2020). If legal store proximity is associated with increased cannabis use, then conceivably, so may illicit cannabis user use of legal stores over the illicit market.

Particularly troublesome then, if desiring legalisation to encourage desistance, are any potential and avoidable factors which may limit legal cannabis accessibility. For

92

example, some Reddit users described poor accessibility to legal cannabis as suppliers simply were unable to match consumer demand, as these two comments demonstrate:

> Until March or February it appears stores in my area will be out of stock since selling out after opening.

> Dispensaries have been out of stock every time I have visited.

In other cases, jurisdictions purposely hindered accessibility, for example, US states and Canada allow sub-jurisdictional areas to locally ban cannabis stores (Caulkins and Kilborn, 2019; Dilley et al., 2017). Some Reddit users specifically described residing in locales which disallowed legal shops:

> Coloradoan resident here, my city forbids recreational stores from opening. While I'm not far from Denver I still have never been in a recreational store.

> Many don't know that counties exist which do, and can legitimately, ban dispensaries from opening.

However, localised banning of cannabis sale may do little in limiting actual cannabis access. Individuals presumably can access the illicit suppliers they used pre-legal sale. Furthermore, even with harsher disincentives pre-legalisation (i.e., law enforcement punishment for use and possession), these Reddit users still obtained cannabis illicitly. While these smaller locales may ban a brick-and-mortar store, they can not prohibit cannabis consumption and possession. Thus, such restrictive policies on legal cannabis sale may only dissuade consumers from buying legal cannabis locally. Consumers could still access cannabis in a nearby locale that permits legal stores, which only serves to shift consumer tax money and economic growth into another area. Disparities in local legalisation policy may lead to situations such as this Reddit user described, where they bought cannabis through an intermediary whose livelihood involved transporting legally bought cannabis into counties that ban stores:

> For $10, I can pay a local who travels to, and back, from the next county or make the forty-minute drive myself. The pot tax I pay doesn't go to my local county as they banned

dispensaries. So, what could go into local community funds goes into the car of the guy who drives 80-mile trips daily.

The above demonstrates the possible futility of sub-jurisdictional areas locally restricting legal cannabis access whilst others do not.

Legal cannabis accessibility represents a simple, but important, situational difference which has clear implications for the consumer-market choice decision. If accessing legal cannabis becomes highly difficult or impossible (as the above Reddit users discussed), then any desistance influence legalisation may theoretically create becomes seriously hindered. If accessing legal cannabis becomes too difficult, it may arguably overshadow any benefit of using the legal market. It may be irrelevant how much legal cannabis or service improves upon its illicit counterpart, if no supply exists or is extremely burdensome to obtain.

Distrusting purchasing legal cannabis emerged as another reason for continuing illicit market use. Distrust stemmed from fears over showing their identifiable information (i.e., their ID) when buying legal cannabis. These consumers worried that if their identifiable information leaked into the public, and they lost their anonymity as a cannabis user, it would jeopardise their livelihood in some way. For example, this Reddit user argued that in the United States, cannabis remains federally illegal meaning any federal employee, or federally governed activity, remains risky for a known cannabis user:

> States have legalised cannabis recreationally, but it remains illegal under federal law. Many legitimate reasons exist for not wanting your photo, bank account, name, address, and information showing you use of a schedule 1 drug within a database. Working in a federal job, owning guns, crossing borders, social stigma, a data leak, and security clearance are all possible reasons.

Likewise, these cannabis comments discussed the potential job complications if one loses their cannabis user anonymity:

> In Colorado, legal dispensaries record your driving license, and you might not want information of you using a dispensary in some database. If drug use might be an issue in your job, then you'll continue using a dealer.

My friend who has a while collar office job told me his company emailed the entire staff on the day cannabis was legalised. The email said staff could still be tested and fired for it.

Therefore, remaining confidential was a key goal for these consumers which, for them, was better satisfied by continuing to buy cannabis illicitly. Arguably, the objective validity or legitimacy of confidentiality fears is not necessarily important, as the fears themselves (real or imagined) disincentivised buying legal cannabis over illicit. However, fears of work-place discrimination may not be ungrounded, as legal cases exist where employers have fired employees over testing positive for cannabis use despite consumption being legal (Burns, 2019; Oyaas, 2016).

Differences in cannabis consumer situations may conceivably predispose an individual to prioritising a confidentiality goal. Situations and circumstances may differ as some may hold occupations or lifestyle choices where being a known cannabis user risks worse consequences than another (Cornish and Clarke, 2014). As an earlier comment demonstrated, being a federal employee in the United States may constitute a unique situation which makes openly buying legal cannabis legitimately risky. Other similar examples may reasonably include those working in healthcare, education, or law enforcement. Thus, the lived situations of some users may tangibly present more risk and greater negative consequence than others if their cannabis use becomes known. Interestingly, this analysis indicates that fears over confidentiality outweighed any fear of law enforcement punishment for these Reddit users.

Uruguayan students expressed similar confidentiality fears when asked their intention to register with the government for cannabis access, as they similarly discussed fears of employer discrimination from being a known cannabis user (Boidi et al., 2016). However, Uruguay employs a far more restrictive form of legalisation (that requires registering on an identifiable list) than the United States or Canada (Hall et al., 2019; Kilmer, 2019). Therefore, the above indicates that even in less restrictive policy regimes (such as the United States or Canada) that requires no such registration, confidentiality issues may still feasibly disincentivise legal purchasing. Further support of a consumer need for anonymity comes from research on the consequences of the Netherlands requiring coffee shops to keep a verifiable list of members of Dutch cannabis customers (and only members could purchase). Coinciding with this temporary policy change which

removed confidentiality, coffee shops lost a large portion of local business which later reversed once the policy was removed (van Ooyen-Houben et al., 2016).

Lastly, and representing a part departure from the purely pragmatic reasoning of previous themes, some consumer comments discussed that having a positive relationship and familiarity with their illicit supplier encouraged them to continue illicit market use. Nonetheless, a familiar relationship brought certain practical benefits which improved the illicit buying experience. For instance, this Reddit user described having sincere transactions with the illicit market through using known suppliers:

> I have always had good experiences with my dealers, and one of them became a good friend of mine who I met when buying from him years ago. The only time a dealer ripped me off was when I used a random guy. In my experience, if you find the right guys, avoid buying it randomly, they are good to you.

Trust between participants in any market is important and even more so in an uncertain one such as an illicit drug market (DiMaggio and Louch, 1998; Granovetter, 2005; Kollock, 1994; Reuter and Caulkins, 2004). Therefore, it makes sense that Reddit users who described trustworthy positive relations with their illicit supplier attributed this as a reason for remaining illicit purchasers. Furthermore, research into the illicit drug dealer decision of whether to 'rip off' a buyer or not, identified one rationale behind doing so as selling to an unfamiliar or irregular customer (Jacques et al., 2014). The excerpt above similarly demonstrates the former point, as this Reddit user discussed only experiencing being cheated when they used an unfamiliar supplier.

Other comments described further benefits from having closer relationships with their illicit supplier, for example, having more socially enjoyable experiences during transactions, alongside receiving free cannabis gifts and better deals, as this Reddit user described:

> My dealer cares for me and I often get free cannabis. I can smoke for free at his place, and he gives me multiple grams for free. One time I asked him if could pay $40 for 8g of cannabis to help him out but he convinced me to pay $30, what a great guy.

Literature on the act of gifting between drug dealers and consumers indicates an underlying reasoning behind such gifts, as it may bolster existing relationships between

customers (Coomber, 2003). Therefore, the gifting described by Reddit users may benefit the illicit supplier (whether done intentionally or not) by helping maintain consumer demand amidst competing legal sellers.

However, while the consumer-dealer relationship subtheme noted economic and practical benefits, some described more compassionate motivations for continuing illicit market use. The personal relationships for these consumers played a larger role in their decisions and reflected a sense of loyalty towards their supplier. They continued purchasing from their illicit cannabis supplier for arguably non-pragmatic reasoning:

> You know, many have close relationships with their dealers, and they view that to stop using, and supporting, their business would be a betrayal.

> My dealer is a good friend, he needs the business, so I continue to use him.

One comment even specifically described occasionally buying from their supplier despite the legal market offering better prices:

> The dispensaries do have better selection and pricing, but I still buy from him to support him because he is a friend of mine.

Another disliked the impersonality of using a legal cannabis store, contrasting their current legal purchasing experiences with past illicit market interactions:

> Using my dealer was a lot more personal, he cared for me, asked how I have been, knew my name, and would even call me to ask how I was if I had not used him in a while. The dispensary never remembers my name, and while they ask how I am they definitely care little for my answer.

The above non-pragmatic motivations for continuing illicit market use contrasts against the economic and practical reasoning present in other subthemes. However, monetary or practical goals are not the only way one can benefit an act (Cornish and Clarke, 2017, 2014; Leclerc and Wortley, 2014; Wortley, 2014). Having a good consumer-dealer relationship satisfied social goals such as friendship and companionship. These consumers indicated they could better satisfy these social goals through continuing to purchase cannabis from their illicit suppliers than through legal sellers. Furthermore,

97

alongside closer relationships came practical benefits such as reliable service, gifts and special allowances which improve illicit service.

Considering the above indicates a key point for how the consumer market-choice decision may be bounded by different environment influences and past experiences (Cornish and Clarke, 2017, 2014; Leclerc and Wortley, 2014; Wortley, 2014). Even for consumers not discussing this relationship directly, their interactions (i.e., past experiences) with illicit suppliers would shape their perceptions alongside interpretations of the illicit market and cannabis characteristics. Specifically, the consumer knowledge of illicit market pricing, cannabis quality and service, would logically arise from their past personal experiences of using illicit suppliers. Importantly, these past personal experiences, and the subsequent anecdotal information the consumer gained from these past experiences, would shape their market-choice decision-making process. A consumer whose illicit supplier has been fair, honest, friendly, and/or offered good product characteristics engendered a (justifiably) favourable view of the illicit market which encouraged a habituation decision.

However, a positive consumer-dealer relationship requires finding a reliable and trustworthy illicit supplier. Stumbling across a reputable illicit supplier is unguaranteed and (at least) partly up to chance. Hence, a positive experience with the illicit market represents an important situational difference that may vastly alter how favourably a consumer compares the legal market with the illicit. As the following section demonstrates, the core reason for every consumer comment preferring legal market service stemmed from poor past experiences with illicit suppliers.

4.3.2   Desisted Consumers

These consumers all described legal sellers as better satisfying their desired service characteristics than illicit suppliers. One desired characteristic that emerged was convenience of service. Buying illicit cannabis requires knowing a dealer contact, locating them, and organising an agreeable time where both parties can meet. For these consumers, obtaining cannabis legally proved far easier than organising a meeting with an illicit supplier:

It is quick, easy, and convenient to get cannabis now. No longer do you need to be free when your dealer is and I can avoid spending time with people that I would likely never choose to hang out with normally.

Contacting a dealer can be extremely inconvenient with the possibility of having to wait sometimes. Having a store is great, I love it.

Development (and permittance) of online digital services further increases convenience. Such services, akin to popular food delivery apps, allows users to easily identify store locations and place online orders for pick up or delivery:

I move around a lot in California and use a certain app that lets you find cannabis stores or get it delivered. It is so easy now, and from being around in the 1990s it is like I have gone to heaven.

Using google maps I found a cannabis store in Tacoma and bought some, it was as easy as buying a bar of chocolate from a grocery shop.

Therefore, legal suppliers better satisfied a convenience goal for these consumers than illicit suppliers ever did or could.

Furthermore, some consumers described willingly paying high prices for legal cannabis due to the more convenient service. Hence, this represents another example of consumer decision-making where they willingly lowered the aspiration level of one goal (cheaper costs) to better satisfy another (convenience). One Reddit user aptly termed high legal prices as a 'convenience tax', one happily paid to avoid burdensome interactions with illicit suppliers, as these two comments demonstrate:

People in Colorado, when the state first legalised, termed the very high legal prices as a "convenience tax" as they could now avoid having to play 'phone tag' with dealers.

Convenience easily justifies the 20% higher price. I think the tax is a fair trade for avoiding any phone tag with a dealer.

Again, Reddit user comments demonstrate the important role that differing situational circumstances may play in influencing the consumer market-choice decision (Cornish

and Clarke, 2017). Recall that the accessibility subtheme in the previous section showed users who attributed their continued use of the illicit market as stemming from poor access to legal cannabis. The end market-choice for these users (those constituting the accessibility and convenience subthemes) appeared to stem from whether, by circumstance, they resided in an area that had, or lacked, accessible legal cannabis.

Moving on from convenience, a highly praised service characteristic of the legal market was its wide selection of cannabis and related products. Considering their past experiences, these consumers described their local legal market offering a far larger selection of cannabis products than their illicit cannabis suppliers ever could, as these two comments describe:

> The dispensaries outcompete in terms of variety. In a dispensary I can get four differing strains at the same price that I would get for buying a half an ounce of one type of cannabis, so why would you not choose the dispensary?

> I think the variety that legalisation offers possibly impacts the average dealer the most. Personally, choosing between strains was something I never even considered until I actually had dozens of strains to choose from.

While cannabis refers to a single plant, research indicates it may have differing psychoactive effects depending on a variety of factors, such as whether it originates from an indica or sativa plant, how it is grown, and the seed genealogy (Brunt et al., 2014; de la Fuente et al., 2020; Green, 2009; Piomelli and Russo, 2016; Wall et al., 2019). Cannabis consumers are known to have differing preferences for cannabis effects (Decorte, 2011; Gould et al., 2019). Consequently, the ability to choose from a larger variety of strains with differing psychoactive effects may form a powerful incentive for consumers to use the legal market over the illicit. Furthermore, alongside increased selection of cannabis strains is a greater selection of non-herb cannabis products, as these two comments demonstrate:

> A dealer won't have all the weed products you get in dispensary. Products like edibles, wax, weed lube, and anything else you might imagine.

> It's like being in a candy shop, there are countless flower strains, edibles of all kinds, drinks, ointments, mints, and energy shots.

100

Thus, the past experiences for these cannabis consumers involved accepting a limited selection of cannabis strains and non-herb products. The legal market, through offering an unprecedented range of products, better satisfied a selection goal which encouraged consumers to desist illicit market use in favour of buying cannabis legally.

Similarly, the consistency of legal cannabis products incentivised some to start using the legal market. Specifically, in this context, consistency refers to legal suppliers providing reliable information on their cannabis potency, type and effects of their sold products. Hence, users could know with more confidence exactly what they were buying and using. Contrastingly, the past experiences of these consumers involved obtaining illicit cannabis whose quality and effects were inconsistent, as these comments demonstrate:

> It being regulated, you can actually be aware of what you get, its potency, and so on, compare this to buying a bag of unknown stuff from a suspicious unreliable person.

> A store offers everything I could want and I know what I am buying. I know what potency the products are and the shop employees are supportive. While prices are higher, paying more means I can get cannabis in the same way that I get alcohol, which I think is right.

> Unlike my dealer, they can reliably give me the correct strain name and information on the THC and CBD percentages of their cannabis. Have not looked back since.

Indeed, retail illicit drug sellers and cannabis owners may tend to have only imprecise knowledge of this product at best (Caulkins, 2007; Decorte, 2011; Reuter and Caulkins, 2004). Thus, being able to obtain cannabis with accurately known effects constitutes a considerable situational difference for a cannabis user who previously had to accept whatever their illicit suppliers happened to have in stock. As mentioned, cannabis users may have differing preferences for cannabis effects, thus the freedom in (or at least, increase the chances of) reliably obtaining a specific type of 'high' may theoretically be a strong incentive for using the legal market over the illicit (Decorte, 2011; Gould et al., 2019).

Lastly, some consumer comments described viewing legal market cannabis products as safer which encouraged them to buy cannabis legally. They (reasonably)

argued that legal product was safer to use as illicit cannabis came from individuals subject to no formal regulations or quality standards. Hence, the legal market presented an option that could better satisfy their safety goal as these two comments demonstrate:

> Smoking something that was held to a certain standard feels better than placing faith in an unregulated grower.

> I go to a shop with proper quality control to buy it.

Again, certain comments demonstrated users lowering their aspiration level for one goal to better satisfy another. Specifically, some justified paying more for legal product to guarantee their cannabis underwent appropriate quality control, as these two comments discussed:

> Paying a bit more is something I happily do to be sure that no parasites or bacteria exist on my weed.

> The new legal stores test, control, and maintain their bud so the price does not bother me as I'm guaranteed to not be smoking pesticides.

One discussed benefit of recreational cannabis legalisation involved consumers being able to obtain cannabis uncontaminated with impurities and therefore be less dangerous to use (Hall et al., 2019). These consumer comments indicate the possibility that this public health benefit may also aid in attracting health conscious cannabis users from the illicit market.

The above Reddit user comments clearly demonstrate that the legal market may considerably improve the cannabis purchasing experience. Arguably however, these benefits are standard practice in legal businesses. Customers usually expect convenient access, consistency, a selection and safety when buying products from a business. What made these legal market service characteristics so appealing to consumers stemmed from their own past, poor, or subpar experiences with illicit suppliers (Selten, 2002; Simon, 1978, 1955; Wortley, 2014). Legal sellers, by simply operating at standard levels of competency (for legal businesses), better satisfied the respective desired service characteristic of the examined consumers. Note the emphasis here is competency, rather

than the service being legal in of itself, as these examined consumers focused upon practical benefits that legal services provided rather than an idealistic or political belief in legalisation.

Figure 3 below depicts a hypothetical decision-making process of the cannabis consumer market choice decision, derived from the examined data.
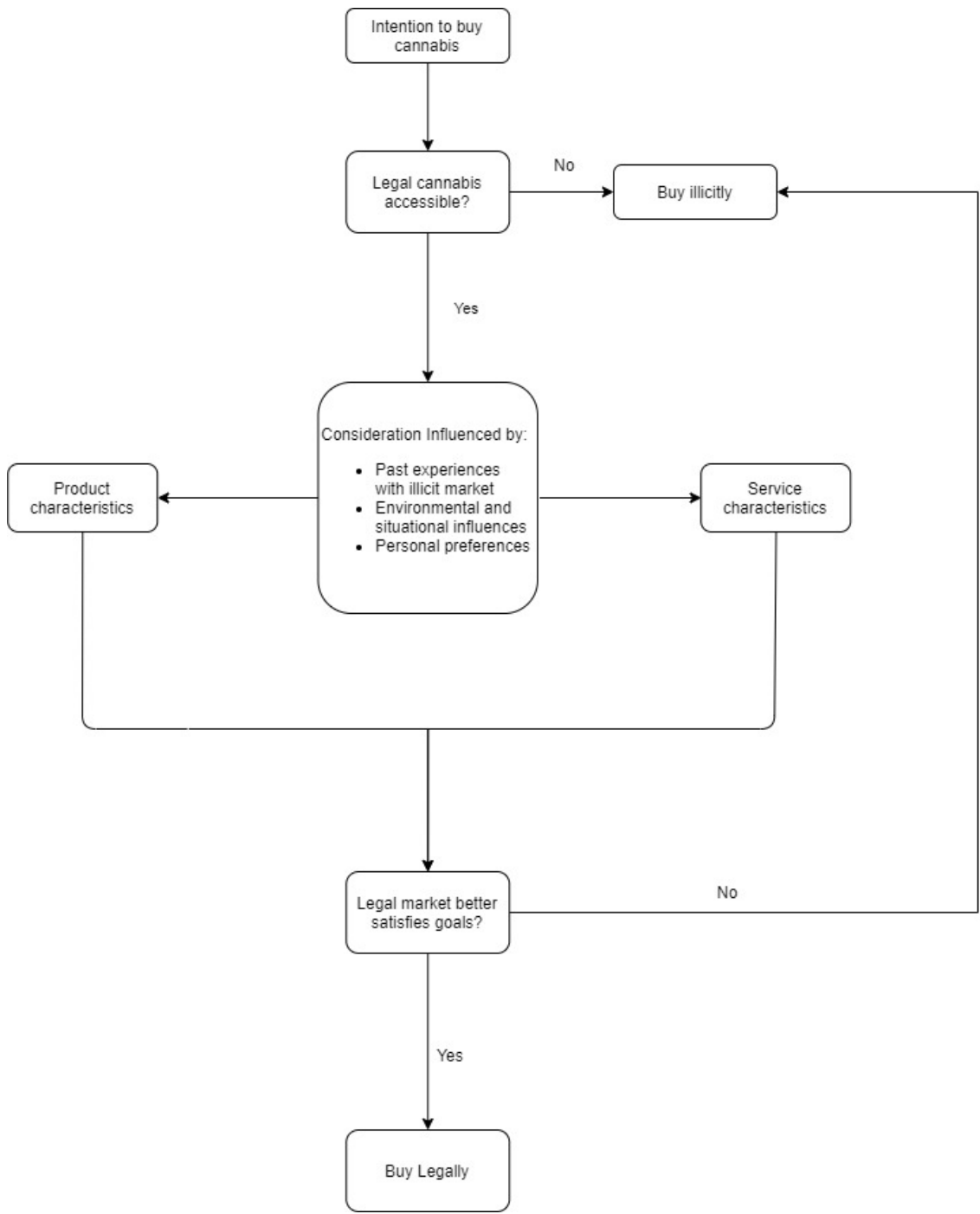
Figure 3. Hypothetical consumer market choice decision

4.4   *Personal Growing*

While this chapter focuses on the consumer choice between the illicit or legal market, an alternative legal cannabis obtainment option emerged that deserves acknowledgement. Specifically, the possibility for consumers to grow their own cannabis which represents another option for legally acquiring cannabis. Thus, any possible factors influencing the consumer decision to personally grow their own cannabis become relevant. Though, in general, legalised locales generally limit the quantity an individual can legally grow, Reddit users who discussed personally growing cannabis, described it as comfortably satisfying their demand (Hall et al., 2019):

> For two years, a single plant lasted me. I don't think I smoke heavily but, most likely, there are less evenings where I don't smoke than when I do.

> Over here in Maine, I cultivated three pounds this summer and there is no way I can possibly smoke that much.

A heavy cannabis consumer would theoretically likely only need one plant to satisfy their consumption rate per year (Caulkins and Kilmer, 2016). Furthermore, with most (currently) recreationally legalised jurisdictions (that permit personal growing) allowing citizens to grow several plants, this option is a valid choice for users to fulfil their own cannabis demand (Caulkins and Kilmer, 2016; Hall et al., 2019; NCSL, 2021).

However, growing your own cannabis, opposed to buying it illicitly or legally, entails different considerations and requirements. A grower must dedicate some effort towards obtaining seeds, creating a small grow site, continually maintaining said plant, and harvesting it themselves (Green, 2009). Reddit users held conflicting opinions on the difficulty for consumers growing their own cannabis. Some comments described growing cannabis as difficult, particularly so if desiring consistent and high-quality cannabis, as these two comments demonstrate:

People tried to get into growing cannabis once legalisation happened, but they didn't really know how much is involved with growing good quality cannabis. Costs can be expensive for a good set up and the work can be hard.

What proves hard is being able to consistently reproduce the same result each time.

However, others described personally growing cannabis as less difficult, as these two comments demonstrate:

I have no idea what you are doing if you're spending more than a quarter of an hour maintaining a plant each day.

At the very least, you'll get acceptable weed if you (daily) spend 10 minutes caring for each plant, have educated yourself (on what to feed the plant and how to care for the plant), and obtained good seeds.

Contrasting accounts of cannabis growing may stem from individual differences in cultivation skill and differing thresholds for effort (Cornish and Clarke, 2014, 2011; Selten, 2002). Regardless, while personal cannabis growing could conceivably satisfy consumer demand, it requires (at least) some degree of effort and ability to do it effectively alongside shouldering the risk of harvesting low quality cannabis. Even considering accounts describing personal growing as a relatively easy endeavour, it would require more time investment and effort than simply buying it legally or illicitly (assuming reasonable physical access to suppliers in either market). Thus, some consumers may decide that buying cannabis is the superior option:

Growing cannabis is more difficulty than people realise, and I can say from experience. I cultivated a plant in the summer and got an 1/8oz of crappy weed as a result, it is far less difficult to just purchase it.

Some environmental and situational differences may influence the difficulty of personal growing and thus its uptake as a consumer choice for cannabis supply. Firstly, the climate of a legalised locale may affect how difficult outdoor cultivation is. While cannabis plants are relatively flexible in where they can grow, some climates are more

suited than others (Green, 2009). Therefore, individuals may be more willing to attempt and likely succeed at outdoor growing if residing in a climate that is hospitable for cannabis. For example, consider this comment describing growing in California:

> In California outdoor growing can reap quite high quality cannabis, around ½lb from each plant, but you got to be careful for pests (like caterpillars).

While Colorado may have relatively more subpar conditions for growing cannabis outdoors:

> You can't just chuck them outside and water a few times per day then expect them to thrive in Colorado as the state is close to being an arid desert, it requires more than that.

Thus, a consumer may (justifiably) perceive growing outdoors in a suitable climate as representing less effort and low-cost investment than in an unsuitable one.

Hydroponic growing does mean individuals can personally grow cannabis anywhere as indoor cultivation circumvents climate restrictions (Decorte and Potter, 2015; Paoli et al., 2010). However, indoor growing may be more difficult than outdoor growing, have more requirements, and incur greater cost overall than growing outdoors which may dissuade a prospective grower. For example, hydroponic growing requires an indoor space dedicated to growing cannabis, specialised equipment and incurs electricity costs:

> You can't really set up indoor growing and forget about it. Growing indoors is much more work than outdoors which has little overhead. Indoor growing requires a dedicated space as the flowering stage requires darkness for half a day and equipment like specific lights that will also rack up your electricity costs.

Secondly, a situation difference in consumer experience may be that their jurisdiction simply prohibits personal growing. In Washington state, any grower of cannabis for recreational purposes must have a production license, even if for small quantities (effectively making personal growing impossible for the individual user), while Illinois also prohibits personal growing (Hall et al., 2019; Lancione et al., 2020). This

policy choice removes personal growing as a legal alternative that may incentivise a consumer to obtain cannabis legally rather than illicitly:

> Washington needs to change things, we can't legally grow our own plants so we are stuck with taxes or deals, while other states have better laws surrounding cultivation.

Other instances of policy restrictions on personal growing exist in Colorado and Nevada. Colorado forbids visible personal outdoor growing while Nevada only permits personal growing of cannabis if outside a 25-mile radius of a cannabis dispensary (Hall et al., 2019; Lancione et al., 2020). Such lighter restrictions may not have as decisive an impact on legal personal growing as entirely prohibiting it, but may still conceivably discourage consumer experimentation with personal growing to some degree:

> Here in Colorado, you can't legally grow outdoors if your plants are visible to anyone else which stops people from putting some seeds in their yard to see what happens.

Furthermore, Coloradoan policy may inadvertently make the more expensive indoor growing method the only viable method:

> Essentially, you can only really have a large grow site indoors in Colorado, which unfortunately means far higher electricity costs. If you could grow outdoors, the cost would lower considerably.

Clearly, a jurisdiction permitting personal cannabis growing is a policy choice that may encourage a cannabis consumer to desist illicit market use. Moreover, this offers empirical support that jurisdictions that only permit personal growing but not commercial production, such as Vermont and the District of Columbia, may feasibly influence some consumer desistance from illicit market use (Hall et al., 2019; Kilmer, 2019; Lancione et al., 2020). Conversely, jurisdictions such as Washington and Illinois that prohibit personal growing are possibly removing a policy choice that may influence some consumer desistance (Hall et al., 2019; Lancione et al., 2020). Considering the consumer accessibility issues discussed previously, permitting personal growing may be a useful policy choice for a consumer residing in locations with poor legal market accessibility.

With permitted growing, this consumer at least has an option for obtaining legal cannabis which does not require inconvenient travel to the nearest store.

4.5 Summary

Legalisation may create substantial situational changes for cannabis users. The presence of legal obtainment methods for recreational cannabis means users are faced with a new choice. A 'search for alternatives' begins as users (in some capacity) decide whether the legal or illicit market better satisfies their own specific goals and desires as a cannabis purchaser (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014). Users discussed desiring and considering varying combinations of certain product and service characteristics in their market-choice decision. Therefore, the decisions of consumers examined in this chapter were not random nor unintelligible, but rational and understandable.

Furthermore, interpreting the data indicated examples of consumer decisions and rationality being bounded by environmental influences (Cornish and Clarke, 2017; Gigerenzer and Selten, 2002; Lockton, 2012; Selten, 2002; Simon, 1978, 1955; Wortley, 2014). For instance, while consumers are free to choose their suppliers, factors beyond their direct control influenced whether the legal or illicit market offered superior cannabis prices, quality, and/or accessibility.

Equally, past experiences may crucially bound the consumer-market choice, as previous interactions with illicit suppliers likely play a major (if not sole) role in shaping their perceptions of illicit market characteristics. For instance, knowledge of illicit market prices, quality and service would come from past interactions with illicit suppliers. Importantly, these perspectives and experiences provides the information consumers rationally assessed when comparing the illicit market with the legal. Naturally, those with more negative perspectives of, and experiences with, illicit suppliers may (all other factors being equal) view the legal market more favourably. Likewise, those with favourable interactions with illicit suppliers may more critically view the legal market, whilst potentially requiring the legal market to be relatively more superior before desisting.

Therefore, while consumers made rational choices based on their own individual preferences (i.e., their goals), their end decision was (at least partly) bounded by factors,

experiences and circumstances outside of their direct control (Cornish and Clarke, 2014; Selten, 2002; Simon, 1955; Wortley, 2014).

Personally growing cannabis represents an alternative option for consumers desiring to cease illicit market use. As self-supplying poses the same (as buying legal cannabis) threat to the illicit market (i.e., losing consumer demand), it deserves attention. Offering home-growing as an option may prove useful as a legal option for consumers who struggle to access legal cannabis. Again, while the consumer has agency to choose home growing, factors outside their control may affect its appealability. Certain climates make outdoor cannabis growing more difficult whilst indoor growing may be more expensive (when considering electricity costs) and require dedicated inside space (i.e., to grow cannabis and store needed equipment) (Decorte and Potter, 2015; Green, 2009; Paoli et al., 2010). Also, personal growing likely requires greater effort than simply purchasing cannabis illicitly or legally which may dissuade some consumers.

In closing, this chapter offered contrasting perspectives on the illicit-legal market competition and helps answer the first research question of this thesis, which asked what influences a cannabis consumer to use the legal or illicit cannabis market. These contrasting views become particularly useful for offering potential explanations for why legalisation may, or may not, encroach upon illicit market demand. Importantly, analysis indicates that under the right circumstances, legal sale and the option to personally grow your own cannabis, may incentivise consumers to desist illicit market use.

The present analysis has several limitations to keep in mind. As the findings stem from qualitative inquiry, they are not generalisable. Secondly, the present findings likely come from cannabis users over the age limit for purchasing and using legal cannabis. [22] Hence, how minor cannabis users react to legalisation is unexplored. Finally, there are several weaknesses (alongside strengths) of using Reddit data for analysis which was thoroughly discussed in section 3.2.3 of the methodology chapter.

---

[22] This is implied as comments discussed the purchasing of legal cannabis, thus, presumably (assuming their accounts are not fabricated) these Reddit users must be over the required age limit.

Chapter 5: Supplier Reddit Analysis

This chapter explores how illicit cannabis suppliers perceive, and react to, the commercial threat that legalisation and the legal market pose. Comments from, or discussing, ex-illicit (or current) cannabis suppliers on Reddit were thematically analysed (Bailey, 2017; Braun and Clarke, 2006; Hawkins, 2017; Patton, 2002). Thematic themes were interpreted through the lens of Rational Choice Perspective (RCP) and Bounded Rationality concepts (Cornish and Clarke, 2017, 2014; Gigerenzer and Selten, 2002; Kubrin et al., 2009; Leclerc and Wortley, 2014; Lockton, 2012; Selten, 2002; Simon, 1990, 1978, 1955; Wortley, 2014). This chapter also applies the Risk and Prices (R&P) theory to interpret Reddit supplier discussions of law enforcement risk changes (Caulkins and MacCoun, 2003; Caulkins and Reuter, 2010, 1998; Reuter and Kleiman, 1986). Understanding how, and why, illicit cannabis suppliers react to legalisation is key to understanding the potential consequences it poses for the illicit market.

Following an overview of the thematic themes, this chapter first examines how illicit suppliers assessed the viability of illicit cannabis sale before exploring their varying reactions to legalisation and this assessment.

5.1   Thematic Themes Overview

In total, 428 relevant references emerged from analysing supplier comments. These discussed their experiences with cannabis legalisation and particularly, how it impacted their criminal involvement decisions (Cornish and Clarke, 2017, 2014). Several themes emerged from these comments which Figure 4 depicts below. Thematic themes split into two hierarchal levels. The first level identifies the supplier criminal involvement decision, i.e., whether they chose to continue competing against their local legal cannabis market (habituation), cease illicit activity entirely (desistance), or adapt their illicit modus operandi considerably (adaptation). The second level contains the reasoning underpinning the above decisions and identifies more specific responses. The following sections explore the structure depicted in Figure 4 in detail before concluding.

Reasoning
- Illicit profit unsatisfactory.
- Unable to maintain consumer demand.
- Product and/or service characteristics subpar to legal markets.
- Not worth it to improve modus operandi.

Change Modus Operandi ←**Adaptation**— **Supplier Reaction** —**Desistance**→ *Cease Illicit Activity*

Habituation

Responses
- Target under-age market.
- Target other illicit drugs.
- Cross-border canabis trafficking.

Responses
- Join non-cannabis related market.
- Join legal cannabis market.

Maintain Current Modus Operandi

Responses
- Compete against legal market.
- No modus operandi change.
- Minimal modus operandi change.

Legalisation benefits
- Law enforcement risk reduced.
- Legal cannabis tax.

Reasoning
- Continued success.
- Illicit profit satisfactory.
- Current modus operandi can maintain consumer demand.
- Product and/or service characteristics superior to legal markets.

Figure 4. Supplier Thematic Theme Overview

Note, while RCP splits criminal involvement decisions between initiation, continuation and desistance, initiation is substituted with adaptation for the present analysis (Cornish and Clarke, 2017, 2014). Initiation describes offenders personally attempting new types or variants of crimes, possibly in response to previous crimes becoming unviable for goal satisfaction (Cornish and Clarke, 2017, 2014). However, the examined data can not determine whether an illicit cannabis supplier changing their illicit modus operandi represented a new behaviour, or a repeat of previous strategies. Hence, semantically, the word adaptation is more apt than initiation.

5.2   Supplier Reaction

Cannabis legalisation may be a substantial environmental change that affects the situation of illicit cannabis suppliers. Two decision processes are of interest. Firstly, what characteristics of legalisation did illicit cannabis suppliers consider, or perceive, as affecting the viability of illicit cannabis sale and why. Secondly, what were the subsequent criminal involvement decisions stemming from a supplier deeming illicit cannabis sale as viable or not (Kubrin et al., 2009; Leclerc and Wortley, 2014).

5.2.1   Viability of Local Illicit Cannabis Sale

Supplier comments discussed three characteristics when considering if their illicit cannabis sale operation could compete against the legal market (whilst remaining worth the effort), these being cannabis price, cannabis quality and service. Beginning with price, some discussed legal market prices as being more expensive than their own rates, which helped them maintain consumer demand, as these two comments demonstrate:

> People still choose to get it from the illicit market as its cheaper than rec, so my business didn't slow down much.

> As someone who grows cannabis, my friends continue buying from me for my cheaper prices. Recreational cannabis is more expensive than what black market prices used to be.

Alternatively, other supplier comments discussed having to lower their own prices to remain competitive and maintain consumer demand, as these comments demonstrate:

> Prices are lower because of the numerous dispensaries that are now around here in Washington, so I have altered my prices.

> I am an Oregonian dealer who grows and sells. I have had to lower my own prices. As an example, I used to sell an O for 210, now it goes for 150.

Available quantitative comparisons of cannabis prices in legalised locales show average illicit rates remaining below legal prices (Bahji and Stephenson, 2019; Mahamad et al., 2020). However, keep in mind, these comparisons only examined the short periods following legal sale (five months or less), thus longer-term trends are unclear (Bahji and Stephenson, 2019; Mahamad et al., 2020). One survey found cannabis consumers in legalised locales were, in general, more likely to perceive legal cannabis as more expensive (Fataar et al., 2021). Hence, the literature is in keeping with these supplier accounts of illicit rates remaining below legal prices. Further, the present analysis empirically demonstrates a possible explanation for cheaper illicit prices, it stemming from illicit suppliers keeping their prices below legal rates to maintain consumer demand.

While lowering prices may maintain consumer demand amidst a competing legal market, an undercutting strategy would potentially lower profit (all other factors being equal). Simultaneously, undercutting lowers illicit cannabis sale reward while increasing its cost, as the return on each sale may become relatively lower. Thus, to some degree, a supplier must willingly adjust their profit aspiration level downwards to make undercutting a satisficing choice (Selten, 2002, 1998).

If legal cannabis prices are much higher than illicit rates, the required downward adjustment of the aspiration level may be relatively minor. However, if legal prices are much lower, or continue to lower, (or continuously lowers), illicit cannabis sale reward may become increasingly unworthwhile for suppliers despite some profiting remaining possible. For these suppliers, an unwillingness to lower their profit aspiration level meant illicit cannabis sale became an unviable method, as these two comments demonstrate:

> I have to start considering a different line of work, as prices have screwed me, $900 a pound just about gives me $200 profit. The market favours buyers.

> An eight used to go for 60, now it is common for it to go as low as 35. How much I make per gram has lowered so my margins have seriously suffered. Guessing that I have to stop selling now.

Other illicit suppliers described legal cannabis prices as being too cheap to feasibly compete against, as these two comments demonstrate:

Prices are too cheap to compete with. Dispensaries sell 1/8oz at 20 dollars while 25 used to be a good deal. You can even get ounces for $100 on the weekend.

Stopped selling cannabis as I could not compete with store prices.

Discussions of legal prices lowering enough to threaten illicit cannabis supplier prices, or requiring them to lower their own prices, is not unexpected. While illicit suppliers do not incur expenses from taxes or license payments, they still shoulder unique operating costs from having to handle law enforcement and compensate for punishment risk (Caulkins and Kilmer, 2016; Caulkins and MacCoun, 2003; Caulkins and Reuter, 1998; Reuter and Kleiman, 1986). Further, production and distribution costs may lower substantially for legal operations as they become increasingly efficient over time (Caulkins, 2010; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019). Indeed, Fataar et al (2021) found consumers were more likely to perceive legal cannabis as cheaper if they resided in a jurisdiction that employed legal sale for longer. Therefore, considering the above two points, legal prices lowering enough to threaten the profits of some illicit suppliers is feasible.

As similarly done in section 4.2.1 of the previous chapter, the potential link between length of legal sale operating, and legal prices lowering, and/or challenging illicit supplier rates, is explorable from the Reddit data. Table 3 presents the total amount of relevant supplier comments by time elapsed since legal sale began in each state by years. Table 3 also shows the percentage of supplier price comments in three categories by year. The first category ('Unchanged') indicates illicit prices were unaffected by the legal market as suppliers did not have to lower their own prices. The second ('Lowered prices') and third ('Infeasible/Unworthwhile') indicate that legal cannabis prices influenced illicit prices to lower and negatively affected the feasibility and/or profitability of illicit sale. The former directly discussed suppliers having to lower their own prices, while the latter discussed legal prices as being low enough to make illicit sale infeasible or unworthwhile.

Table 3 displays some clear trends where higher percentages of the second and third categories emerge as legal sale is operational for longer. Conversely, percentages for the first category were higher when legal sale was more recent. These simple statistics support the possibility that the contradictory viewpoints from supplier comments regarding cannabis prices, may partly stem from differences in the length in which legal sale was operational.

114

Table 3. Percentage of relevant supplier price subtheme references

Year from legal sale	References	Unchanged	Lowered prices	Infeasible/Unworthwhile
0	9	67%	33%	0%
1	10	50%	20%	30%
2	24	25%	42%	33%

There are clear limitations of the above data that one must keep in mind. The data in Table 3 only represents a proportion of the supplier price subtheme comments, as a comment had to explicitly state or indicate a specific location, and thus other supplier price comments are unrepresented. Furthermore, the data is not a representative estimation of supplier perceptions and decisions. However, the purpose of these simple statistics was to only offer a possible explanation from the data itself, for the contradictory viewpoints on price seen in the examined supplier comments. Nevertheless, the trends seen in Table 3 are in keeping with other sources of information that indicate legal prices as lowering over time, specifically, other Reddit user comments that discussed legal prices lowering overtime, other empirical literature, and literature hypothetically discussing legal price lowering overtime (Caulkins, 2010; Fataar et al., 2021; Kilmer et al., 2010b; Kleiman, 2017). Lastly, unlike Table 2, the fourth year from legal sale was removed in Table 3 as only one suitable comment existed. [23]

Considering RCP, theoretical explanations for these contradictory reactions to legal price may be understood by considering the potential different situations illicit suppliers experience with the legal market (Cornish and Clarke, 2017). Like all goods, legal cannabis prices may vary by locale. Naturally, suppliers residing in areas where prices are lower presents a more difficult situation (if desiring to outcompete the legal market), than those residing where prices are relatively higher. For instance, differing tax levels may mean legal cannabis prices are (all other factors being equal) relatively higher or lower. Thus, the supplier assessment of their illicit cannabis sale viability is arguably (at least partly) constrained and shaped by factors outside their control (i.e., environment influences), regardless of their individual capability (Gigerenzer and Selten, 2002; Lockton, 2012; Simon, 1990).

---

[23] This removed comment indicated suppliers have to lower their illicit prices

Nonetheless, individual differences likely play an important role (Cornish and Clarke, 2017; Selten, 2002). For instance, differences in profit goal aspiration levels may explain contradictory viewpoints, i.e., a supplier who is more flexible regarding acceptable levels of profit may feel, and be, less impacted by legalisation. For instance, two suppliers may need to lower their cannabis prices comparatively to maintain demand. However, one who is unwilling to accept lower profits may perceive, and discuss, the legal market as being a greater threat towards their operation. Unfortunately, the present data does not offer more personal or demographic details on each Reddit user. Thus, more detailed consideration of the potential role in which individual differences play on supplier decision-making is limited in this analysis.

Cannabis quality represents another arena (alongside price) where legal and illicit cannabis suppliers vied for consumer demand. Illicit cannabis suppliers claiming to offer higher quality cannabis described it helping to maintain their consumer demand amidst a competing legal market, as these two comments demonstrate:

> I live in Washington and experience no difficulties in selling my harvest of bud despite many legal shops existing. Grow quality stuff and you can still have many customers.

> My stuff is aways good, so my customers prefer using me rather than dispensaries whose quality varies.

Some supplier comments claimed to offer both better prices and superior quality. However, these comments still described undercutting legal market prices, thus demonstrating that undercutting remained a necessary strategy for them to maintain consumer demand (despite having, from their perception, a comparable quality product) from competing legal suppliers:

> I have superior quality and cheaper price than a recreational dispensary.

> My own sells quality that rivals a dispensary, but he lowered prices to be more accessible when he went downtown.

Other suppliers described the opposite situation, their local legal market offered cheaper and/or higher quality cannabis. This situation requires the illicit cannabis supplier

116

to fulfil two requirements to remain competitive, undercut legal prices while procuring higher quality cannabis. Logically, obtaining higher quality cannabis may incur more cost than lower quality cannabis. Meaning illicit cannabis sale reward may also reduce (alongside from undercutting) due to the potential costs of obtaining higher quality cannabis. Overall, suppliers in this situation deemed illicit cannabis sale as unviable, or extremely difficult, for satisfying a profit goal, as these two comments demonstrate:

> A street dealer struggles to profit while competing with stores, as stores have quality product for significantly lower prices.

> I am an ex-dealer that operated out of Washington. Compared to what I could get, the shops sold higher quality at a superior price.

Legal cannabis quality also represents another potential situational difference for illicit suppliers which may impact their ability to successfully compete against the legal market. A locale containing legal sellers who sell relatively high-quality product theoretically presents a greater threat to local illicit suppliers as consumer have greater reason to start legal purchasing (as explored in the previous chapter). Though no comment discussed specific details, it is interesting to consider how individual differences may feasibly change the threat legal cannabis quality poses to an illicit supplier. Differing supplier skills and/or past experiences may influence their access to high quality cannabis (Selten, 2002; Simon, 1978, 1955; Wortley, 2014). For example, a supplier may know a contact for high quality cannabis from past experiences, or they themselves may be skilled in cultivating cannabis. Therefore, the supplier with access to good quality cannabis may perceive the legal market as less threatening, and vice versa.

Like consumer discussions of quality, illicit supplier descriptions of their own cannabis quality may be subjective and inaccurate (Caulkins, 2007; Decorte, 2011; Reuter and Caulkins, 2004). Like consumers, illicit suppliers may be equally unaware of the quality of the cannabis they sell or grow (Caulkins, 2007; Decorte, 2011; Reuter and Caulkins, 2004). Nonetheless, clearly, these examined illicit suppliers perceived their cannabis quality as having tangible impacts on the successfulness of their operation for competing against legal suppliers.

Suppliers also considered legal market service characteristics. As with quality and price, service represents another arena where legal and illicit cannabis suppliers may

compete for consumer demand. Legal service creates a new problematic situation for illicit suppliers, as by simply existing, an accessible legal market may raise the standards of what cannabis consumers expect from their suppliers. Thus, the level of service an illicit supplier offered pre-legal sale may no longer satisfy current consumer expectations, as this comment discussed:

> Its only due to government regulation that these people ever had a successful business. The majority of weed suppliers treat their buyers extremely poorly and they have customers because it is difficult for users to find an alternative seller.

For example, these supplier comments described stopping illicit sale as they could not match the convenience and selection legal suppliers offered:

> People stopped using me after legalisation because of the attraction of a wider selection, edibles, and so on, I have stopped now.

> Many black and grey market dealers have left the business because of legal cannabis. Personally, I miss cannabis work. A cannabis store is just too convenient, and it offers a lot of variety at good prices.

An exchange between two Reddit users demonstrates the potential negative influence legal market service has on illicit supplier access to demand. The supplier could not compete on convenience or selection. Furthermore, while the supplier could hypothetically offer lower prices as a strategy for maintaining consumer demand, the subsequent loss in profit made selling illicit cannabis unworthwhile. Thus, the supplier was unwilling to lower their profit aspiration level, to offset their relatively (to the legal market) poor service, enough to remain competitive.

> Pricing your cannabis below legal rates was impossible?

> While I could undercut legal prices, I could not lower it enough to compensate for my relative lack of convenience and selection (compared to the shops) as lowering my prices even further would have made the money not worth it.

Therefore, an illicit cannabis supplier who adjusts to, or already operated, an excellent service may better keep consumer demand amidst a competing legal market. As discussed in the previous chapter, much consumer reasoning behind their market-choice decision reflected tangible economic and practical benefits, rather than if their supplier operated legally or illegally. Therefore, an illicit supplier whose operation satisfies the consumer desired characteristics for cannabis purchasing may theoretically thrive despite a competing legal market. One Reddit user comment exemplified such a professional illicit cannabis service:

> Once ordered, I will bring the product to you in under an hour, alternatively I accept bookings of specific time slots if that's more convenient. If you're my friend, I don't mind accepting digital payment. If I have some history with you previously then I don't mind giving you some credit. My packaging is branded, I provide strain information, and give the customer little extras like free hash or a brownie as I come across them. I am also open to fulfilling special requests which I will try my best to satisfy, for example I've done cakes alongside oil and wax extracts. If you have a need for me to be discrete then you'll receive your cannabis in a nondescript plastic envelop that is sealed and inodorous.

The above excerpt demonstrates this illicit supplier satisfying several service characteristics, which both illicit and legal cannabis purchasers discussed desiring in the previous chapter. This supplier satisfies convenience by offering delivery within the hour or at a booked time. By providing accurate strain information the supplier also satisfies consumer desires of product consistency. The supplier satisfies product selection, offering both hash and edibles while also being willing to procure special requests. This supplier also offers discretion thus appealing to any consumer valuing confidentiality. Lastly, their discussion of special perks and cannabis product gifts reflect the consumer-dealer relationship subtheme comments. Other notable services Reddit users claimed include a punch card system (e.g., every 5th similar quantity purchase being free), supplying organically grown vegetables alongside cannabis, and one claimed to provide accurate lab reports of their cannabis.

Thus, a legal cannabis market may struggle to desist more professional suppliers than those less skilled or competent. The examined data does not directly explain why some suppliers could offer superior services than others. However, differences in

119

individual skill, thinking capacity and personal experience theoretically may influence how a supplier operates their legal cannabis service (Cornish and Clarke, 2017, 2014; Selten, 2002). For instance, one supplier may be more proficient at business and/or willing to put more effort into their operation than another. Further, the legal market itself presents an important situational difference as its accessibility and service may set the standard for illicit suppliers to match or surpass for maintaining consumer demand.

In closing, these supplier comments discussed illicit cannabis sale as both viable and unviable. Suppliers perceived illicit cannabis sale as remaining viable after legalisation if it still satisfied their personal profit goal aspiration level (Selten, 2002, 1998; Simon, 1957; Wortley, 2014). While a supplier requires consumer demand for profit, and demand arose as a key consideration throughout the comments, it was only a means to create profit. If any changes or efforts to maintain demand critically jeopardised profit satisficing (i.e., pushed profits below their profit goal aspiration level), suppliers deemed illicit cannabis sale as unviable. Furthermore, unsurprisingly, no supplier comment discussed accepting a negative return to maintain consumer demand. The focus on profit for these examined illicit cannabis suppliers here supports R&P theory which argues that illicit drug sellers are primarily motivated by earning money rather than pathological or ideological reasons (Caulkins and MacCoun, 2003; Reuter and Kleiman, 1986).

Of course, other non-profit motivations for supplying cannabis exist, for example, illicit cannabis growers have been known to produce for financial and non-financial reasons (Potter et al., 2013). However, it makes logical sense that only illicit suppliers prioritising a profit goal would perceive, and feel threatened by, a competitive legal cannabis market. Furthermore, when considering the desire for legalisation to harm the illicit market, the individuals in mind to target are those profiting illicitly off the plant and propping up an illicit market, not a hobbyist grower or cannabis connoisseur.

See Figure 6 below, which depicts a possible hypothetical illicit cannabis supplier decision process, derived from the examined data, regarding illicit cannabis sale viability.
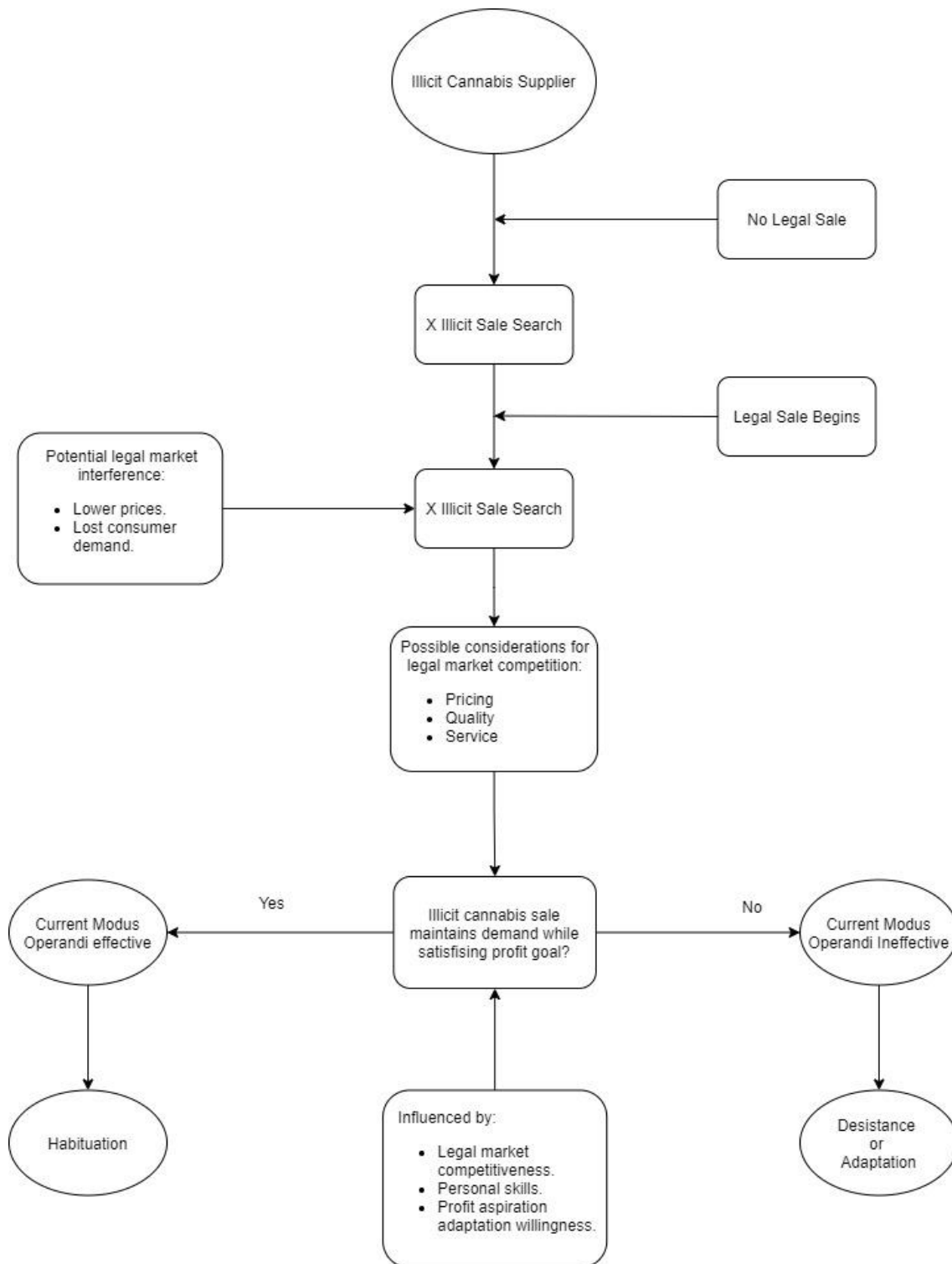
Figure 5. Hypothetical illicit cannabis sale method viability assessment process

5.2.2   *Supplier Criminal Involvement Decisions*

All the examined supplier comments gave insight into the habituation, desistance or adaptation criminal involvement decisions of illicit cannabis suppliers (Cornish and

Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014). Importantly, these supplier comments all attributed any criminal involvement changes, or consideration of changes in the case of habituation, to cannabis legalisation and its legal market. However, not every comment offered specific reasoning for why legalisation motivated said changes. For example, a supplier comment may describe cannabis legalisation causing their own desistance without specifically stating what aspect of it was responsible.

Nonetheless, each criminal involvement decision subtheme contained some comments with reasoning behind their choice (of which the previous section discussed). Furthermore, it is difficult to think of any other reason for why the examined illicit cannabis supplier comments would attribute substantial changes in behaviour, such as desistance or adaptation to legalisation, besides it impacting the viability of illicit sale in some way. Regardless, comments not detailing the specific reasoning behind said criminal involvement changes still offer valuable insight into what the habituation, desistance and adaptation decisions entailed for suppliers operating amidst a competing legal market.

Habituation

The habituation decision involved a supplier continuing illicit cannabis sale with little to no modus operandi change. What defined the habituation choice was the decision to continue competing against the local legal market for demand. The previous section 5.2.1 detailed the competitive relationship between illicit and legal cannabis suppliers, so the description here is brief. These suppliers could still satisfy their profit goal aspiration levels amidst a competing legal market, hence, repeated success encouraged the habituation decision (Cornish and Clarke, 2014). While these illicit cannabis suppliers may have to improve their pricing, quality, service and/or lower their own profit goal aspiration level, such changes do not constitute as significant modus operandi changes as the desistance or adaptation decisions entail.

Interestingly, some comments in the habituation subtheme discussed legalisation indirectly benefitting the situation of illicit cannabis suppliers, which by extension, made habituation a more appealing and feasible choice. For example, one such situational factor is law enforcement which represents an environmental influence that may, through threats

of punishment, constrain illicit drug supplier decisions (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978). Furthermore, R&P theory indicate law enforcement risk may increase the operational costs of illicit drug operations. Thus, potential implications exist when illicit supplier comments indicate legalisation as reducing law enforcement risk, as these two comments demonstrate:

> While I'm still selling it illicitly, I feel safer.

> Selling lots of cannabis with lower risk.

Other comments elaborated on why law enforcement risk may reduce for illicit sellers under a legalised setting. One discussed reason involved the legalisation policy choice to permit cannabis possession in small quantities. Under such policy, anyone over the legal age limit may legally possess a certain quantity of cannabis on their person which illicit cannabis suppliers can take advantage of. Specifically, suppliers can reduce their risk by only transporting and selling cannabis at quantities which are at, or below, the legal possession limit, as these two comments discussed:

> The only thing that changed for dealers was that if they only have a small quantity on them when caught they get in no trouble.

> Now that holding around 2.5 ounces is legal, police pulling him over whilst he heads to a meetup and getting arrested is no longer a real fear for him, unless he's smoking at that time.

Considering R&P theory offers additional insight into further consequences of permitting legal cannabis possession, as it may theoretically lower informal law enforcement tax (Caulkins and MacCoun, 2003; Caulkins and Reuter, 2010, 1998; Reuter and Kleiman, 1986). For instance, incurred law enforcement costs from supply-side interventions would reduce if a supplier only carried cannabis quantities below, or at, the legal possession limit. The supplier minimizes any risk of law enforcement seizures and by extension, avoids potential costs of having to recuperate lost product.

Comments also discussed a second reason for lower law enforcement risk. These Reddit user comments perceived, in their locale, law enforcement deprioritising cannabis enforcement after legalisation, as these two comments demonstrate:

> As weed is legal, no one is going to throw you shade. For law enforcement it is just not worth their time and effort. Any incarceration danger almost disappeared entirely.

> Cannabis suppliers are not being pursued by any Washington cops.

Like legal cannabis possession laws, reduced law enforcement priority may lower informal law enforcement tax. For instance, other comments referenced illicit cannabis suppliers engaging in bolder illicit cannabis sale strategies following cannabis legalisation amidst, a less interested law enforcement:

> Once the law passed in Seattle, some people started not only advertising everywhere but began publicly selling (from their cars or from off a bike). The police stated they were ignoring it and that they did not care about it.

Another example demonstrating bold illicit cannabis sale strategies after legalisation involved illicit cannabis suppliers opening physical unlicensed stores, as these two comments demonstrate:

> Unlicensed shops open for months or years before the San Diego police manage to close them.

> Illicit shops are everywhere in the streets.

These bold illicit cannabis sale strategies offer possible examples of illicit cannabis suppliers being able to operate more efficiently and effectively thanks to reduced law enforcement risk (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). Such overt strategies may conceivably have faced certain, or higher risk of, law enforcement before cannabis legalisation occurred.

Lastly, as legalisation appeared to lower the informal law enforcement tax for these examined illicit suppliers, consequently, it may also reduce the risk compensation

needed to justify illicit cannabis sale (Caulkins and MacCoun, 2003; Caulkins and Reuter, 2010, 1998; Reuter and Kleiman, 1986). Recall that working in an illicit drug market may be dangerous and risky, thus illicit market workers may require a certain level of profit to justify the risks that law enforcement partly constitutes. Hence, according to R&P, decreased law enforcement risk from legalisation may entail illicit suppliers requiring less profit to justify the risks of operating. The two comments below indicate this directly, as they discuss how the decreased risk of illicit cannabis sale justified satisfying a lower profit goal aspiration level:

Business in Colorado has been fine for me. The risk being low makes the lower prices ok.

While I make less now, I no longer have to worry about who I am selling to. The police have become far less of a concern.

Thus, supplier comments indicate the possibility that legalisation may inadvertently lower operational costs for illicit cannabis suppliers through decreasing law enforcement risk. Consider also that these law enforcement risk reductions may theoretically occur before legal sale begins or under legalisation regimes which stop short of allowing commercial sale. [24] In these scenarios, illicit cannabis suppliers may enjoy a situation in which they reap benefits of lower law enforcement risk without (the previously discussed) negative consequences of operating amidst a competing legal market.

However, while this risk reduction benefitted these described cannabis suppliers, many supplier comments lacked any reference to law enforcement risk which indicates different possibilities. These suppliers may have experienced no risk reduction benefits indicating a different experienced situation. For instance, perhaps law enforcement in their area did not deprioritise cannabis enforcement and/or their modus operandi involved cannabis quantities larger than the legal possession limit. Alternatively, said benefits were too small to make a real difference for their criminal involvement decision and thus be included in their comment (Solymosi et al., 2018). For example, the negative

---

[24] Several jurisdictions which have permitted a commercial legalised cannabis industry have allowed possession and use first while there is some time (often two or more years) before the locale functionally implements legal sale (Hall et al., 2019; NCSL, 2019b).

consequences of a competitive legal cannabis market situation (i.e., one with low prices, higher quality, accessible and/or superior service) may overshadow any risk reduction benefits. After all, there is no real utility for lowered law enforcement risk if the main issue plaguing an illicit supplier is legal market competition rather than enforcement.

Lastly, some supplier comments also discussed legal cannabis taxes favourably as being able to sell cannabis untaxed gave them an advantage over their legal market competitors, as these comments demonstrate:

> We can avoid income tax. Thirty percent or more is a massive hit to your net income.

> I continue to profit because of the large taxes they place.

> Recreational taxes are costly. Black market cannabis is cheaper. My operation slowed little.

Legal taxes represent a second situational difference as they may differ by jurisdiction. For instance, Washington and California apply far higher taxes on recreational cannabis than Oregon or Massachusetts (Boesen, 2020; Hall et al., 2019). Thus, all other factors being equal, an illicit cannabis supplier in the former two states may have less difficulty in pricing their cannabis at or below legal rates compared to those operating in the latter two. In theoretical terms, due to higher tax rates, their profit goal aspiration level is less likely to be challenged, or may not need to be lowered as much to successfully outcompete legal prices.

However, high taxes appeared inconsequential for other examined supplier situations. As described in the former section (and the previous consumer chapter), the legal market may offer prices illicit suppliers struggle to willingly match or undercut. Thus, the legal market in these cases offered competitive prices despite taxation. High taxes may be more relevant for supplier decisions during the early stages of legalisation in locales where the legal market is new, and the possible cost reductions from improved efficiency in legal cannabis industries are less fully realised (Caulkins, 2010; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019), as this comment discussed:

126

The large taxes stopped the illicit market from dying. But street prices are beginning to be matched by store prices, so dealers are getting less customers.

Figure 7 below depicts a hypothetical decision-making process of an illicit cannabis supply choosing a habituation criminal involvement decision, derived from the examined data.
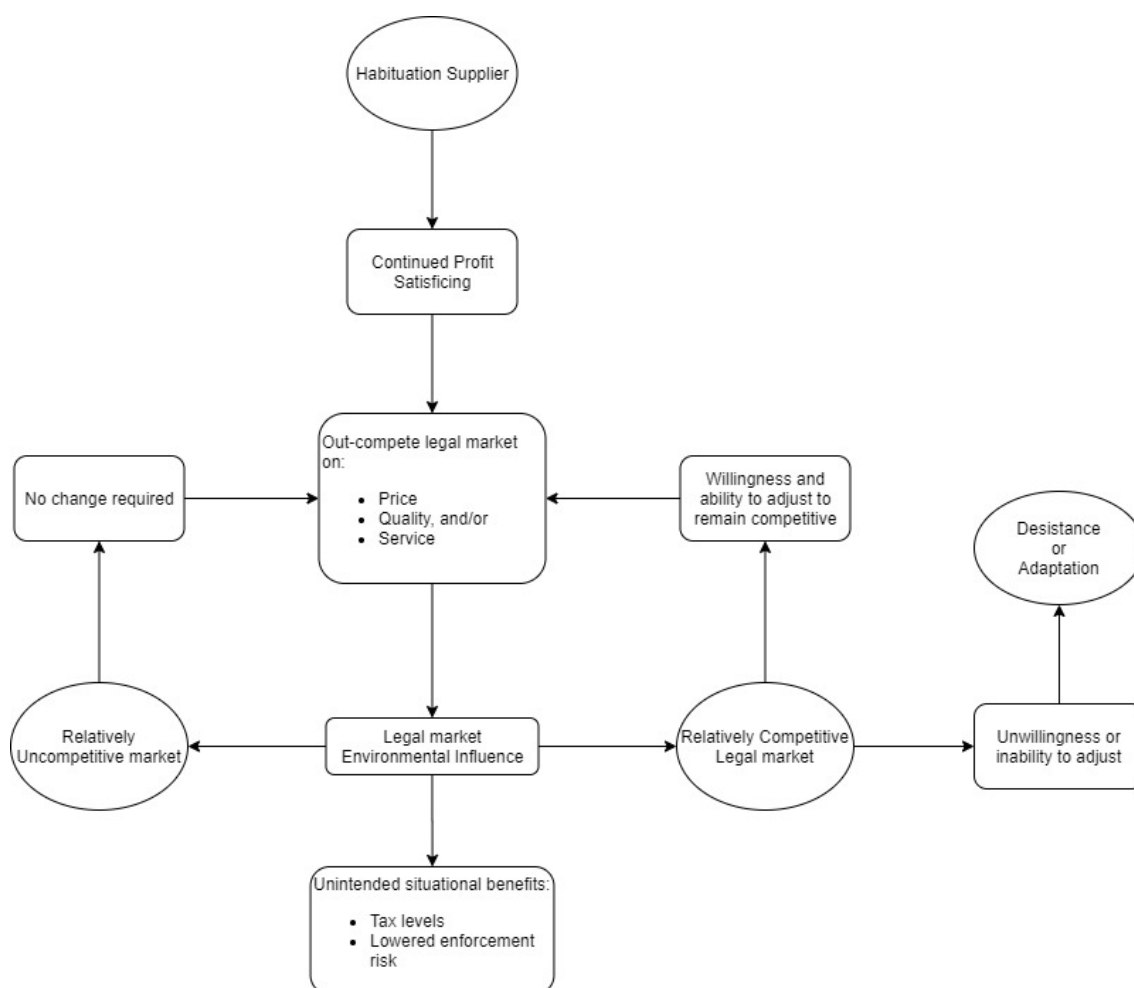

Figure 6. Hypothetical illicit cannabis supplier habituation process

Desistance

An alternative supplier response to cannabis legalisation involved stopping illicit cannabis sale. Furthermore, these comments indicated (at least during the time of their Reddit conversation) complete desistance from illicit activity as comments described ex-illicit suppliers entering legitimate employment:

> I am employed in a more difficult job now, I stopped selling weed as the margin was no longer there and little free cash flow existed.

> My sibling sold weed but went back to school because the profit margins disappeared.

Other supplier desistance comments specified entering the recreational legal cannabis market. Two reasons emerged for ex-illicit cannabis suppliers joining the legal market. The first (and previously discussed in section 5.2.1), involved these ex-illicit suppliers joining the legal cannabis market as illicit sale failed to satisfy their profit goal aspiration level. More interestingly, the second involved illicit suppliers willingly entering the legal market as they preferred it to illicit work. The latter represents a different legal market influence on supplier decision-making than previously discussed. Before, supplier reasoning for stopping illicit cannabis sale stemmed only from difficulties in competing against legal suppliers, i.e., the legal market indirectly coerced a criminal involvement decision change. Alternatively, these supplier comments indicate that the legal market incentivised them to desist (rather than disincentivising illicit sale).

For example, consider these two comments discussing ex-illicit cannabis suppliers planning to enter the legal market before legalisation or legal sale occurred (note, Aurora is a Canadian legal cannabis company):

> He was cultivating cannabis across the state in numerous buildings and once it became legal, he started distributing and selling it all legitimately. Ex-drug dealers and growers make up the majority of his workforce.

> My illicit suppliers invested into companies like Aurora and also, they have jobs lined up.

The above comments indicate that some reasoning influenced a premeditated decision to legitimise their operation and/or enter the legal market as workers.

Other supplier comments discussed the benefits of working legally, which offers some insight into how, and why, the legal market may incentivise, and retain, illicit supplier desistance. Firstly, they discussed being able to earn more by working legally than they could illicitly. Hence, legal market work could satisfy a higher profit goal

aspiration level than illicit cannabis sale (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978), as these two comments demonstrate:

> Clever dealers legitimised and entered the industry. Now I get a paid salary from working in the legal market and I make 20x more than I ever did working illicitly.

> He earns much more now by turning his grow operation and profits into a legal business which sells to dispensaries.

Interestingly, this means operating legally for these suppliers remained more profitable than illicit sale despite having to pay taxes, licenses, and other regulatory requirements.

Other comments elaborated on some reasons for why legal work may outperform illicit profits. These comments argued that working legally meant accessing a larger consumer market and moving higher volumes of cannabis than they could illicitly. Thus, while profit per cannabis quantity may be lower, selling larger quantities generated more income overall, as these two comments described:

> Once the state passed the law, he got his license. Now he supplies dispensaries and moves even more product than before. He actually earns more than what he did when working illicitly.

> He got his license and opened a legal shop in a busy area. While profits lowered per gram, his market has expanded considerably.

The above reasoning may arguably reflect the removal of informal law enforcement tax (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986). Desisting and working in a legal cannabis market means no more incurred costs from having to operate inefficiently to avoid law enforcement detection. Unhindered by risk, a legal cannabis supplier could sell as much legal cannabis to as many consumers as possible without having to operate inefficiently to avoid, or limit, law enforcement intervention. In the above cases, the cost of the informal law enforcement tax may have outweighed the costs of operating legally.

Law enforcement risk removal, combined with the potential to make more profit through legal operations, (arguably) represents a relatively optimised outcome for a supplier reacting to legalisation (of those examined in this chapter). These suppliers were

not only able to capitalise on legalisation to improve their income, but were able to neutralise a risk which is ever present when selling drugs illicitly:

> On flower alone he makes four times as much as what he made when selling illicitly and now, it is no longer possible for him to get arrested doing something he loves.

Even where an ex-illicit cannabis supplier described illicit market work as more profitable than operating legally, removing law enforcement risk may help justify accepting lower profits, as this comment described:

> He said illicit work would likely be more profitable as he could avoid taxes but taking on the extra risk is not really worth it.

Furthermore, working in the legal market may hold other incentives beyond price and risk that illicit cannabis suppliers may value. For example, one Reddit user claiming to have experience in legal cannabis production discussed several other advantages of legitimising besides profit:

> Alongside the high costs, several positives exist such as being able to run a steady business, having taxes that can be reported, potential in the long term, and the ability to expand without risking violence which can be particularly hard in an illicit industry.

Likewise, working in a legal store may offer quality of life improvements from selling illicit cannabis. As the below ex-illicit cannabis dealer described, their new job offered certain benefits which working illicitly could not:

> I work in a place that has sensible hours and good security measures (an alarm system, security cameras, and glass that can actually stop bullets). I am more than content with the privacy I get, my wage, and the peace that comes with this being my career.

Thus, the above three excerpts demonstrate instances of aspiration adaptation where the suppliers accepted lowered profits in favour of satisfying different desires and goals (Cornish and Clarke, 2017; Selten, 2002).

That some illicit cannabis suppliers better capitalised off cannabis legalisation does not dismiss the rationality of those less successful, lack of optimisation does not equate irrationality (Selten, 2002). Desisting into the legal market once illicit cannabis sale failed to satisfy a profit aspiration level still demonstrates a rational and reasonable choice, even if it reaped less reward than those who pre-emptively desisted. While the available data is limited in discussing this directly, taking a bounded view of rationality opens up many plausible explanations for these differing illicit cannabis supplier experiences and successes (Cornish and Clarke, 2017, 2014; Selten, 2002, 1998; Simon, 1978, 1955; Wortley, 2014).

For example, illicit cannabis suppliers may differ in their thinking capacity and/or have different knowledge that predisposed some to identifying opportunity in the legal market that others missed. Furthermore, they may have different skills that influence whether, and if so, how effectively, they could benefit off legal market opportunity. One illicit cannabis supplier may be better equipped than another to firstly perceive legal market opportunity and to capitalise on it. To disagree, means arguing that all illicit cannabis suppliers have the same capabilities and undergo the same situational influences in their lives which is clearly false. Another possibility is that an ex-illicit cannabis supplier was particularly ineffective in selling illicit cannabis but functions relatively better under a legal situation, thus reaping more reward from the latter. Besides these theoretical explanations, a common-sense observation is that in any job or industry there always exists variation in the skills, ability and luck for its members. There is no sensible reason to suggest that the ex-illicit cannabis suppliers examined, or a legal cannabis industry, is any different.

Arguably, legalisation-based desistance may hold several advantages over supply-side law enforcement. Firstly, by economically targeting a fundamental cause of illicit sale (i.e., the ability of a supplier to profit), the desistance influence of legalisation is relatively less constrained. Supply-side enforcement interventions (i.e., seizures, crop eradication, raids, crackdowns, etc) must maintain some presence to constantly impact the illicit market (Mazerolle et al., 2007). Contrastingly, legal markets exert their influence without requiring a direct and concentrated force, with the only requirement being legal stores existing in relative vicinity which vie for cannabis demand.

Consequently, a second advantage of legalisation-based desistance is that it may hold more longevity than supply-side enforcement, as its reason for existence may not

disappear as easily as the latter. Supply-side enforcement requires constant exertion of resources in a locale, or on a supplier, which must end at some point. For example, a crackdown in an area can not last indefinitely as police resources will inevitably be required elsewhere (Mazerolle et al., 2007). The influence from a competitive legal cannabis market is ever present, amorphous and far less physically restricted (within the legalised locale) than law enforcement interventions. While the threat of law enforcement punishment constitutes an indirect influence which may discourage some illicit sale, it still logically requires punishment to occur for reinforcing said threat.

A third advantage comes from legalisation-based desistance providing possible improvements over displacement. Law enforcement supply-side interventions on illicit drug markets are commonly criticised for simply displacing crime (Berlusconi et al., 2017; Giommoni et al., 2017; Mazerolle et al., 2007; Seccombe, 1995; Toth and Mitchell, 2018; Windle and Farrell, 2012). For instance, individuals may simply move their illicit drug operations to different physical locations (target displacement) or simply wait until the law enforcement intervention inevitably ends (temporal displacement) (Reppetto, 1976; Windle and Farrell, 2012). Arguably, legalisation-based desistance limits displacement (relative to law enforcement punishment), as the supplier would have to operate in an area outside the economic influence of the legal market. [25]

A hypothetical example best illustrates the above three points. Consider two illicit cannabis suppliers, A and B, where A resides in a legalised jurisdiction with a competitive legal market while B lives in a prohibited jurisdiction. Supplier A has stopped illicit sale as they can not cannot profitably compete against their local legal market. Supplier B has stopped operations as police are conducting a crackdown in their selling area. Supplier A may attempt to travel to the nearest town to find new consumers. However, this town itself contains legal stores meaning a comparable competitive influence that jeopardised their operation remains present, and may do so in other locales in the legalised jurisdiction. Contrastingly, supplier B may simply travel outside the, much smaller (compared to an entire jurisdiction), crackdown area or wait until it inevitably ends to continue their operation normally.

Fourthly, as the individual willingly (though possibly partly coerced by circumstance) chooses to stop, legalisation-based desistance avoids any harms for the

---

[25] Economic influence refers to locales which have operating legal cannabis suppliers.

individual, and financial costs for the state associated with an arrested illicit supplier going through the criminal justice system (Apel and Sweeten, 2010; Boshier and Johnson, 1974; Pager, 2003; Sampson and Laub, 1997). Lastly, legalisation-based desistance avoids the criticism that supply-side enforcement may inadvertently increase local drug dealer revenue through raising prices as, alternatively, the present analysis indicates it can do the opposite (Caulkins and Reuter, 2010; Kilmer et al., 2015).

In cases where the legal market attracted supplier desistance (as opposed to disincentivising illicit sale), similar advantages exist. Furthermore, entering the legal cannabis industry indicates greater longevity for desistance, when considering employment is an important factor which may discourage recidivism (Latessa et al., 2013).

Potential caveats for legalisation-based desistance are the requirement of the recreational legal cannabis market to be firstly present (i.e., have stores and supply in a locale), that it is commercially competitive enough to illicit cannabis suppliers for consumer demand, and that the government maintains their legalisation policy. Furthermore, the above positives only logically apply to illicit cannabis suppliers operating in the legalised locale. Further, as is discussed in the following section, the same legalisation influence which encouraged desistance may still displace individuals into other illicit activities. Nonetheless, a competitive legal cannabis market demonstrates the potential to rationally incentivise desistance and discourage recidivism of local illicit cannabis suppliers. Legalisation-based desistance also shows promising benefits when compared with traditional supply-side enforcement strategies. However, this not to say law enforcement can ignore illicit cannabis sale amidst a competing legal market. Unlicensed sale is unlikely to go away when considering unlicensed alcohol and tobacco sale still exist despite most countries historically permitting both substances (Gallagher et al., 2019; Gilmore et al., 2014; Lachenmeier et al., 2011).

Figure 7 below depicts a hypothetical decision-making process of an illicit cannabis supplier choosing a desistance criminal involvement decision, derived from the examined data.
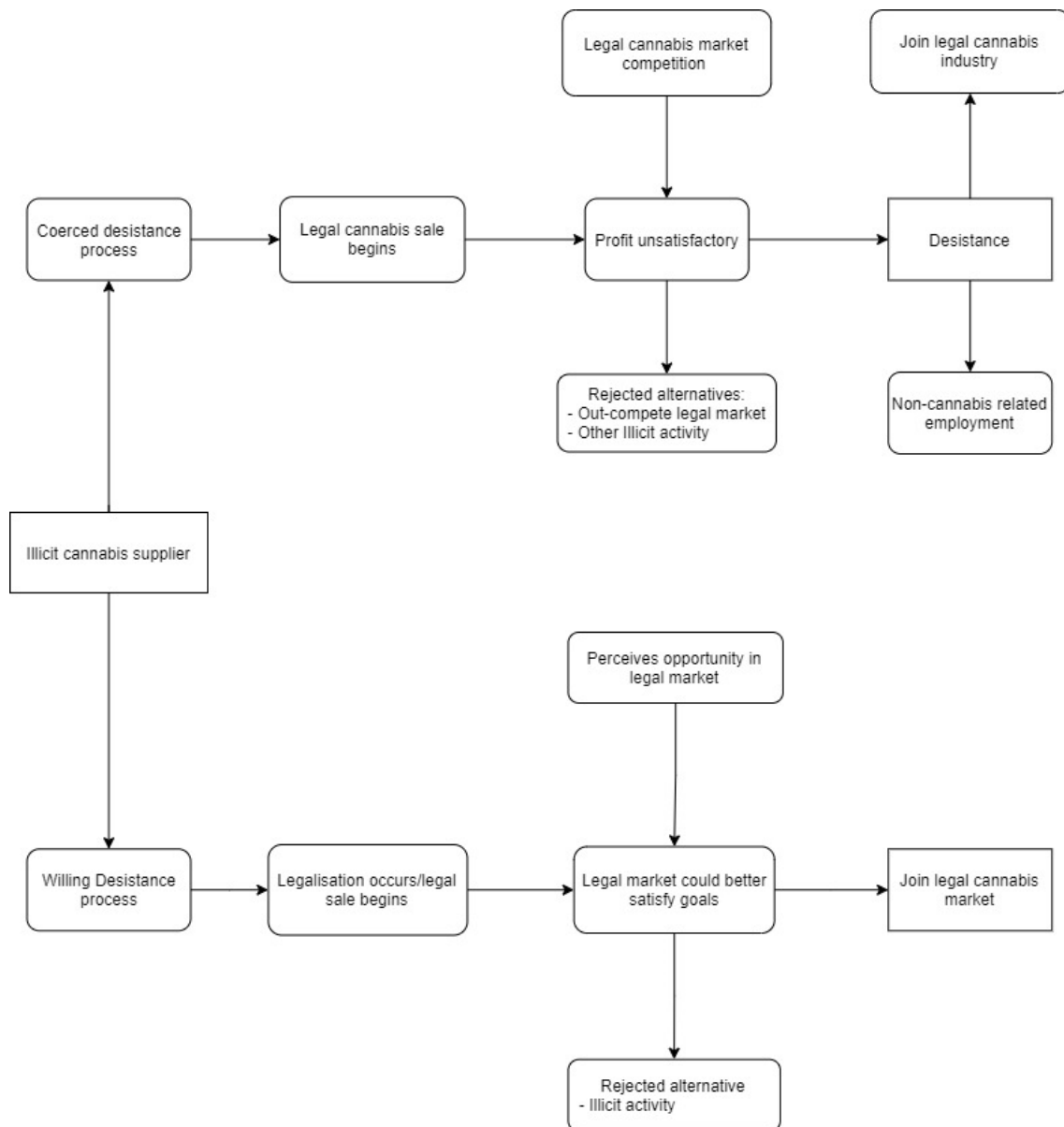
Figure 7. Hypothetical illicit cannabis supplier desistance process

Before moving on, it is worth discussing that not every examined illicit cannabis supplier entering the legal market ceased illicit cannabis sale activity. A few comments described individuals simultaneously working in both the legal and illicit markets. Examining these comments indicate this strategy offered these suppliers certain advantages. For example, consider this Reddit user comment discussing growers selling to both the legal and illicit market:

> Numerous growers exist that supply both the illicit market and legal dispensaries now that cannabis is legal.

A cannabis supplier selling to both the illicit and legal market avoids relying on either, thus potentially solving any consumer demand loss issues that operating only illicitly may risk. Furthermore, alongside demand security, using both markets may directly help the supplier better satisfy their profit aspiration level than solely working legally. The illicit proportion of sales is completely untaxed and thus the supplier may reap more profit overall compared to selling their entire stock legally, as this comment demonstrates:

> I am aware of people capitalising off both markets, they manage stores whilst also selling it illicitly in their personal time. They sell it illicitly relatively cheaper but as they do not report they end up earning more.

Furthermore, in certain supplier contexts, using the legal market selectively may lower law enforcement risk. For example, the below Reddit user described their illicit dealer buying cannabis in bulk from legal growers which allegedly posed less risk:

> My dealer buys cannabis in bulk from legal growers which appears more legitimate and because he knows how much legal cannabis costs, he simply prices his stuff below the shops.

<div align="center">Adaptation</div>

Lastly, this section explores the responses of suppliers who continued illicit activity but significantly changed their modus operandi. Like desisted suppliers, an operating legal market meant these suppliers could no longer satisfy their desired profit goal aspiration levels with their pre-legal sale modus operandi. Contrastingly however, they decided to adapt their methods. Interestingly, all the discussed adaptations avoided, or lessened, any direct competition with the legal market which importantly meant that these individuals could again satisfy their profit goal aspiration levels. The rest of the section explores the differing ways illicit suppliers adapted their strategies and why.

The under-age illicit cannabis market arose as one possible solution for suppliers struggling to compete with the legal cannabis market. Supplier comments described the under-age market as providing demand after losing adult customers to the legal market, as these two comments demonstrate:

> The over-21 market has died. The only business for a small dealer comes mostly from high school students.

> Out of my customers, the high school and college students continued but the majority of my customers over 21 stopped using me.

The under-age cannabis market constitutes a still wholly illicit market whose members can not legally buy cannabis. Naturally, targeting or prioritising the under-age market becomes a viable strategy for suppliers who desire to continue selling illicit cannabis locally, but can not commercially compete against the legal market. However, while targeting the under-age market may help secure consumer demand, this strategy may come at a cost. The under-age market may be less profitable than the adult market pre-legal sale:

> From my friend, those under the age limit (21) still desire cannabis, so the market is there but it is not as profitable or good.

The underage market being less profitable makes sense when considering under-age students likely have less disposable income than adults. Thus, an illicit supplier choosing this strategy may feasibly have to lower their profit goal aspiration level (compared to their pre-legal sale goal) to deem this strategy satisfiable.

However, interpretating the data indicates that the legal cannabis market may still indirectly reach and influence the under-age market through individuals diverting legally bought cannabis. Diverting legal cannabis to the under-age market represents a new opportunity and illicit cannabis modus operandi in the post-legal sale era. Those over the age limit can easily leverage their access to legal cannabis and profit off selling to under-age users, as these two comments demonstrate:

> My customers are mostly middle school students who still can not get it legally. I sell them what I buy legally.

> I buy legal cannabis and sell it to high school students at a higher price than what I spent getting it.

136

Thus, those using a purely illicit obtainment modus operandi (i.e., selling illicitly produced cannabis) may still indirectly compete with legal cannabis products from others who have diverted them into the under-age market.

Arguably, this diversion method has less requirements than obtaining purely illicitly produced cannabis. Before legalisation, certain situational and environmental factors may limit an individual obtaining illicit cannabis for sale (Cornish and Clarke, 2017, 2014; Selten, 2002). One would require an illicit market contact (gained through past experiences) or have the skills and means to cultivate it. However, assuming the legal market is physically accessible, one only needs to be at, or over, the respective age limit for purchasing legal cannabis to divert into the underage market.

However, the diverter must sell their legally bought cannabis at a higher price than they paid if desiring profit. Thus, a unique restriction for this diversion strategy involves whether legal market prices are low enough that diverting cannabis remains profitable whilst still out-competing illicitly produced cannabis. However, as previously discussed, and seen in consumer and supplier comments, legal prices lowering below illicit rates in legalised locales appears entirely possible (Caulkins, 2010; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019). Furthermore, supplier comments discussing using the diversion method implies profitability in their experiences.

Interestingly, supplier comments indicate that this diversion modus operandi can supplant a purely illicit cannabis sale modus operandi under the right situational circumstances. Specifically, where legal prices have lowered enough that diverted legal cannabis can out-compete illicitly sourced cannabis on price, and where suppliers are happy with lower profit margins (i.e., have a relatively low profit goal aspiration levels) exist:

> College students, who are more accepting of lower profits from selling legal weed to under-age students, have replaced the older dealers who would not accept such lower profits.

> Once legal prices lowered enough from a saturated market, people had two choices, they could spend $15 on a gram or just ask someone over the age limit to buy them for $10 per gram, obviously they would rather the latter.

Overall, the under-age market may offer refuge for illicit cannabis suppliers struggling to compete against the legal market. However, legalisation may still influence the under-age market, and those who supply it, through creating an opportunity for individuals to profit off diverting legal cannabis to under-age users.

A second alternative adaptation involved selling different illicit drugs. Importantly, operating in other illicit drug markets meant these suppliers avoided any competition with the legal cannabis market. Comments elaborating on their reasoning indicate that selling other illicit drugs offered better profit margins than illicit cannabis sale could after legal sale began. Thus, these ex-illicit cannabis suppliers refused to lower their profit aspiration levels to continue selling illicit cannabis, and in turn, searched for a suitable alternative that could satisfy their goals (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978), as these two comments demonstrate:

> Because the profit margins disappeared and going to a store was easy, I started selling other drugs instead of cannabis.

> I started selling heroin instead as it was a drug that could actually make me profit.

Comments indicate ex-illicit cannabis suppliers selling a range of different illicit drugs, including opiates, meth, heroin, cocaine, ecstasy, prescription pills, mushrooms and psychedelics. Some minor strategic differences emerged for ex-illicit cannabis suppliers transitioning into other illicit drug markets. Some described entering only one other illicit drug market, for example:

> I have to sell cocaine now.

While others described diversifying into two or more, for example:

> I sell oxycodone, meth and heroin after stopping selling cannabis.

However, being an illicit cannabis supplier does not necessarily mean having access to other illicit drugs. Conceivably, some situational and individual reasons may influence whether an illicit cannabis supplier could start selling other illicit drugs (Cornish and Clarke, 2017, 2014; Selten, 2002). Whether the supplier can access these

other illicit drugs may depend on their past experiences and/or their own personal skills. For example, accessing these other illicit drugs would require contacts to purchase from or skills and knowledge to produce it themselves. Therefore, while selling other drugs may be one possible solution to legal market competitive pressure, situational and individual differences may feasibly limit who can successfully adopt this modus operandi change.

Lastly, other comments discussed illicit suppliers moving from local sale to cross-jurisdictional trafficking. Cannabis users in non-legalised locales have no legitimate access to legal cannabis, hence, the supplier avoids any competition with the legal market. Again, the reasoning for this modus operandi change involved the supplier desiring to satisfy a certain profit aspiration level which local illicit sale no longer could, as these two comments demonstrate:

> Of the dealers I know, to make cannabis sale worth the time investment they have to smuggle it outside of the state to upsell it.

> While in state selling sees huge decreases post legalisation, the serious money now comes from transporting it out of the state.

However, trafficking cannabis out may require connections and contacts in other jurisdictions to locate buyers. Thus, whether the individual has such connections through past experiences may influence the feasibility of changing their modus operandi to cross-jurisdictional trafficking (Cornish and Clarke, 2017, 2014; Selten, 2002), as these two comments discuss:

> Illicit suppliers (growers and dealers) ship their stuff to connections in non-legal states where their product is worth more.

> If you are well connected, then you can make real money by shipping out of state where high quality ounces sell for 500 dollars or more.

Trafficking cannabis across jurisdictions may carry larger risk than selling locally in a legalised state. Once in a prohibited jurisdiction, any potential risk reduction arising from operating in a legalised locale (as discussed previously under the habituation

subtheme) would disappear. Furthermore, (assuming in the United States) the supplier risks facing federal punishment (Cambron et al., 2017; Caulkins et al., 2015; Hall et al., 2019; Pardo, 2014). However, trafficking cannabis between a legal and non-legal jurisdiction may satisfy a high enough profit aspiration level that justifies the risk, i.e., there is, as R&P theory discusses, appropriate risk compensation (Caulkins and Reuter, 2010; Reuter and Kleiman, 1986), as this comment described:

> This is nerve-racking and I do it rarely, but moving pounds and pounds of it a thousand miles away can pay off really well as people are willing to pay more. Basically, legalisation shifted the focus to interstate sales, but while it is more profitable, it is more risky.

Discussions of cross-jurisdictional cannabis trafficking methods include driving (as noted in the above excerpt) while others described illicit cannabis suppliers transporting cannabis through post, as these two comments demonstrate:

> Rather than selling locally in Oregon the man mails his cannabis to Florida instead.

> Trucks are driving hundreds of pounds of the stuff while many other people will post it especially if it's a few pounds.

Posting cannabis may restrict individual sales to a certain quantity limit (as described the above second comments), however, it may pose less risk than trafficking cannabis with driving, as the below excerpt discusses:

> Never lost one of my shipments to the police in the post but I have done to postal workers a few times. Driving would be far riskier.

Alongside pushing resident illicit cannabis suppliers into the inter-state trafficking, the legal cannabis market attracted suppliers from non-legal jurisdictions. Rather than sourcing cannabis locally, these suppliers travelled to and bought cannabis legitimately in a legalised jurisdiction to sell back home, as these two comments demonstrate:

> Where I live, those trafficking the stuff to here bought it legally from a nearby state.

> The process is to hit all the recreational shops and buy the daily limit in each then transport it back to the home state to sell.

These out of state buyers also offered local illicit cannabis suppliers in legalised jurisdictions access to other illicit cannabis markets without physically trafficking themselves, as these two comments demonstrate:

> I've observed dealers supporting their lives by doing large orders for out-of-staters, this keeps the black market flourishing.

> They sell to people coming from out of the state.

Illicit suppliers choosing to traffic cannabis from a non-local legalised jurisdiction over sourcing cannabis locally has interesting implications. This indicates that trafficking cannabis from a legalised state was more advantageous for the supplier in some way than locally sourcing cannabis. Furthermore, this trafficking strategy must be lucrative enough to justify the additional transportation costs alongside the increased risk of diverting the legal cannabis across borders. One possible explanation is it offers better profits than selling locally sourced illicit cannabis. Some discussion supported this cheaper price, which discussed Colorado having far lower prices than its non-legal counterparts, as these comments demonstrate:

> They go to Colorado to buy pounds of cannabis for between four and six dollars per gram and then sell it in my state for eight to twelve dollars per gram.

> Deals in Colorado attracted a surge of dealers travelling around half of the entire country to buy huge quantities of cannabis (between 20-75 pounds).

Furthermore, as examined previously (in both this chapter and the previous), consumer and supplier comments discussed cannabis prices (both illicit and legal) lowering after legalisation which offers support for this possibility.

Therefore, implementing legal sale constituted a situational change for these illicit suppliers which jeopardised the profitability of local illicit sale whilst also possibly

improving the reward for cross-jurisdictional trafficking (Cornish and Clarke, 2017; Selten, 2002). Regarding the latter, as legalisation policy is relegated to the specific jurisdiction which legalised, any price reduction consequences (barring the impacts from potential diversion) is restricted to said state. Thus, legal sale may theoretically create, or greaten the arbitrage between the legalised state and other nearby jurisdictions. This finding empirically reinforces predictive literature and hypothetical discussion that argue low legal cannabis prices risks diversion into the illicit markets of non-legal jurisdictions (Caulkins and Bond, 2012; Kleiman, 2017).

An alternative (or complementary) explanation worth considering, involves cannabis quality and how it may provide traffickers a competitive edge over illicit markets in other locales. As numerous Reddit user comments discussed, alongside other research, consumers may perceive legal quality as superior to illicit (Fataar et al., 2021). Equally, illicit cannabis quality may improve if local suppliers feel forced to improve to remain competitive (as discussed in section 5.2.1). Thus, theoretically, cannabis from a legalised state may similarly outcompete illicit cannabis quality in other non-legal jurisdictions and by extension, be more desirable for consumers in these other jurisdictions than local product. Therefore, a supplier trafficking out high quality cannabis from a legalised state may reasonably demand, and receive, higher prices as this comment described occurring from Colorado:

> In Colorado, the plant genetics and equipment available has meant the entire process is almost perfect which makes its quality unparalleled in the country. Pounds of Coloradoan or comparable quality cannabis which go for 1500-1800 can go for 3600 in a non-legalised state.

Considering these adaptational responses, a competitive legal cannabis market displaced these examined suppliers into different illicit activity and strategies which could continue satisfying their profit goal. Specifically, target displacement is seen for suppliers turning to the under-age market (i.e., the decision to sell to under-age rather than adult users), functional displacement for those choosing to sell non-cannabis drugs, and territorial displacement for local illicit suppliers turning to cross-jurisdictional trafficking (Reppetto, 1976; Windle and Farrell, 2012). Therefore, theoretically, the present analysis indicates criticisms of displacement may also apply to legalisation as it does for supply-

side drug law enforcement (Berlusconi et al., 2017; Giommoni et al., 2017; Mazerolle et al., 2007; Seccombe, 1995; Toth and Mitchell, 2018; Windle and Farrell, 2012).

Figure 8 below depicts a hypothetical decision-making process of an illicit cannabis supply adapting their modus operandi in response to the legal cannabis market, derived from the examined data:
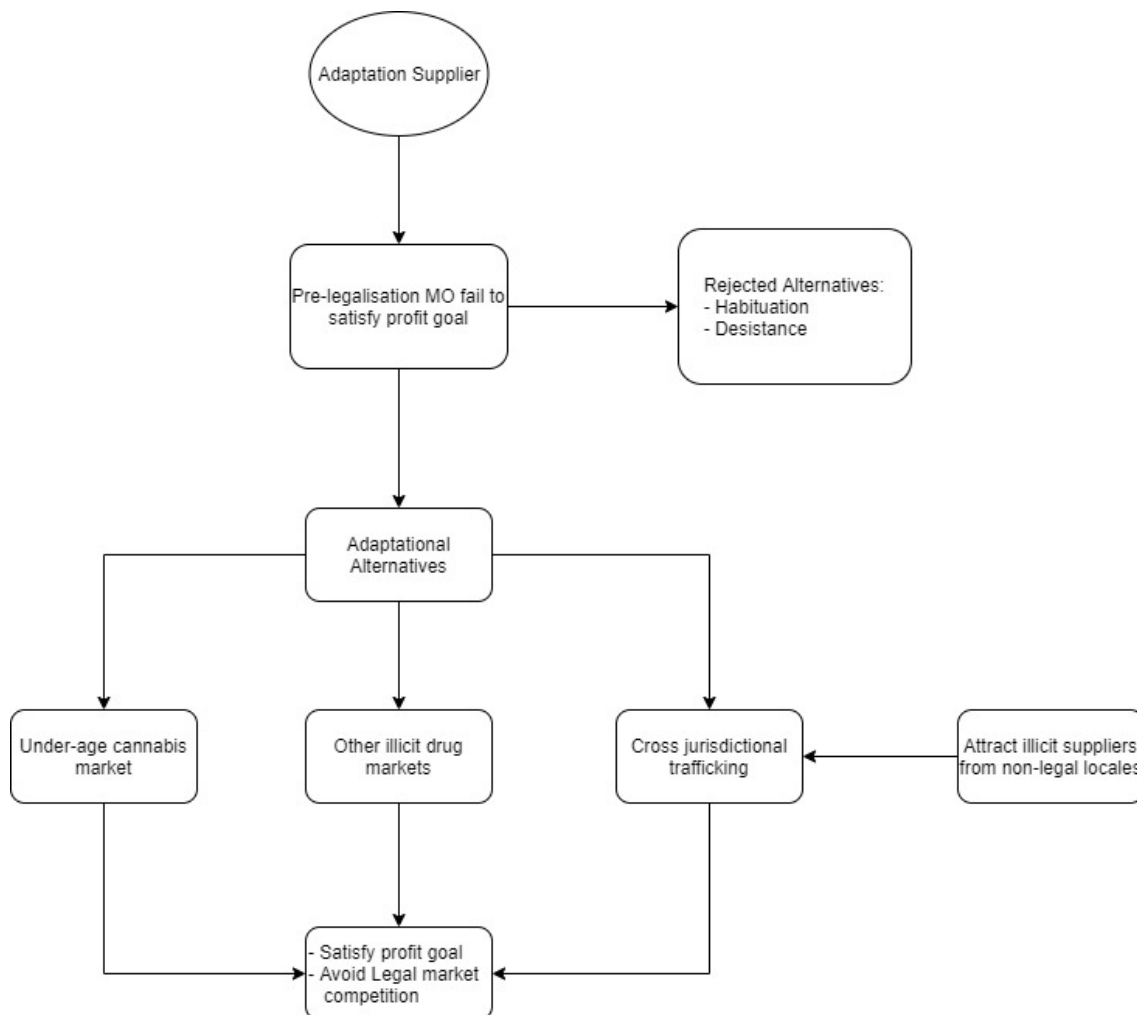
Figure 8. Hypothetical illicit cannabis supplier adaptation process

5.3   *Summary*

This chapter focused on the second research question of this thesis, which asked how illicit suppliers react to recreational cannabis legalisation. Analysing online Reddit forum conversations gave qualitative insights into how, and why, legalisation may influence the criminal involvement decisions of illicit suppliers (Cornish and Clarke, 2017, 2014; Wortley, 2014). Supplier decisions proved not senseless nor irrational, but rather

intelligible and understandable. The underlying reasoning for supplier choices stemmed from whether their modus operandi could, or fail to, satisfy their profit goal aspiration level whilst operating amidst, and competing against, the legal market (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978; Wortley, 2014). Failure, or refusal, to lower their profit goal aspiration level, led suppliers to desist or adapt their modus operandi, while continued satisficing of this goal led to habituation. Further, as the supplier motivation was profit, rather than an ideological or pathological motive, it supports the R&P view that profit primarily motivates illicit drug sellers (Caulkins and MacCoun, 2003; Reuter and Kleiman, 1986).

As people and their decisions constitute market change, the present analysis offers some insight into the wider potential consequences legalisation poses for the illicit market. The desistance and adaptation responses demonstrate the potential of a legal cannabis market to influence and disrupt the illicit market through affecting the incentives and disincentives of illicit cannabis sale for suppliers. Local illicit sale becoming less profitable led to some suppliers adapting their modus operandi to circumvent legal market competition by targeting the under-age market, other drug markets, or illicit cannabis markets in other jurisdictions to continue satisfying their profit goals. Alternatively, others ceased illicit activity entirely and possibly entered the legal cannabis industry itself. Further, analysis also indicates legalisation potentially benefitting illicit cannabis suppliers under certain contexts. Specifically, the lowering of law enforcement risk for local suppliers alongside making cross-border cannabis trafficking from the legalised state more profitable.

Importantly, the present analysis links the above influences with how commercially competitive the legal market is, and specifically whether it outcompetes the illicit market. [26] Consequently, this raises the methodological point that researchers should consider the illicit-legal market competitive context when assessing the consequences legalisation poses to illicit markets. Differing supplier responses may partly arise from residing in locations, and times, where the illicit-legal market competition differs in nature (i.e., where one is superior, worse, or comparable to the other in attracting consumer demand). Ignoring this nuance during research may risk inaccurate

---

[26] The exception being the risk reduction, as this related solely to policy permitting possession and a lessening of law enforcement focus.

interpretations of the potential consequences legalisation poses for illicit markets in specific locales.

Equally important are individual differences in influencing decision-making processes (Cornish and Clarke, 2017, 2014; Selten, 2002, 1998; Simon, 1978, 1955; Wortley, 2014). While the analysed data was limited in exploring individual differences thoroughly, its potential influence on supplier criminal involvement decisions is theoretically acknowledged. Personal desires, experiences and skills would influence the viability of different choices alongside the interpretation of relevant information for illicit cannabis suppliers.

The present analysis has several limitations to keep in mind. The findings coming from qualitative inquiry means they are not generalisable. Secondly, the content of the comments indicates the present analysis focused on the activity of retail illicit cannabis suppliers, i.e., those selling directly to or operating closely with the end consumer. The actions of illicit suppliers at higher market levels are unexplored. Logically however, if those selling directly to the retail market suffer difficulty, then those who supplied them may also experience issues by proxy (as they themselves may lose a customer). Lastly, there are several weaknesses and strengths of analysing Reddit user comments which section 3.2.3 of the methodology chapter detailed.

Chapter 6: Descriptive Statistics

Price data can help identify and understand the possible impacts of cannabis legalisation for illicit cannabis markets. As discussed in section 3.3 of the Methodology chapter, an illicit cannabis price drop in non-legal jurisdictions, coinciding with their neighbour implementing legal sale, may indicate it impacting their illicit markets. Therefore, this chapter descriptively explores a source of cannabis price data (High Times) for the United States to examine whether any clear price drops occurred, and coincided, with jurisdictions implementing legal sale. This chapter splits into three main sections. The first section overviews the entire dataset and considers whether prices differed by time, regulation context and in distance from states with legal sale. Following this, analysis focuses on smaller subregional groups, which each include a legalised state alongside its neighbours. This subregional analysis compares prices before and after legal sale implementation to identify whether price fluctuations coincided with legal sale. Lastly, the third section discusses the subregional analysis findings.

6.1   High Times Analysis Overview

In total 7,780 price submissions from 1,624 cities (with each providing at least one price submission) were analysed. The mean and median gram price paid is $12.49 and $12.50 respectively, while the range is $39.29 (the minimum value being $0.71 and maximum value being $40.00). [27] The inter-quartile range (3.93) indicates most price submissions lay around the average gram price, being between $10.36 and $14.29. Figure 9 shows the High Times cannabis price submissions are normally distributed (Witte and Witte, 2016). The most common cannabis PPG dollar range ($14.00 – $14.99) accounted for roughly 14% of total price submissions. Most price submissions lay between $7.00 – $17.00 (85% of dataset). Price submissions higher than $20 accounted for only 2% of the dataset.

---

[27] As mentioned in the Methodology chapter, ounce prices were calculated into gram prices, hence, the low min value of $0.71.
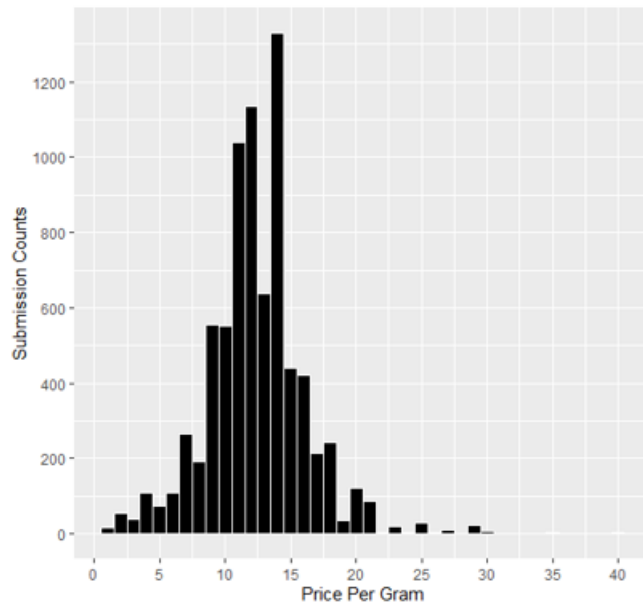
Figure 9. Distribution of High Times price data

6.1.1 Time and Price

Figure 10 plots all price submissions examined from High Times between January 2005 to April 2020. Each point is partially transparent to avoid overplotting and to make higher concentrations of price submissions visible. A small proportion of High Times magazine issues lacked price data for their month (6 months out of a total 184, or roughly 3%). Data was missing for November 2009, April 2012, September 2018, November 2019, December 2019 and March 2020.

Between 2005 to 2011, cannabis price submissions have a wider range where extremely low-price submissions ($0.70 to $3.00) and higher price submissions (above $20.00) occur. After 2011, prices constrict and primarily stay between $4.00 to $18.00 until late 2013. During late 2013, a notable dip in illicit cannabis prices occurs from $18,00 to $15.00. After late 2013, price submissions higher than $18.00 become rarer (n = 9) than before. A small price increase does begin from late 2017 to the end of the dataset where price submissions above $15.00 become more common, but not as numerous as pre-2013. Furthermore, 2018 onwards sees a larger concentration of price submissions between $7.00 and $13.00 (indicated by the darker shading). Overall, Figure 10 indicates a distinctive lowering of cannabis submission prices to High Times from 2013. While this scatterplot includes non-legal states, the dip in cannabis prices from 2013 coincides with

147

the start of cannabis legalisation in Colorado and Washington (Hall et al., 2019; NCSL, 2019b).
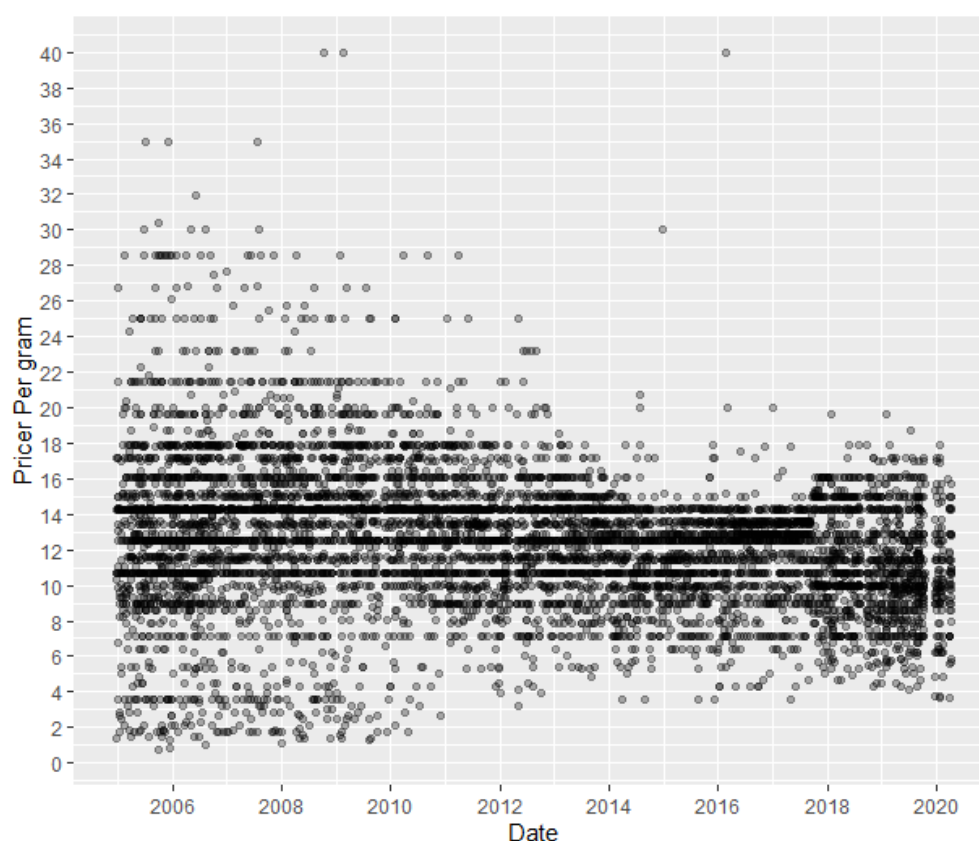
Figure 10. Average PPG January 2005 to Match 2020

6.1.2 *Regulation and Price*

Alongside High Times price submissions development over time, the regulation context under which the price submission occurred is equally important. Different regulation regimes constitute differing situational and environment differences which may affect price (Cornish and Clarke, 2017; Selten, 2002). While this analysis focuses on the possible interaction between recreational cannabis legalisation and illicit market prices, previous research found that states in America with medical cannabis laws had lower prices than others (Zook et al., 2012). Therefore, analysis includes medical cannabis law categories to consider and account for their potential association with price.

Medical cannabis laws vary across the United States. The United States National Conference of State Legislature divide medical cannabis laws into two main categories

(NCSL, 2019a). A comprehensive medical cannabis program (CMCP) provides access to cannabis which can contain enough THC content to cause psychoactive effects. Contrastingly, a limited medical cannabis program (LMCP) only provides access to low THC or CBD cannabis (NCSL, 2019a). Lastly, a few states have not passed any medical cannabis laws, for reference this is referred to as the 'Neither' category.

Table 4 shows summary statistics of High Times price submissions by regulation context. [28] Both medical programs showed cheaper prices after implementation, while the implemented LMCP category was roughly $0.35 more expensive than the CMCP (by approximately 3%). Though the mean difference between the two implemented medical cannabis programs is relatively small, consider the average price for the unimplemented CMCP category was $0.62 more expensive (roughly 5% higher) than the unimplemented LMCP category. The implemented CMCP category was roughly 14% cheaper (a $1.94 difference) than its unimplemented counterpart, while the implemented LMCP category showed a smaller, roughly, 7% decrease (a $0.98 difference).

The larger decrease in, and lowering of, cannabis price in the CMCP category (than LMCP) may possibly stem from it offering cannabis with enough THC to cause psychoactive effects. For cannabis users desiring psychoactive effects, low THC or CBD cannabis is undesirable as such effects are weak or absent (Burstein, 2015). Thus, cannabis consumers wanting to use cannabis with psychoactive effects can not get it through the medical cannabis system (legitimately or illicitly through diversion) if residing in an LMCP state. Hence, a CMCP, which offers cannabis that can cause psychoactive effects may lower illicit cannabis demand more, and thus lead to lowered illicit prices than an LMCP (Gale, 1955; Mankiw, 2011).

Importantly, price submissions under a recreational legal sale context showed the lowest mean prices. Compared to the CMCP (the nearest cheapest value), the implemented legal sale category mean was roughly 21% cheaper ($2.49 less). As no jurisdiction in the United States implemented recreational legal cannabis sale without previously implementing a CMCP (in the examined timeline of this analysis), no specific pre-legal sale category is applicable (NCSL, 2019a).

---

[28] Twenty price submissions are excluded from the data in Table 4, as High Times provided prices monthly and the implementation of cannabis regulation changes for certain jurisdictions occurred mid-month.

Table 4. Gram price by regulatory context

Regulation Context	Count	Mean	Std
Unimplemented CMCP	1995	$13.76	4.02
Implemented CMCP	2901	$11.82	3.18
Unimplemented LMCP	1580	$13.14	4.49
Implemented LMCP	698	$12.16	2.41
Implemented Legal Sale	413	$9.33	2.83
Neither	173	$12.21	4.53

CMCP = comprehensive medical cannabis program

LMCP = limited medical cannabis program

Figure 11 presents boxplots of the same data showing the overall distribution of each category. Most of the boxplot IQRs (inter quartile range) in Figure 11 overlap, the exception being the implemented legal sale price and unimplemented CMCP.

The differences between the medical regulation category price submissions are less clear. The IQR for all medical categories overlap. IQR for both implemented medical cannabis categories become visually narrower and lower than their unimplemented categories. Likewise, the median line for both implemented medical cannabis categories become lower than their unimplemented counterparts. The median price for the implemented CMCP is lower than the implemented LMCP (by roughly 7%). The implemented CMCP shows far more outliers than the implemented LMCP, which may explain the far closer mean prices seen in Table 4.

The Neither category requires discussion for both Table 4 and Figure 11. Interestingly, the implemented CMCP category has a tied median price ($11.67) with the Neither category. A possible explanation for this is that the Neither category submission stretched across the entire timeline of the dataset. Recall, Figure 10 showed a general decrease in illicit cannabis prices over time in the High Times dataset. Hence, the Neither category may reflect that overall, illicit cannabis prices in the High Times dataset decreased. Nonetheless, both the IQRs for implemented medical cannabis programs are narrower than the IQR for the Neither category, indicating both having proportionately more lower price submissions. Furthermore, the mean values for implemented medical cannabis programs were both lower than the Neither category, as seen in Table 4.

The implemented legal sale price boxplot visually stands out from all the others, as its median point ($9.29) is the lowest by far, laying outside the IQR of all the other categories. Its IQR is also the lowest priced ($7.14 to $10.86). Furthermore, the legal sale

category boxplot distribution is further left and narrower than the Neither category. Importantly, analysis of Table 4 and Figure 11 shows that price submissions occurring under legal cannabis sale were cheaper than any other regulatory contexts. The former is in keeping with the possibility of legal sale affecting the local illicit market prices in some way.
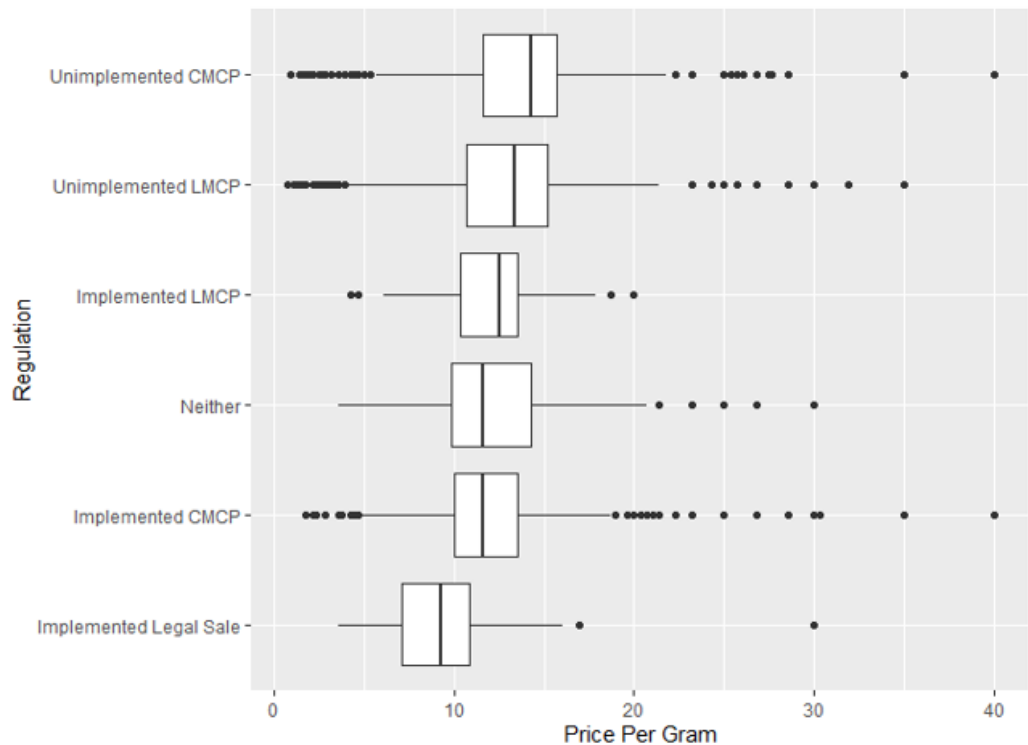
Figure 11. Boxplots of price submissions by regulation

6.1.3 Price and Proximity to Legal Sale

Of key interest is whether illicit cannabis prices differed depending on proximity to a legalised locale, and to explore this three geographical categories are created. Price submissions were split by whether they occurred within a state with legal sale (category A), in a non-legal state that bordered a jurisdiction with legal sale (category B), or in a state that only bordered other non-legal jurisdictions (category C). Table 5 depicts summary statistics of these categories, showing prices in category B being cheaper, on average, than those in category A. The former mean price was $2.15 cheaper (a roughly 17% difference) than the latter.

Table 5. Proximity to legal sale and average cannabis prices

Proximity to rec legalisation	Count	Mean	Std
A) No border with legal sale state	6933	12.80	3.81
B) Borders state with legal sale	427	10.59	2.82
C) State with legal sale	413	9.33	2.83

Figure 12 depicts the same data used in Table 5, showing clear differences in the distribution of the price submissions for each category. While all three IQRs for the categories overlap, the median lines show clear differences between the price submissions in each category. With the median price being $9.29 for price submissions in a recreationally legalised state, $10.70 for prices submissions in state bordering a legal state, and lastly $12.90 for price submissions in states without legal sale or bordering one. Furthermore, the IQR distribution becomes increasingly lower priced as one moves closer to the legal sale source. The IQR for states with legal sale category are $7.14 to $10.86, for the bordering legal state category $8.93 to $12.50 and lastly for those not bordering a legal jurisdiction, $10.70 to $14.30. While the third category shows far more outliers, this is due to it having far more submissions.

Figure 12. Boxplots of proximity and average cannabis prices

As the key discrepancy between category A and B is the latter sharing borders with a legalised state, this offers tentative preliminary support for something related to legal sale as potentially influencing these differences in average price.

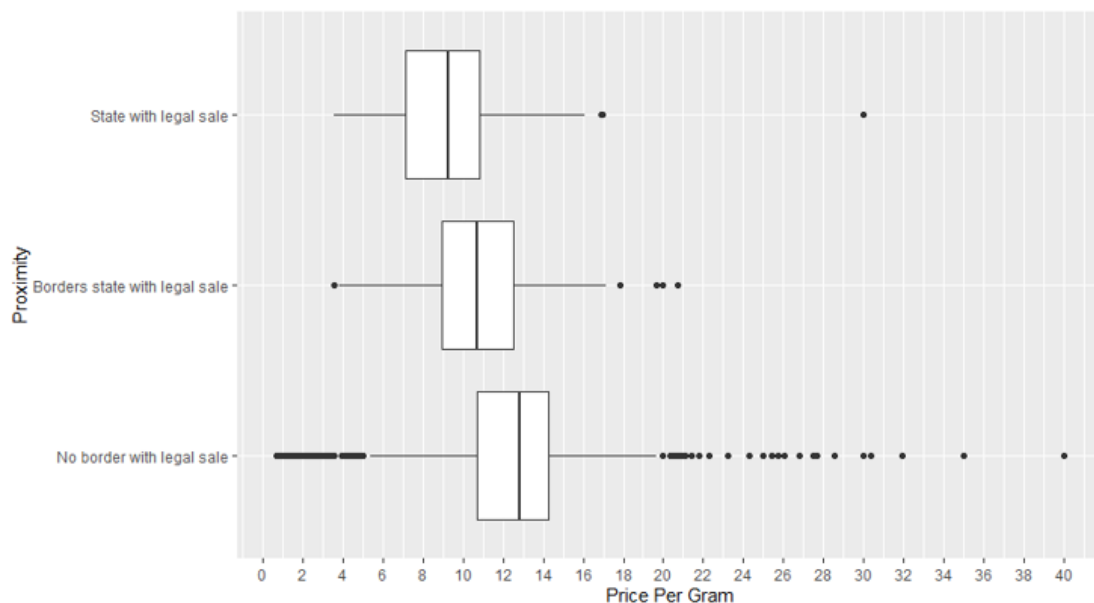Lastly, further categories are added to account for medical cannabis laws i.e., the CMCP (comprehensive medical cannabis program) and LMCP (limited medical cannabis program) in Table 6. Importantly, Table 6 shows mean and median price submissions were always lower if bordering a state that sold cannabis legally, regardless of the medical regulation context. Table 6 has issues with low counts for certain categories which was unavoidable, as far less jurisdictions have implemented recreational cannabis sale or borders one, than the other possible categories within the time period examined.

Table 6. Regulation and Proximity

Regulation and relative location to legal state	Count	Mean	Median	Std
No medical, nor borders legal sale state	132	$12.53	$12.50	$4.69
No medical, borders legal sale state	41	$11.15	$10.00	$3.84
CMCP Unimplemented, bordering legal sale state	1963	$13.80	$14.29	$4.03
CMCP Unimplemented, borders legal sale	32	$11.63	$12.50	$2.25
CMCP Implemented, not bordering legal sale state	2608	$12.00	$11.79	$3.18
CMCP Implemented, borders legal sale	293	$10.20	$10.00	$2.70
LMCP Unimplemented, not bordering legal sale state	1569	$13.16	$13.39	$4.50
LMCP Unimplemented, bordering legal sale state	11	$10.78	$10.71	$1.91
LMCP Implemented, not bordering legal sale state	648	$12.20	$12.50	$2.39
LMCP Implemented bordering legal sale state	50	$11.67	$10.98	$2.53
Legal sale state	413	$9.33	$9.29	$2.83

Of an interesting note, the three states constituting the Neither category seen in Table 4, all bordered legal states. Idaho borders Oregon, Washington and Nevada, while Nebraska and Kansas border Colorado. This opens the possibility of the Neither category having relatively low prices (compared to the CMCP and LMCP categories), as seen in Table 4 and Figure 11, despite no medicalisation. Hence, this may partially stem from these states all bordering a jurisdiction that implemented legal sale.

6.1.4   Overview Summary

High Times price submissions showed distinct differences by relevant categories. States with legal sale themselves showed the cheapest prices. Other research examining illicit cannabis prices in the United States similarly found legalised jurisdictions had lower prices (Meinhofer and Rubli, 2021). Importantly, the present analysis showed jurisdictions bordering states with legal sale had, on average, lower prices than others (barring the legalised states themselves). Consequently, a potential explanation for this is

some characteristic related to legal sale influencing the prices in non-legal bordering states. The following section explores this possibility more precisely.

Before moving on, the overview analysis for price, regulation and proximity were all repeated with only price submissions after 2014 (the first instance of legal sale implementation in the United States), to ensure findings seen were not unduly influenced by price trends that existed between 2005-2014. This repeat of analysis showed comparable results between price, proximity and regulation, with categories holding similar rankings (i.e., prices were cheapest in legal states followed by their neighbouring jurisdictions, regardless of medical cannabis regulation). Similarly, the overview analysis was repeated with outliers removed, using the inter-quartile range method, to see if results drastically changed (Coleman, 2018). Again, the relative rankings of the categories remained comparable.

6.2   Subregional Analysis

As discussed in section 3.3 of the Methodology chapter, the cheaper prices seen for jurisdictions bordering legalised locales may reflect legal sale influencing the illicit markets of the former. For instance, through legal cannabis diversion (by consumers or suppliers) or an influx of cheaper trafficked illicit cannabis (as seen in the overview analysis, legal states themselves had the lowest average prices). In both cases, legal sale may have inadvertently created opportunity for suppliers to capitalise on, and/or incentivise consumers with cheaper prices (Cornish and Clarke, 2017, 2014; Wortley, 2014). Thus, illicit prices may conceivably have lowered in states bordering legalised jurisdictions as trafficked cannabis, and/or lack of consumer interest, forces illicit cannabis suppliers to lower their own rates to maintain demand.

However, entirely possible are other reasons or factors unrelated to legalisation contributing to bordering jurisdictions having lower prices. For example, suppliers may have obtained cheaper illicit cannabis from an unknown source. Moreover, the United States jurisdictions are varied and diverse, and it would be an assumption to think legal sale impacted illicit prices identically when considering the potential influence of wider contextual factors unique to each state. Therefore, it becomes vitally important to explore the price data more precisely to determine whether the data strongly indicates a potential association between legal sale and illicit cannabis price decreases. To achieve the above,

this section changes the unit of analysis from the entire United States to sub-jurisdictional groupings consisting of states which have implemented legal sale and their bordering neighbours. Importantly, analysis focuses on linking price decreases temporally to specific instances of legal sale implementation.

Table 7 below shows key dates for cannabis legal sale implementation in jurisdictions used for these subregional analyses. Not every legal state is depicted in the table below, as their cannabis sale occurred too late, or after, the High Times dataset period used to establish post-legal sale trends.

Table 7. Recreational cannabis legal sale implementation dates

Jurisdiction	Legal Sales
Colorado	01/01/2014
Washington	08/07/2014
Oregon	01/10/2015
Nevada	01/07/2017
California	01/01/2018

As stated in the Methodology chapter, certain rules applied to this subregional analysis (specifically section 3.3.4 details these rules and justifications with examples). Firstly, analysis only included sub-state locations that contained at least one price submission before and after the relevant legal sale start date. Secondly, if a subregional group contained bordering jurisdictions which later legalised themselves, analysis only used the pre-legal prices for these bordering jurisdictions. Lastly, where one state bordered two legalised states, it was placed in the subregional group of the state which implemented legal sale first.

While inquiry focuses upon prices in neighbouring jurisdictions, legalised states are also considered. If any price decrease in a bordering jurisdiction reflects price changes in their legalised neighbour, this would support the possibility of a shared underlying influence. Moreover, if these price changes coincide with legal sale implementation, it indicates this shared possible influence being, or associated with, legalisation.

Table 8 below shows summary statistics of High Times price submissions for Colorado, before and after legal sale started in January 2014. Both the mean and median show that average price submissions after legal sale are lower. There is a difference between mean gram price of $3.07 (a roughly 26% decrease), and a median difference of $2.68 (a roughly 23% decrease). The standard deviation values indicate the distribution

155

of data is slightly more variable in the pre-legal sale period. The range of prices is also smaller after legal sale ($16.78 in the first period compared to $13.4).

Table 8. Colorado price submissions before and after Colorado legal sale

Colorado	Count	Mean	Median	Std	Min	Max
Pre legal sale	144	$11.69	$11.61	$2.17	$1.79	$18.57
Post legal sale	108	$8.61	$8.93	$2.32	$3.57	$16.07

Figure 13 plots the High Times price submissions from Table 8 across time. Figure 13 indicates a price decrease coinciding with Coloradoan legal sale. The trend line for the pre-legal sale period indicates cannabis prices gradually decreasing between 2005 to 2014 (by roughly $2.00 over nine years). The post-legal sale period trend line shows cannabis price immediately dropping from roughly $11.00 to $10.00. Furthermore, the post-legal sale trend gradient decrease becomes steeper, lowering roughly $3.00 over a shorter period of six years (between 2014 to early 2020). Lastly, only after legal sale did price submissions below $8.00 become commonplace (barring two price submissions between 2006-2008) while prices above $12.00 became far rarer.
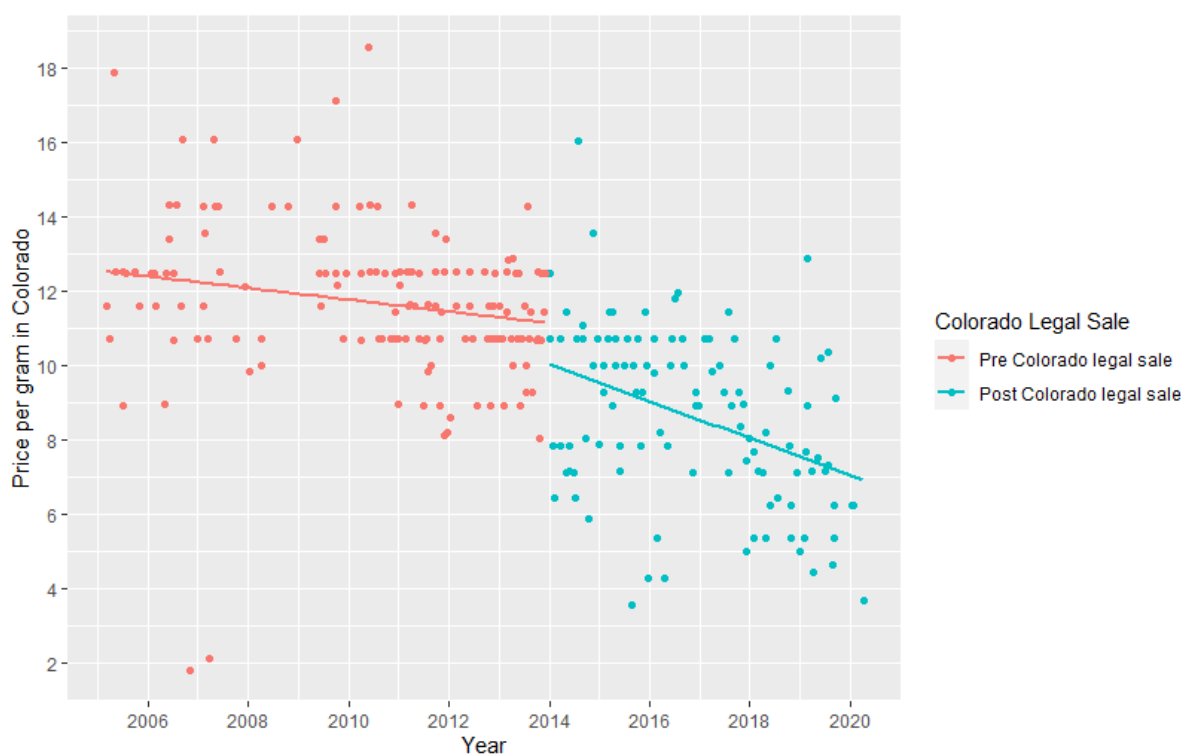

Figure 13. Colorado High Times prices before and after Colorado legal sale

Colorado borders seven states, Wyoming, Nebraska, Kansas, New Mexico, Utah, Oklahoma and Arizona. Table 9 below shows summary statistics of High Times price submissions for these states, before and after legal sale started. Both the mean and median show average prices being lower after Colorado implemented legal sale. There is a mean difference of $2.08 (a roughly 16% decrease) and a median difference of $1.79 (a roughly 14% decrease). The average price decreases in the bordering states are smaller than those seen in Colorado itself, a 16% mean decrease compared to 26%, and a 14% median decrease compared to 23%. The average price (both median and mean) are higher for bordering jurisdictions in both the pre- and post-legal sale periods. The range of prices is also smaller after legal sale for these bordering jurisdictions ($25.54 pre-legal sale compared to $15.85 post-legal sale).

Table 9. Bordering Colorado Jurisdiction price submissions before and after Colorado legal sale

Bordering CO	Count	Mean	Median	Std	Min	Max
Pre legal sale	315	$12.84	$12.50	$4.10	$1.25	$26.79
Post legal sale	211	$10.76	$10.71	$2.60	$4.46	$19.64

Figure 14 below plots the cannabis price submission data for states bordering Colorado. Figure 14 shows a similar pattern to Colorado, with price decreases coinciding with it implementing legal sale. However, the pre-legal sale trend line differs from its Coloradoan counterpart, as it indicates cannabis price was gradually increasing before legal sale occurred. Once legal sale began, a roughly $1.00 price drop (comparable to that seen in the Coloradoan prices) occurs and the trend line for this period begins decreasing. Compared to the pre-legal sale period, price submissions above $15.00 became rarer and prices below $7.00 occur for the first time since early 2010, in late 2017.

There is a notable increase in prices from 2014-2016 to 2016-2018, though price submissions then generally show further decreases from 2018 onwards. Furthermore, 2014-2018 sees only one price submission above $15.00 in early 2014. Past 2018, eight price submissions over $15.00 occurred, however at the same time this same period also saw far more price submissions occurring below $9.00 than previously.
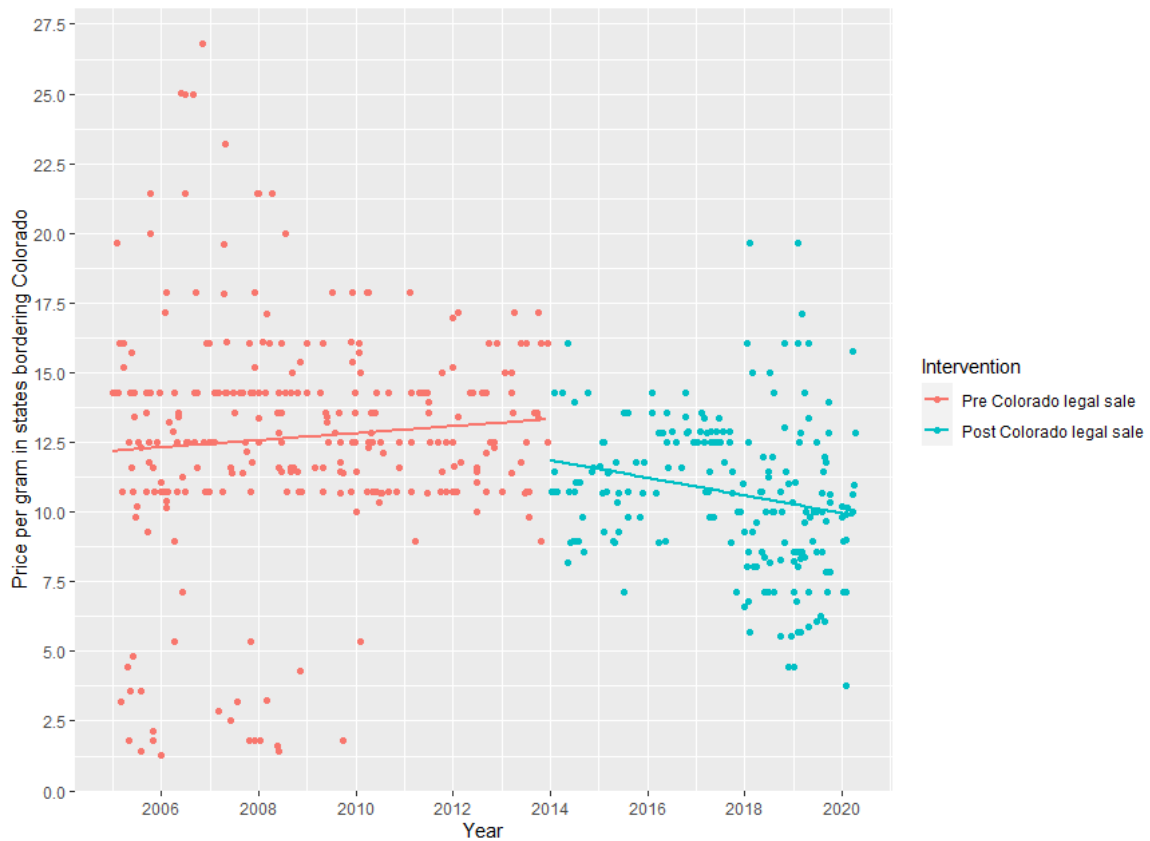
Figure 14. High Times prices for Colorado bordering jurisdictions before and after Colorado legal sale

Importantly, both Figure 13 and Figure 14 showing similar patterns in the post legal sale period indicate a shared underlying influence. Further, the price decreases coinciding neatly with Coloradoan legal sale starting, supports the possibility of the two being associated.

Table 10 below shows all the jurisdictions bordering Colorado had lower average price submissions in the post legal sale period. However, some states showed larger changes than others. Arizona showed a $2.89 mean decrease, roughly 22% less. Nebraska showed a $2.17 mean decrease, roughly 18% less. New Mexico showed a $2.35 mean decrease, roughly 18% less. Kansas showed a $2.65 mean decrease, roughly 20% less. Oklahoma showed a $0.49 mean decrease, roughly 4% less. Only Salt Lake City in Utah have submissions before and after Colorado legal sale, with the location showing a $0.31 decrease in price, a roughly 3% decrease. Lastly, the few submissions for Wyoming showed a $2.39 decrease, roughly a 14% decrease.

Table 10. High Times prices in bordering Colorado jurisdictions before and after Colorado legal sale

State	Legal sale	Count	Mean	Std
Arizona	Pre	111	$13.06	$3.36
	Post	83	$10.17	$2.40
Kansas	Pre	34	$13.45	$4.44
	Post	15	$10.80	$2.07
Nebraska	Pre	53	$13.00	$4.40
	Post	19	$10.70	$3.66
New Mexico	Pre	38	$12.99	$4.55
	Post	24	$10.72	$1.68
Oklahoma	Pre	44	$12.41	$5.30
	Post	31	$11.92	$2.38
Utah	Pre	32	$11.18	$2.09
	Post	36	$10.87	$2.86
Wyoming	Pre	3	$16.67	$7.44
	Post	3	$14.28	$3.09

The price decreases seen in the Coloradoan subregional group may reflect individuals capitalising off opportunity that Coloradoan legal sale inadvertently created (Cornish and Clarke, 2017). For instance, Coloradoan legal cannabis prices may have lowered enough (thanks to efficient legal production) that suppliers could profit off of diverting it into neighbouring jurisdictions (Caulkins, 2010; Caulkins and Bond, 2012; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019). [29] Hence, price decreases in bordering jurisdictions may stem from illicit suppliers lowering their own prices to compete with diverted product.

Likewise, Coloradoan illicit price decreases may conceivably have stemmed from local illicit suppliers lowering their own prices to compete with the legal market over consumer demand (Gale, 1955; Mankiw, 2011). [30] Consequently, this potentially links Coloradoan legal sale with widening the arbitrage opportunity for those willing to traffic Coloradoan illicit cannabis into neighbouring states. The average Coloradoan price was, pre-legal sale, lower than the prices in jurisdictions neighbouring it , thus indicating the possibility of cannabis movement outwards of Colorado being profitable, and occurring before legal sale (Caulkins and Bond, 2012; Chandra et al., 2014; Giommoni and Gundur, 2018). However, the difference in mean price between Colorado and its neighbours was far larger in the post-legal sale period (roughly doubling from $0.99 to $2.08), indicating a trafficking modus operandi may theoretically offer greater reward after legal sale began

---

[29] Further, in a later section, a source of Coloradoan legal prices is examined which show prices did decrease over the timeline examined in this analysis.

[30] A scenario qualitatively and empirically explored in the Reddit analyse chapters.

(Cornish and Clarke, 2017; Wortley, 2014). Thus, the price decreases for Coloradoan neighbours may reflect an influx of this cheaper illicit cannabis.

Equally, a possibility is that residents of jurisdictions bordering Colorado are increasingly using the Coloradoan legal market as opposed to their local illicit suppliers. Consequently, illicit price reductions in bordering jurisdictions may reflect illicit suppliers lowering their own prices to help maintain demand and keep local cannabis users from using the Coloradoan legal market (Gale, 1955; Mankiw, 2011). Research has indicated residents of non-legal states travelling to their legalised neighbour to purchase legal cannabis in the United States (Hansen et al., 2020).

Washington, Oregon, Nevada, California and Massachusetts all underwent an identical descriptive analysis procedure as the Coloradoan subregional group. However, as these analyses were repetitive and their implications for this thesis can be described concisely, key results are summarised in the following paragraphs and in Table 11 below. However, the full analysis of these subregional groups, with all figures and tables, is in Appendix A.

As Table 11 shows, all locales had lower mean prices after legal sale implementation (though to varying degrees). However, visual inspection of scatterplots for each subgroup showed more nuanced stories. Importantly, no subregional group showed as distinct signs of price changes coinciding with legal sale as Colorado or its neighbouring states did. Key observations from the scatterplots for each state are as follows:

- Figure 19 shows Washington experiencing a price drop coinciding with it implementing legal sale. However, prices then gradually trended upwards for the rest of the dataset.
- Figure 21 showed Oregon prices appeared to lower at the start of 2015 (while legal sale started nine months later in October). Prices then remained low until increasing suddenly in late 2017, which then resembled pre-legal sale patterns.
- Figure 23 showed Nevada experienced no immediate price drop while prices began decreasing more sharply after legal sale compared to the pre-legal sale trend. However, Nevada is missing data extensively between 2013 to mid-2016, a key period for establishing its pre-legal sale trend over a longer time period.

160

- Figure 24 shows Californian price decreases appeared, in keeping with a previous long-term trend of a gradual lowering in prices.

Regarding jurisdictions bordering the above states, Figure 20 shows post-legal sale data for states bordering Washington was too poor (no usable price submissions existed between 2015 to 2018) to support, or disprove, whether legal sale influenced illicit prices. Figure 22 showed neighbouring California and Nevada displayed no signs of price changes coinciding with Oregonian legal sale. It is worth noting the rules set out in section 3.3.4 of the Methodology chapter limited the usable data for these analyses. No bordering jurisdictions to California and Nevada were eligible as all their neighbours either legalised themselves, or already bordered another legalised state, by the time they implemented legal sale. Likewise, the large gap in data for states bordering Washington is partly due to Oregon implementing legal sale themselves not longer after Washington alongside neighbouring Idaho being poorly represented in the data. Lastly, some data is excluded from the bordering Oregon analysis as both California and Nevada implemented legal sale themselves.

Table 11. Non-Coloradoan mean price comparisons

Locale	Pre-sale	Post-sale	Difference
Washington	$10.56	$8.57	$1.99
Bordering WA	$9.47	$9.27	$0.20
Oregon	$9.20	$7.46	$1.74
Bordering OR	$12.23	$10.34	$1.89
California	$11.74	$9.65	$2.09
Nevada	$13.30	$10.80	$2.50

*California and Nevada had no eligible bordering states, as their neighbours had either legalised themselves before or already bordered a legalised state before they themselves legalised.

Clearly, analysing the non-Coloradoan subregional groups contradicts previously made predictions and interpretations on how illicit prices may react to legal cannabis sale. Prices did not always distinctly drop when legal sale began nor did a gradual decrease always occur (indeed, in certain cases the trend began increasing). Nonetheless, the Coloradoan subregional group showed clear and distinctive signs of price changes coinciding with its legal sale. The following section focuses upon exploring wider contextual factors for the examined states to understand and possibly explain these conflicting results.

6.3   Discussion

Out of the five sub-regional groups analysed, only the Coloradoan group demonstrated clear support for legal sale influencing illicit prices. Price submissions in Colorado showed a clear drop and its post-legal sale trend line decreased more steeply in Figure 13. Importantly, jurisdictions bordering Colorado also showed an immediate drop in cannabis price coinciding with Coloradoan legal sale alongside their post-legal sale price trend line decreasing (in contrast to an increase in the pre-legal sale period) in Figure 14. The other examined legal states and their neighbouring jurisdictions did not show such distinctive price changes coinciding with, and continuing, after legal sale implementation.

The above raises the question of why the High Times price data for the Coloradoan subregional group differed to the others. One possibility is the Coloradoan price data coincidentally aligning with the state implementing legal sale, however, such a view may be over-simplistic. Methodological issues, differing legalisation policy choice, and wider contextual factors regarding the examined states may offer plausible explanations for why the other sub-regional groups showed different patterns, which is explored in the following sections. Further, a section examines Coloradoan legal cannabis price data to explore whether it supports, or opposes, the decreases seen for the Coloradoan subgroup as being associated with its legal market.

6.3.1   Methodological Data Issues

Several methodological issues affected the sub-regional analysis which led to insufficient data for analysing prices in bordering jurisdictions. For instance, High Times consisting of volunteered price submissions may have predisposed certain sub-jurisdictional groups to having less price submissions than others due to geographical placement. Washington borders only two states while Colorado borders seven states. Naturally, the bordering Colorado group would receive more High Times price submissions than the bordering Washington group. Furthermore, Washington, Oregon and California all border the sea on the west while other states completely Colorado.

Further, the above means that any missing data in bordering jurisdictions were more concerning for the non-Coloradoan groups. For instance, Idaho (bordering Oregon) and Wyoming (bordering Colorado) lacked data for large periods. However, Wyoming

162

presents less of an issue for the Coloradoan subregional group analysis as alongside this state, several others bordered Colorado. However, for Washington which only borders Oregon and Idaho (that is excluding the Canadian province of British Columbia), data from Idaho represented half of the potential data for the Washington subregional group.

Further, the positioning of legal states and their dates of sale implementation predisposed Washington, Oregon, California and Nevada to lose potential data to explore price changes on their neighbours. During dataset timeline, states implementing legal sale were overrepresented in the west coast region of the United States. These western states either bordered another state which legalised a few years later, or their neighbours priorly bordered another legal state. The issue here is the inability to isolate any possible impact of legal sale to a specific legal state and identify a clearly defined intervention point (as detailed in section 3.3.4).

For instance, only price submissions occurring for Oregon before it implemented legal sale, could be used to explore the possible impact of Washington legal sale on Oregonian illicit prices. After Oregon legalised, it would be impossible to differentiate between the impact of Washington legalisation on Oregonian prices and Oregon legal sale on its own prices. Likewise, the same applies to neighbouring jurisdictions, as the initial intervention point (i.e., bordering a state with legal sale for the first time) for Idaho occurred only for Washington and not Oregon. For California and Nevada, the former discussed point means no suitable neighbouring jurisdictions existed for isolating the impact of their legal sale on non-local illicit markets. California and Nevada either bordered jurisdictions that implemented legal sale themselves previously or already bordered another state with legal sale. Contrastingly, no states bordering Colorado legalised during the examined period, nor had previously bordered a state that had.

Overall, the above means that there was simply not enough data from High Times to make a serious claim regarding the potential impact of legal sale on bordering jurisdictions for any of the subregional groups, barring Colorado. To emphasise, this means the data is too incomplete for these subregional jurisdictions to support the possibility of any, or lack of, impact from legal sale on bordering jurisdictions.

6.3.2   *The Legalised States*

163

While data is lacking for analysing the impact of legal sale in prices for bordering jurisdictions in non-Coloradoan subregional groups, another valid question remains. Specifically, why would Oregon, Washington and California (who contain enough data) not show comparable price decreases coinciding with implementing their own legal sale, as Colorado did. [31] One possibility is that Coloradoan price changes coincided with legal sale being simple chance. However, that the non-Coloradoan states examined showed no distinctive price decreases coinciding with their legal sale does not necessarily invalidate the Coloradoan findings.

Wider contextual factors may exist that made the situation for legal and illicit cannabis suppliers different in Oregon, Washington and California (Cornish and Clarke, 2017, 2014; Wortley, 2014). It is an assumption to believe that the impacts of legal sale on illicit cannabis markets across different locales would necessarily be homogenous. The former view assumes the same environmental and situational factors are exacting the same pressure (or lack of) on the decision-making processes of illicit cannabis market participants (Cornish and Clarke, 2014; Selten, 2002; Simon, 1978; Wortley, 2014).

6.3.3   Illicit Market Context

The previous Reddit analyses highlighted the methodological importance of considering the commercial competitiveness of the illicit market. An operating legal cannabis market competes with the local illicit market, thus if the latter is particularly extensive and engrained in the area, this may influence how commercially competitive the legal market must be to disrupt it.

California is well known as a significant producer and trafficker of illicit cannabis within the United States, particularly from the so called emerald triangle in its northwest region, consisting of Mendocino, Humboldt and Trinity counties (DEA, 2018; Hecht, 2014; Johnson, 2019, 2017; Kilmer et al., 2010a; Lee, 2012; Silvaggio, 2018; Weisheit, 2013). Furthermore, California has also been known as a shipment point into the United

---

[31] The data from Nevada is extremely sparse between 2013 to mid-2016, thus it is unclear whether the steeper price decline seen in its post-legal sale period (after mid-2017) represents a sudden change in trend or direction if considering a period over one year.

States for cannabis from Mexico (DEA, 2018, 2017). Similarly, though less notorious, Oregon has also been known as a major domestic producer of illicit cannabis (Hurley et al., 2010; Johnson, 2019, 2017; Lee, 2012; OLCC, 2021). Contrastingly, Colorado does not share the same historical notoriety with illicit cannabis as California or Oregon. Thus, the legal markets in California and Oregon may conceivably have faced more difficulty in competing against their illicit counterparts than in Colorado.

An illicit market situational factor of interest would be its prices before legal sale began (Cornish and Clarke, 2017, 2014; Wortley, 2014). As the Reddit analysis chapter and other literature indicate, cheaper or comparably (to illicit prices) priced legal cannabis may incentivise consumers to purchase cannabis legally rather than illicitly (Amlung et al., 2019; Amlung and MacKillop, 2019). Consequently, illicit suppliers may then lower their own prices to maintain demand. Thus, all other factors being equal, how expensive illicit prices were preceding legal sale may influence the visible impact, or association, of legal prices on illicit prices (at least during the early period following legal sale starting). If illicit prices are particularly cheap in a location, then legal cannabis prices must lower further to challenge, and drive down, illicit market rates.

Re-examining the pre-legal sale data shows some differences between Washington, Oregon, California and Colorado. The average (mean and median) price before legal sale was higher in Colorado (mean $11.69 and median $11.61) than Oregon (mean $9.20 and median $9.29), or Washington (mean $10.56 and median $10.00), while California was comparable (mean $11.74 and median $11.25). However, this is including all the data points before the states started legal sale. Considering only the High Times price submissions occurring a few years preceding legal sale implementation, gives a timelier average pre-legal sale market rate.

Table 12 calculates the average prices in the four years preceding legal sale implementation for Colorado, Washington, Oregon and California. Table 12 shows that Colorado had on average (using the mean values), higher prices before implementing legal sale than Washington (by roughly 16%), Oregon (by roughly 33%) or California (by roughly 13%). Likewise, Table 12 shows the Coloradoan average price in the post-legal period becomes more comparable to other states. Colorado price dropped by roughly a quarter (24%), Washington dropped by roughly 10%, while Oregon and California dropped by only 2%. Median price values differ slightly but, importantly, also show Coloradoan pre-legal sale prices were relatively higher than the other states.

165

Table 12. Colorado, Washington, Oregon and California prices in the four years preceding, and all years following, legal sale implementation dates

State	Legal sale	Count	Mean	Median
Colorado	Pre	92	$11.37	$11.43
	Post	108	$8.61	$8.93
Washington	Pre	56	$9.55	$9.91
	Post	72	$8.57	$8.93
Oregon	Pre	42	$7.61	$7.14
	Post	60	$7.46	$7.14
California	Pre	62	$9.86	$10.00
	Post	42	$9.65	$10.00

Thus, Coloradoan illicit prices (from the High Times data) would have been, all other factors being equal, more vulnerable to higher legal prices than in Washington, Oregon or California. Vulnerable here meaning that legal cannabis prices could have theoretically challenged illicit prices while being more expensive in Colorado than the other discussed states. To illustrate this, consider a hypothetical example using the mean pre-legal sale price from Table 12. An average legal cannabis price of $10.50 would comfortably undercut the average High Times price submissions for Colorado in the four years before legal sale. However, $10.50 is far above the $7.61 for Oregon, higher than $9.55 for Washington, and higher than $9.86 for California.

Crucially, the same argument applies to bordering jurisdictions when considering again the geographical placement of the examined states in America. For instance, Washington, Oregon and California sharing borders with each other meant having neighbours with low prices in the four-year preceding period (as seen in Table 12). Contrastingly, the jurisdictions bordering Colorado had relatively higher prices on average, $12.54. When considering only the prices in the four years preceding Coloradoan legal sale, the average gram price for bordering jurisdictions was even higher (than if considering the entire pre-legal sale period) at $12.95. Thus, legal prices in Colorado could theoretically be much higher while still competing with the High Times illicit prices in nearby illicit cannabis markets. Consequently, this creates greater opportunity for individuals to profitably divert legal cannabis, and/or to incentivise consumers in bordering jurisdictions away from their local illicit markets (Cornish and Clarke, 2014; Leclerc and Wortley, 2014).

High pre-legal sale illicit prices may partially explain the far more visually distinctive shift in illicit prices coinciding around legal sale for the Coloradoan

subregional group seen in Figure 13 and Figure 14. Furthermore, this may explain why the Coloradoan subregional group showed such immediate change. It may take some time for the legal cannabis market to mature, and production prices to lower, to challenge illicit market rates (Caulkins, 2010; Fataar et al., 2021; Kilmer et al., 2010b; Kleiman, 2017). However, this time would theoretically be shorter, all other factors being equal, if the location had higher illicit cannabis prices initially. This is particularly more relevant in the present circumstance when considering the legal cannabis markets in the United States are relatively new. Any possible changes in the High Times data needed to have occurred relatively quickly to become observable.

6.3.4   Legal Regulation and State Specific Factors

The literature discusses extensively the possible differing consequences that different legalisation policy choices may have on relevant measures such as price (Caulkins et al., 2015; Caulkins and Kilmer, 2016; Kilmer, 2019). Also possible are state specific factors that may have affected how legal sale influenced illicit market prices across the dataset timeline. This section explores the above two possibilities.

As qualitatively demonstrated in the Reddit analysis, one clear, and relevant, situational difference in cannabis legalisation is taxation. The examined legalised jurisdictions all tax cannabis with a weight-based and/or excise taxation (Boesen, 2020; Cammenga, 2020; Hall et al., 2019). Barring Colorado and Oregon, these states currently may also apply their general sales tax on recreational cannabis alongside any weight-based and/or excise taxation. However, differences in the percentage taxed, and total markup, vary by state as shown in Table 13 (Boesen, 2020; Cammenga, 2020; Hall et al., 2019).

Table 13. Tax rates

State	Mark Up	Excise Taxes	Other Taxes
Colorado	27.9%	15% wholesale; 10% retail	2.9% sales
Colorado (2017 tax change)	30%	15% wholesale; 15% retail	N/A

Washington	75%	25% grower; 25% processor; 25% retail	N/A
Washington (2015 tax change)	43.5%	37% retail	6.5% sales
Oregon	20%	17% retail	3% sales (optional)
California	40% or more (estimated)	15% retail	Weight based taxes ($9.65/oz. flower, $2.87/oz. leaves, $1.35/oz plants); 7.25% - 10.25% sales; Cultivation per square (optional rates for local areas)

Both Colorado and Washington changed their tax rates in 2017 and 2015 respectively. The Californian retail excise tax is also higher than it appears as the state levies it at the wholesale level using an Average Market Price value which marks up wholesale prices by 80% (Boesen, 2020). Thus, California taxes $100 worth of cannabis at 15% of a calculated average market value of $180. Further raising the mark up for California are the weight-based, sales and cultivation per square taxes.

These different tax rates may have created different situational influences on illicit cannabis price as businesses may pass down such taxes on products to the consumer by selling at higher prices. Higher taxed cannabis would threaten illicit prices less than lower taxed cannabis, as the former would increase the potential retail price consumers have to pay for legal cannabis (all other factors being equal). Likewise, higher legal prices would theoretically mean illicit cannabis suppliers may not have to lower their own prices (or not have to lower it as much) to remain competitive amidst a competing legal market.

Therefore, the higher tax rate in Washington may partially explain it showing a different price pattern to Colorado. Likewise, the high tax rate in California may also partially explain why the price submissions for the state showed far less of a difference between its pre- and post-legal sale periods than Colorado. Oregon has the lowest taxes out of the four, however as discussed in section 6.3.3, they also had the lowest average prices by far in the four years preceding its own legal sale.

Attention now focuses on the context of specific states, beginning with Washington. The post-legal price trend in Washington may have been influenced by several situational factors unique to Washington that differ from those seen in Colorado (besides those already discussed). Firstly, Washington has imposed certain restrictions on legal cannabis that limited overall legal cannabis supply. Washington caps the total permitted amount of producible cannabis and business licenses that individuals can apply for (Kilmer, 2019; Pardo, 2014). Furthermore, Washington also prohibits personal cannabis cultivation (Hall et al., 2019; Lancione et al., 2020). Such restrictions may possibly restrict the total amount of legal cannabis sold, and potentially divertible, into the illicit cannabis market. Less supply may mean higher prices (Gale, 1955; Mankiw, 2011). In contrast, Colorado held no such restrictions of total producible cannabis or licenses, and permits personal cannabis production (Hall et al., 2019).

Another regulation situational difference to consider is the revamp of the Washington medical cannabis industry after implementing recreational legal cannabis sale. Before July 2016, the Washington medical cannabis industry was largely unregulated, with growers and retailers only needing to comply with general business regulations and not any industry specific requirements (Hunt and Pacula, 2017; Kleiman et al., 2015; O'Connor et al., 2016). However, in July 2014 as Washington implemented industry specific regulations for a commercial cannabis market, an unregulated medical market existing simultaneously became an incongruity. Washington passed Senate Bill 5052 in 2015 which required all medicinal cannabis dispensary sales to be folded into the same framework as recreational cannabis retail stores by July 2016 (WSLCB, 2015). Medical dispensaries failing to comply with these new regulations had to cease operations (WSLCB, 2015).

At the same time, the WSLCB (Washington State Liquor and Cannabis Board) issued a canopy study to assess whether current cannabis production limits could satisfy the newly legitimised medical cannabis market (O'Connor et al., 2016). This study estimated that the current canopy of cannabis supply could sufficiently supply both the medical and recreational cannabis markets (O'Connor et al., 2016). Consequently, as Washington caps cultivation licenses and said study determined current production met consumer demand, Washington did not create any new cannabis cultivation licenses for the now illegitimate medical cannabis growers to apply for (Kilmer, 2019; MacIver, 2016; WSLCB, 2016a).

While this estimation entails some uncertainty (due to the unregulated and untracked nature of the medical cannabis market prior to Senate Bill 5052), a report by Kleiman et al (2015) assessed the market share of the transactional medical cannabis industry (which excluded medical personal growing or non-commercial sharing) in October 2015. This assessment estimated that the medical cannabis industry constituted 37% (the low and high estimates being 21% and 55% respectively) of the overall Washington cannabis market share (Kleiman et al., 2015). Thus, delegitimising medical cannabis growers, while not offering them the opportunity to apply for new growing licenses, potentially cut a large proportion of total cannabis supply in Washington State.

Such a decrease may partially explain the increasing price trend seen in the Washington post-legal sale period. Such changes may have hindered a main supplier of cannabis within Washington and increased cannabis price generally in Washington as total supply fell (Gale, 1955; Mankiw, 2011). Further, such changes may have influenced the High Times price submissions for Washington if a proportion of the unregulated medical cannabis market was diverting into its illicit market. Such diversion is far from impossible, rather it seems highly likely when considering the unregulated nature of the Washington medical cannabis market pre-2016 (Kleiman et al., 2015; O'Connor et al., 2016). Interestingly, a Reddit user comment (that was not used in the Reddit chapter) did discuss this occurring:

> I5052 was passed in Washington during July, it essentially restricted medical cannabis leading to many dispensaries and collective grows shutting down, this mean supply got cut which led to prices remaining steady and rising a small amount.

While Washington state did increase the total amount of dispensary retail licenses to accommodate the medical cannabis industry (from 334 to 556), this still presents a cap that medical cannabis suppliers previously avoided prior to Senate Bill 5052 (WSLCB, 2016b). Furthermore, they would have to compete for the limited, and thus highly sought-after, licenses in contrast to previous regulations.

Due to the above, the contextual context of Washington legalisation differs from Colorado which experienced no such restrictions on personal growing, production limits or such abrupt changes to a major cannabis industry in the state (i.e., the medical cannabis industry). Such factors may possibly explain the different development of the High Times

price submissions in Washington to Colorado, specifically that illicit cannabis prices in Washington appeared to increase after its initial drop in its post-legal sale period.

The High Times submissions for Oregon saw its lowest prices in the examined period between 2015 to late 2017. While this period roughly aligns with Oregon beginning legal sale, Figure 21 depicts this price decrease first occurring at the start of 2015, which is months before Oregon began their legal sale in October of that year. However, this is in keeping with the possibility that illicit cannabis prices in Oregon may have lowered enough so that initial legal pricing in Oregon could not seriously challenge illicit market rates.

However, the High Times data for Oregon from late 2017 onwards raises some theoretical issues when considering reported legal cannabis prices from the OLCC (Oregon Liquor Control Commission). In Figure 21, the High Times data for Oregon shows a clear increase in illicit cannabis prices beginning from late 2017. The High Times gram price data for Oregon remained under, or comparable to, the OLCC recorded median gram prices prior to late 2017 (OLCC, 2021, 2019). However, from late 2017, the OLCC (2021) recorded median gram prices that were cheaper than the High Times data for the same period. The OLCC (2021, 2019) reported legal median gram price to being at roughly $7.50 per gram in November 2017, then it lowered to and remained roughly around $5.00 per gram from July 2018 onwards. However, during the same period (i.e., November 2017 onwards) the High Times data showed Oregon illicit cannabis prices were on average higher. For example, in the High Times data, the calculated median gram prices in 2018 was $7.50 and $8.00 in 2019.

Considering the above, the cannabis prices observed from late 2017 onwards contradict previous theoretical interpretations of the interaction between legal and illicit cannabis prices. Illicit prices did not lower in tandem with the recorded OLCC (2021) legal cannabis prices changes, and there are several possibilities that may explain this. The Oregon High Times data past late 2017 may be grossly unrepresentative of illicit prices, and/or the OLCC (2021) report of median legal cannabis prices is inaccurate. Possibly, some (currently) unobservable, and unrelated to legalisation, factor may be influencing the Oregon prices. Lastly, considering the Reddit thematic analysis chapter, several consumer themes emerged depicting reasoning behind continued illicit cannabis purchasing that excluded any cost-saving goal (Cornish and Clarke, 2017, 2014). Hence, as some cannabis consumers may possibly still buy illicit cannabis despite cheaper legal

alternatives, it is possible that (after Oregonian legal prices became cheaper than illicit), illicit price submissions made to High Times may be biased towards consumer purchases made without a cost-saving goal in mind.

The Californian price submissions show little change around the implementation of legal sale. This raises several questions when considering illicit prices in California were higher than Washington in Table 12 and both shared similarly high tax rates, yet Washington showed an average price drop while Californian prices remained stable. Furthermore, Californian post-legal sale prices are more expensive than post-legal Colorado, Washington and Oregon. The present data thus indicates that Californian illicit prices changed little its legal sale implementation date and post-legal sale period.

Exploring information on Californian legalisation implementation offers a possible explanation of why the High Times price submissions changed little. Californian legalisation policy has an opt-out choice, meaning counties can self-regulate cannabis as they wish. This choice is not novel, as Colorado, Washington and Oregon also allow counties to locally prohibit legal stores. However, California has experienced a relative dearth of legal cannabis stores. For instance, in 2019, estimations indicated as much as 70% of Californian municipalities banned any commercial legal cannabis activity (Schroyer and McVey, 2019; Unger et al., 2020), and California had the lowest quantity of licensed recreational stores per population in the United States (Dorbian, 2019).

Overall, this makes the situational circumstance of Californian recreational cannabis legalisation relatively resilient towards any influence from a recreational legal cannabis market. Proportionally, much of California has lacked legal cannabis store presence (Schroyer and McVey, 2019; Unger et al., 2020), meaning the illicit cannabis market in California may be operating with less significant competition from the recreational cannabis market if accessing it proves inconvenient for many. As the Reddit analysis qualitatively showed, convenient access to legal stores can be an important incentive for consumers to purchase cannabis legally rather than illicitly.

Furthermore (as discussed in section 6.3.3), this lack of legal market presence is combined with a state that historically has an extensive and engrained illicit cannabis market (DEA, 2018; Hecht, 2014; Johnson, 2019, 2017; Kilmer et al., 2010a; Lee, 2012; Silvaggio, 2018; Weisheit, 2013). These contextual differences may explain why the High Times data itself showed little to no indication of prices changing when California began officially permitting legal cannabis sale.

6.3.5 Medical Regulation

As shown in the overhead analysis, price submissions were, on average, lower if in a CMCP (comprehensive medical cannabis program) compared to a LMCP (limited medical cannabis program). If such medical cannabis laws changed during the period examined for the subregional sections, then this means it may conceivably have influenced the price changes for said subregional groups. Therefore, it becomes necessary to identify whether, and if so which, states changed their medical cannabis regulation during the examined period.

Firstly, no examined jurisdiction implemented cannabis legalisation and sale without first introducing a comprehensive medical cannabis program (NCSL, 2019a, 2019b). Secondly, regarding bordering jurisdictions, many already bordered another state with legalisation, which as mentioned, means said state already implemented a CMCP before legalisation. Washington borders Oregon, while California, Oregon and Nevada, all border one another. Washington and Oregon also border Idaho, who have implemented no medical cannabis laws during the examined period.

Generally, jurisdictions bordering Colorado did not change their medical cannabis laws. Colorado borders two states that have not considered any medical cannabis laws (Nebraska and Kansas), two states (Arizona and New Mexico) who implemented CMCPs and one state (Wyoming) who implemented an LMCP prior to Colorado implementing legal sale. Bordering Oklahoma and Utah did implement a comprehensive medical cannabis program in 2018 raising the possibility that it could have influenced High Times price submissions for this group. However, over three years passed between Coloradoan legalisation before said medical cannabis implementation. Nonetheless, in any further analysis of the jurisdictions bordering Colorado, medical regulation is suitably statistically accounted for.

6.3.6 Colorado Legal Prices

Lastly, attention focuses on Colorado and its neighbours before concluding this chapter. The Coloradoan subregional analysis showed price drops coinciding with the implementation of legal sale. If legal sale and these observed illicit cannabis price decreases are related, then legal cannabis price changes should theoretically reflect itself (to some degree) within the High Times price data (Cornish and Clarke, 2017, 2014;

Jacques and Bernasco, 2014). As discussed, lowering legal prices may create illicit opportunities for traffickers to profit from diversion, and/or increase reward for illicit cannabis trafficking by driving down local illicit prices which greatens arbitrage opportunity. Equally, low legal prices may incentivise cannabis users in bordering jurisdictions with better deals, which in turn may encourage their local suppliers to lower their own prices to maintain demand. Thus, if Coloradoan legal sale influenced illicit prices, then as legal prices rose or fell, the High Times price submissions should show a somewhat comparable pattern across the same period.

The CDOR (Colorado Department of Revenue) calculates the median market prices of unprocessed retail cannabis per pound sold, or distributed, from retail cannabis cultivation facilities (Colorado Department of Revenue, 2021). The CDOR uses this data in devising the average market rate for levying excise tax on cannabis (Boesen, 2020; Hall et al., 2019). This data offers the opportunity to compare a measure of legal bud cannabis (the same form of cannabis reported to High Times) price with the price data for the Coloradoan subregional group. This is not a perfect comparison as the Colorado median market value is in pounds and at the wholesale level (i.e., from a cultivator), while the High times data represents illicit retail level transactions calculated at the gram level. However, this wholesale bud cannabis is ultimately the same cannabis sold in retail stores.

Nonetheless, what is of interest is whether any similarities exist between the pattern of price changes between the two datasets across 2014-2020 (as Colorado began legal sale in January 2014). If similarities exist, this offers corroborating support for the legal market influencing the illicit cannabis markets within the Coloradoan subregional group. Only legal cannabis price data up to the first quarter of 2020 is used to align with the period of the High Times data. Figure 15 below plots these legal median market prices from the CDOR for Colorado, alongside the High Times data for Colorado and its bordering jurisdictions at three-month intervals (comparable to the CDOR data) from 2014 onwards (the start of legal sale in Colorado).
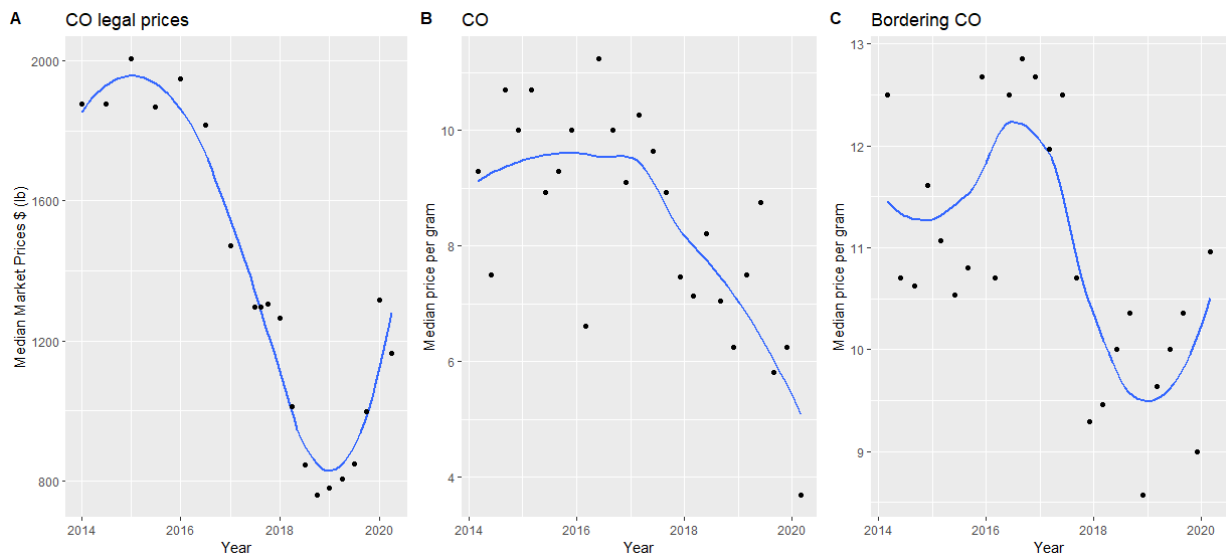
174

Figure 15. Plot A, legal median cannabis bud prices (lb), Source Colorado Department of Revenue. Plot B, median High Times cannabis prices in Colorado from 2014 onwards. Plot C, median High Times cannabis prices in jurisdictions bordering Colorado from 2014 onward. Please note the y-axes for the graphs are not congruent.

Plot A shows that legal prices remain relatively consistent between 2014 to early 2016 between the first six data points. The seventh data point shows the first large price drop occurring at the start of 2017, with the rest of 2017 seeing a further small drop while prices remain steady. Lastly, 2018 sees a further price drop until it dips to the lowest point in the entire period before prices begin increasing from 2019 onwards to early 2020. Plot B depicts the illicit cannabis prices reported to High Times from Colorado. The plot B trendline indicates that average illicit cannabis prices remained roughly constant between 2014 to 2017 in Colorado. However, prices began decreasing after the first three months of 2017, a trend that continued for the rest of the period.

Lastly, Plot C depicts illicit cannabis prices in the jurisdictions bordering Colorado. Plot C shows three distinctive data point groupings, the first is between 2014 to late 2016, the second is roughly 2016 to mid-2017, then the third constitutes the rest of the period. There is a price increase moving from the first group of data points to the second and a larger decrease from the second to the third beginning in roughly mid-2017. Observing the trend line for the third grouping indicates prices continuing to decrease from 2018 onwards before increasing again from 2019.

The High Times data for Colorado and the jurisdictions bordering it, share several similarities and differences with the CDOR data. The prices from High Times for

Colorado (Plot B) and legal prices (Plot A) showed a relative period of stability before prices decreased in 2017, though Plot A indicates decreases occurring earlier in 2017 than Plot B. The data from High Times for Colorado also continually decreased after 2019 whereas the legal price data indicated an increase in early 2020. The bordering Colorado jurisdiction category differed most from the other two figures during the 2014 to mid-2016 period, which showed price stability before a sudden increase in 2016. By early 2017, Plot C begins showing a remarkably similar pattern to the legal price data in Plot A, where prices begin decreasing in 2017. Furthermore, the trend line between 2018 to early 2021 shows a similar bell shape in price changes for both Plot A and C.

Overall, this rough reflection, between the calculated legal median prices for Colorado and the High Times data is additional tentative support of the possibility that Coloradoan legal sale may be associated with the High Times prices for the Coloradoan subregional group. Particularly interesting is that the (proportionally) largest drop in prices began in 2017 across all three plots in Figure 15. Furthermore, the legal price drop preceding the illicit price drop is in keeping with the possibility of legal market influence. If illicit prices did lower because of legal cannabis pricing, it makes sense that it would be because legal prices lowered first and then the illicit market responds. Likewise, if legal cannabis diversion is occurring, then any decrease in legal prices should precede any illicit price decreases.

The High Times and legal cannabis price development between 2014 to early 2020 is not identical. However, such symmetry would appear strange as it would indicate that the Coloradoan legal market completely subverted illicit market prices immediately and entirely, both locally and in its neighbours. That the figures demonstrate some similarities indicates the legal market partially influencing said illicit cannabis markets, which is far more reasonable and realistic.

6.4   Summary

In closing, this analysis showed that High Times price submissions occurring in legalised states and their neighbours, were cheaper than other jurisdictions in the United States. Furthermore, this remained so when accounting for medical cannabis laws. A more granular analysis of subregional groups indicated only illicit prices for Colorado and its

neighbours showed distinctive price changes coinciding with recreational legal sale beginning.

Acknowledging methodological issues with the High Times data, wider contextual factors, and differences between these state groupings argue against simply accepting that the subregional group data for Colorado coincidentally aligned with legal sale starting. Contextual differences (i.e., regulation choices, regulation changes and the illicit market context) between the examined legal states may have changed the situational experiences of illicit cannabis market participants, and by extension, how legal sale impacted illicit prices (Cornish and Clarke, 2017, 2014, 2011; Leclerc and Wortley, 2014). Further evidence for Coloradoan legal sale potentially influencing illicit prices arose from comparing it with available legal cannabis price data from the CDOR (Colorado Department of Revenue). Specifically, illicit and legal cannabis price trends between 2014 to early 2020 showed clear similarities.

The present analysis regarding illicit prices for the Coloradoan subregional group, alongside the comparison with CDOR legal price data, is in keeping with the possibility of Coloradoan legal sale being associated with price decreases in neighbouring jurisdictions. As discussed previously, such price decreases may indicate cross-border cannabis movement. Consequently, the present inquiry justifies further analysis of the price data, using more sophisticated statistical methods, for the jurisdictions bordering Colorado.

The reader should keep in mind several inherent limitations of the High Times dataset when considering the present findings, which were detailed in section 3.3.2 of the Methodology chapter. Importantly, the researcher re-emphasises that the present analysis can only indicate the possibility of potential associations between legal sale and the price changes observed for the Coloradoan subregional group.

Chapter 7: Price Data Statistical Modelling

In this chapter, associations are estimated between Coloradoan legal cannabis sale and High Times illicit prices in states bordering Colorado through two statistical models. Firstly, an interrupted time series analysis using segmented regression contrasts cannabis prices before and after legal sale started (Bernal et al., 2017; McDowall, 2004; Wagner et al., 2002). Secondly, a multiple linear regression model estimates the association between operational Coloradoan retail cannabis store licenses and prices, while controlling for other confounder influences (Aiken, 2004; Kovera, 2010; Tarling, 2009; Uyanık and Güler, 2013). This chapter focuses on the third research question of this thesis, regarding wider cannabis trafficking flows. First, the results from both statistical model analyses are reported alongside limitations before discussing their implications.

7.1   Interrupted Time Series Analysis

A necessary requirement for an interrupted time series analysis is calculating the average quarterly cannabis gram prices, shown in Table 14 (Bernal et al., 2017; Wagner et al., 2002). [32] Year quarters were used as certain months only had one price submission. In total, 36 mean quarterly prices represent the pre-legal sale period, while 26 mean quarterly prices constitute the post-legal sale period. The latter is on average roughly 14% cheaper ($1.83 less) than the pre-legal sale period. Also, post-legal period prices have a smaller range than the pre-legal sale period, being $4.15 compared to $6.88. The standard deviation indicates less variance for the post-legal sale period.

Table 14. Summary Stats Mean Quarterly Prices

Stats	Whole Period	Pre-legal sale	Post-legal sale
Count	62	36	26
Mean	$12.18	$12.97	$11.14
Min	$9.03	$10.09	$9.03
Max	$16.97	$16.97	$13.18
Std dev	$1.65	$1.45	$1.24

---

[32] These quarterly averages stem from the exact same data used in section 6.2 of the previous chapter, specifically the prices for jurisdictions bordering Colorado.

Conducting Pearson correlation tests between mean quarterly price and time (i.e., number of quarters passed) for both periods indicate clear differences (Witte and Witte, 2016). The pre-legal sale period showed a low and insignificant positive correlation ($r = 0.16$, $p > 0.05$). Contrastingly, the after legal sale period showed a moderate and significant negative correlation ($r = -0.46$, $p < 0.05$). Thus, while average prices were marginally increasing prior to legal sale, afterwards they began decreasing at a faster rate (i.e., the post-legal sale correlation strength is more than double the pre-legal sale period). These correlations are in keeping with a possible association between Coloradoan legal sale and decreasing prices in jurisdictions bordering Colorado.

Below, Table 15 depicts the segmented regression results. Overall, the model explains roughly 34% of total cannabis price variation ($r^2 = 0.336$). The 'baseline trend' estimates cannabis gram price increased by roughly 3 cents per quarter before legal sale. The 'level change' indicates immediately after legal sale (i.e., the first quarter following Coloradoan legal sale, January to March 2014), quarterly mean cannabis gram price dropped by $1.34. Lastly, 'trend change' indicates mean quarterly cannabis gram prices lowering by roughly 10 cents per quarter.

The interrupted time series analysis indicates distinct price changes for jurisdictions bordering Colorado that coincided with its legal sale starting. Post-legal sale prices decreased over time in contrast to an increase prior to its implementation. Furthermore, this change approximately tripled in magnitude (a 3-cent increase, compared to a roughly 10-cent decrease, per quarter). Also, the model indicated a large and sudden price drop in the first quarter, which suggests an immediate association between Coloradoan legal sale and lowered prices in its bordering jurisdictions. Therefore, model results are in keeping with the possibility of a relationship between Coloradoan legal sale and lowered prices in its bordering jurisdictions.

Table 15. Segmented Regression Results

Model	Estimate
(Intercept)	12.25961
Baseline trend	0.02481
Level change	-1.34001
Trend change	-0.09819
First quarter	0.58205
Second quarter	0.29121
Third quarter	0.14341

Adjusted R square: 0.336.

As mentioned in section 3.3.5 of the Methodology chapter, autocorrelation in time series data may bias the model by underestimating standard errors (Wagner et al., 2002). A Durbin-Watson test indicated a slight positive correlation present in the model of 1.89 which is within the normal range of 1.5 to 2.5, and insignificant ($p > 0.05$), meaning no adjustments for auto-correlation were required (Durbin and Watson, 1950; Wagner et al., 2002). Also, dummy variables for each quarter (with the fourth quarter used as the reference value) controlled for possible seasonal patterns in the data (Bernal et al., 2017; Hategeka et al., 2020).

7.2   Multiple Linear Regression

The interrupted time series model indicated associated price changes coinciding with Coloradoan legal sale. However, as discussed in the Methodology chapter in section 3.3.6, a range of factors may possibly influence price. For example, literature and theory indicate law enforcement risk may affect prices (Caulkins and MacCoun, 2003; Caulkins and Reuter, 1998; Reuter and Kleiman, 1986). For example, if law enforcement risk is lower in Salt Lake City and higher in Albuquerque for cannabis suppliers, the latter may theoretically show higher prices (all other factors being equal). Equally, law enforcement risk may vary in the same location across time if police strategies change. Multiple linear regression is used to estimate the association of active Coloradoan store licenses (a proxy for the legal market) with illicit price, whilst controlling for the influence of other relevant variables, such as law enforcement (Aiken, 2004; Tarling, 2009; Uyanık and Güler, 2013).

Table 17 depicts the variables used (recall that section 3.3.6 of the Methodology chapter discussed and justified the inclusion of these variables). Price is the dependent variable (specifically the same data used in section 6.2, of the previous chapter, to analyse price changes in states bordering Colorado). Quantity of store licenses is the independent variable of interest which proxies legal market size and diversion opportunity. Every other variable is a strict control variable containing data from jurisdictions bordering Colorado. Scale refers to the geographical level the data is collected at.

Table 16. Multiple linear regression model variable.

Variable	Scale	Source

Price	City	High Times
Active Coloradoan store licenses	State	Colorado Department of Revenue (CDOR)
Cannabis sale/production arrest rates	City	Federal Bureau of Investigation (FBI)
Cannabis possession arrest rates	City	Federal Bureau of Investigation (FBI)
Number of Police Officers	City	Federal Bureau of Investigation (FBI)
Medical Regulation	State	National Conference of State Legislature (NCSL)
Distance from Colorado	City	Bing Maps
Median Household Income	County	United States Census Bureau
Population	City	United States Census Bureau
Time	N/A	High Times

7.2.1 Bivariate Analysis

This section contains the results of bivariate analyses between each variable and the dependent variable. Variables which show some relationship or correlation with price were included in the model.

Independent Predictor Variable

The Colorado Department of Revenue (CDOR) publicly provides monthly data on operational retail licenses (which aligns perfectly with the monthly reporting of cannabis prices from High Times). [33] During January 2014 (when Colorado first sold recreational cannabis), 147 active retail licenses became operational, the largest single increase in the timeline of the dataset. By April 2020 (the end of the High Times dataset timeline), licenses increased to 587. Excluding the initial January month in 2014, active commercial retail licenses increased by roughly 6 per month. [34] A Spearman Rho correlation test showed a negative relationship between operational licenses and price ($r = -0.38$, $p < 0.01$) across the entire dataset (Witte and Witte, 2016). Thus, as active commercial retail licenses began, and increased, reported cannabis prices in neighbouring states generally decreased. In the model, this variable is coded as 0 prior to 2014, while each subsequent month is the quantity of active licenses the CDOR reported

Independent control variables

---

[33] See https://sbg.colorado.gov/med-licensed-facilities, both medical and retail store licenses are offered.

[34] The exact figure to two decimal places being 5.87.

181

Several control variables are analysed.

Law enforcement

As discussed previously, law enforcement risk may influence drug prices (Boivin, 2014; Caulkins and MacCoun, 2003; Caulkins and Reuter, 2010, 1998; Reuter and Kleiman, 1986). Concisely put (as previous chapters have discussed this relationship thoroughly), increased law enforcement-imposed risk on illicit drug suppliers is associated with higher drug prices and vice versa, meaning the decreased prices in Coloradoan neighbours may conceivably (at least partly) stem from lowered risk. Three variables are collected from the FBI crime data explorer to proxy risk, these being, cannabis arrest statistics for sale/manufacturing (FBI report these as the same), possession and number of police employed. [35] This data is calculated at a rate per 100,000 capita to account for population varying by locale. Population data from the United States Census was used to calculate the rate per capita. [36]

Figure 16 plots FBI data on cannabis arrests and the number of police employed with illicit price cannabis prices. Visually, there are clear positive relationships between the arrest variables and price, while police employed shows a marginal increase. Spearman rho showed positive correlations between cannabis arrests and price data. Specifically, the sale/production arrest rate showed the largest significant correlation ($r = 0.26$, $p < 0.01$) followed by possession arrest rate ($r = 0.11$, $p < 0.05$). Police employed showed an insignificant, and the smallest, correlation ($r = 0.08$, $p > 0.05$).

Greater arrests corresponding to higher prices is in keeping with Risk and Prices theory (Boivin, 2014; Caulkins and MacCoun, 2003; Caulkins and Reuter, 2010, 1998; Reuter and Kleiman, 1986). Supply side arrests showing a stronger correlation than possession, makes intuitive sense as it represents direct risks for suppliers. While police employed showing the lowest (and insignificant correlation) may stem from it simply conveying police force size. Contrastingly, higher cannabis arrest rates may logically

---

[35] See https://crime-data-explorer.fr.cloud.gov/. Accessed 11/02/2020.

[36] See https://www.census.gov/programs-surveys/popest/data/tables.html. Accessed 11/02/2020.

reflect said police departments prioritising cannabis enforcement relatively more, regardless of the total number of police officers.
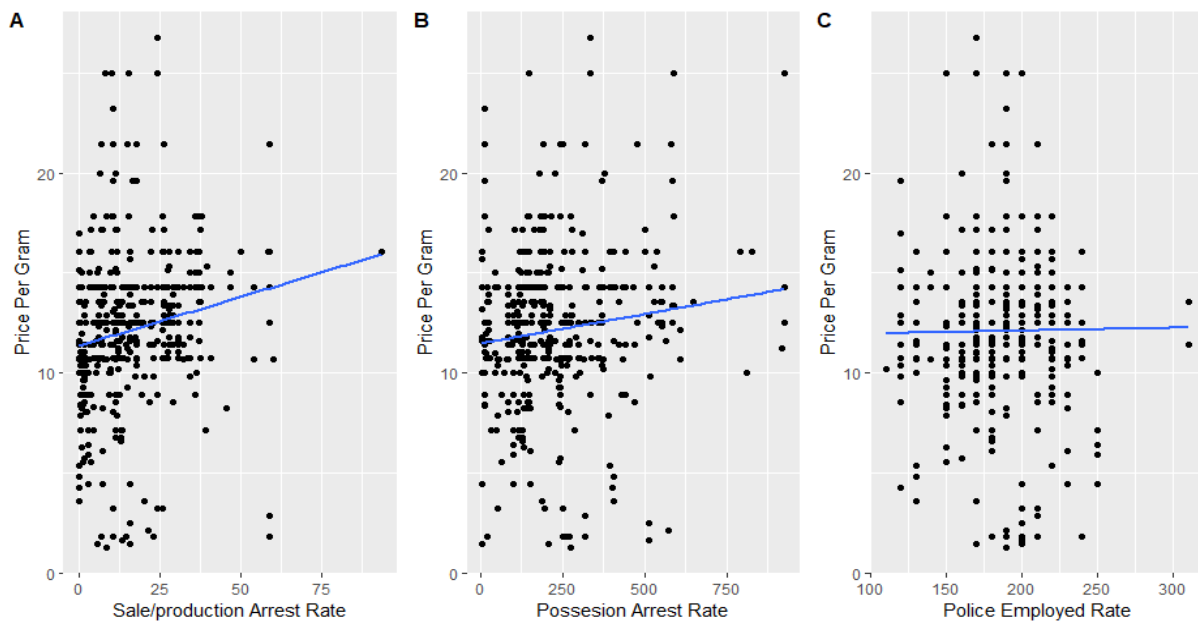

Figure 16. Law Enforcement Proxies rate per 100,000

Medical regulation laws

In addition to previous literature indicating the potential of medical cannabis regulation to influence illicit prices (Pacula et al., 2015; Zook et al., 2012), descriptive analysis of High Times showed differences in price by medical cannabis regulation. Recall, prices were, on average, cheaper in jurisdictions with a comprehensive medical cannabis program (CMCP) compared to submissions occurring under a limited medical cannabis program (LMCP). States bordering Colorado differ in medical cannabis regulation during the High Times dataset (NCSL, 2019a). Nebraska and Kansas have no medical cannabis laws, others implemented medical regulation prior to 2005 (Arizona and New Mexico implemented CMCPs, while Wyoming implemented a LMCP), and Oklahoma and Utah shifted to a CMCP in 2018.

In total, 315 submissions occurred under no medical regulation, only 12 under an LMCP, and 199 under a CMCP. Average price was highest for no medical regulation ($12.37), second highest for LMCP ($12.10), and lowest for CMCP ($11.41). These averages are in keeping with the possibility of an association between medical regulation policy and prices. A Kruskal-Wallis test (a non-parametric alternative to ANOVA)

183

indicated average differences between these groups as significant (p < 0.01) (Dai, 2017). An unpaired two-samples Wilcoxon Test was also conducted to identify which pairs of groups differed, finding that only CMCP and no medical regulation categories showed a significant change in mean prices (p < 0.01) (Gibbons, 2004). CMCP and LMCP are represented in the regression model using dummy variables, with no medical regulation as the reference variable (Tarling, 2009).

<div align="center">Distance</div>

Using the geographical centre of Colorado (specific co-ordinates being 39°00′00″N 105°32′42.6″W), price changes in the pre- and post-legal sale period for cities in jurisdictions bordering Colorado are compared. Figure 17 shows that pre-legal sale cities further from Colorado had higher prices and Spearman Rho showed a significant positive correlation (r = 22, p < 0.05). Conversely, during the post-legal sale period, cities further from Colorado had marginally lower prices, however, Spearman Rho indicated an insignificant weak negative correlation (r = 0.05, p < 0.05). Overall, this indicates after legal sale that distance from Colorado became a less important association for prices in the examined cities.
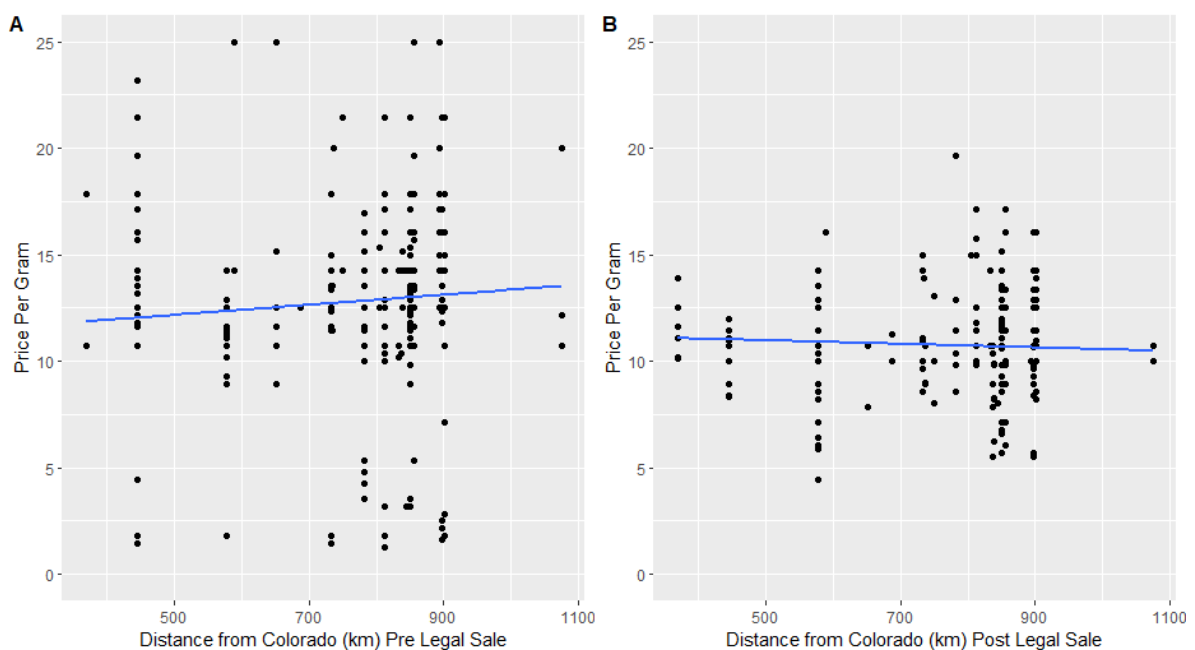

Figure 17. Price by distance. Plot A, prices before Colorado implemented legal sale. Plot B, prices after Colorado implemented legal sale.

This bivariate pre-post comparison of prices produces some conflicting findings when considering the theory and research (previously discussed), into illicit drug prices by distance (Caulkins and Bond, 2012; Chandra et al., 2014, 2011; Chandra and Barkell, 2013; Chandra and Joba, 2015; Giommoni and Gundur, 2018; Lahaie et al., 2016; Reuter, 2014; Zook et al., 2012). On one hand, the price gradient is contradictory at the city level, as if cannabis was trafficked out of Colorado in bordering jurisdictions, then some increasing gradient should theoretically be visible. Interestingly, Figure 17 still indicates a trafficking flow disruption coinciding with legal sale, as a previous clear increasing price gradient from Colorado disappeared.

On the other hand, prices in the post-legal sale period are noticeably lower at the state level. Average price is roughly 16% lower ($10.69 compared to $12.68) after legal sale. Also, prices over $15 become rarer (only 5% compared to 23%). Average prices for Colorado in the post-legal sale period is roughly 20% lower than its neighbours (being $8.61), meaning at the state level, a decreasing price gradient from Colorado into its neighbours exists. Further, illicit cannabis trafficking theoretically becomes a more profitable opportunity in the post-legal sale period as the difference in average price roughly doubles from $0.99 to $2.08 (Cornish and Clarke, 2014). Thus, these state-level price decreases still indicate a possible association between Coloradoan legal sale and prices in neighbouring illicit cannabis markets.

Admittedly, the distance analysis suffers from clear methodological issues at the city level. High Times data contains far more cities and price submissions between the 700-900km distances. Furthermore, there are large gaps of data between 350km to 600km, and beyond 900km is essentially barren (barring two submissions). Similarly, the pre-legal sale period also contains several gaps of data. Thus, entirely possible are failures to accurately represent price variation over distance from missing distances. Regarding an alternative explanation, one possibility is that Colorado is not the only supplier to these other states. Conceivably, other jurisdictions may be, or have started, supplying cannabis to states bordering Colorado. Such a scenario may disrupt any identification of a clear price gradient linking Colorado with trafficking cannabis to its neighbours.

Economic development and individual spending power

Figure 18 and Spearman rho correlation analysis ($r = -0.23$, $p < 0.05$) showed a negative relationship, where price submissions tended to be cheaper if in counties with higher median household income. [37]
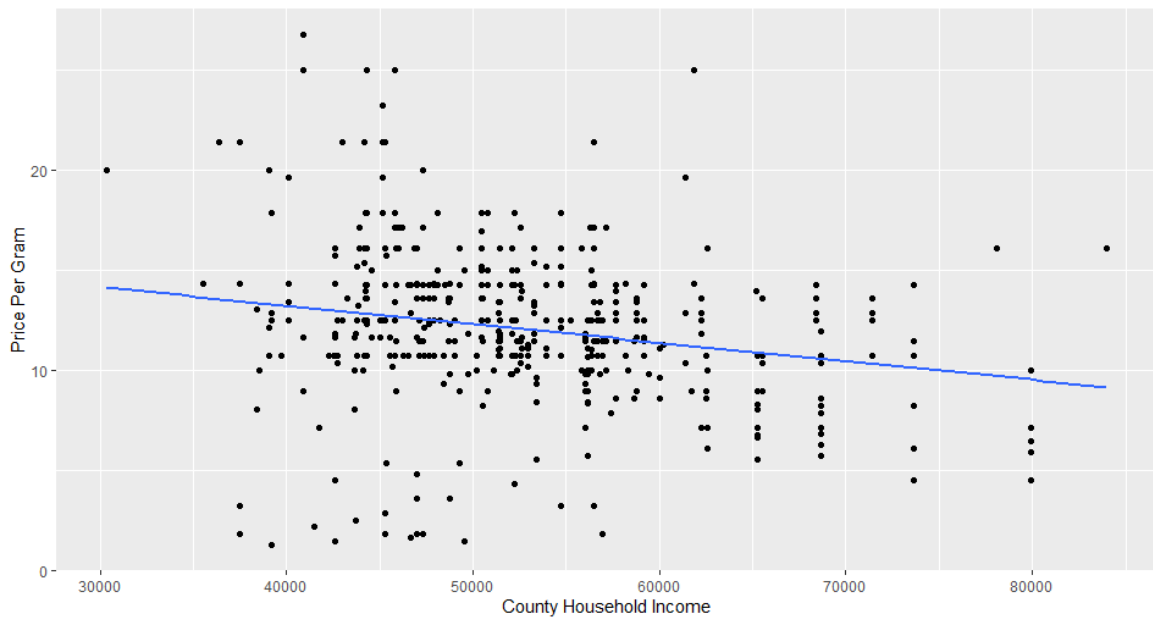
Figure 18. County Household Income at Gram price

<div style="text-align:center">Population</div>

Also examined is population at the city level as a measure for demand, however, this only provided a weak insignificant correlation ($r = 0.03$, $p > 0.05$).

<div style="text-align:center">Time</div>

Lastly, a time variable is included which counts each subsequent month from the start of the dataset to its end. As discussed in 3.3.6, the time variable accounts for underlying variation in prices resulting from price submissions occurring at different points in time.

---

[37] Data gathered from https://www.census.gov/data/datasets/2019/demo/saipe/2019-state-and-county.html

7.2.2 Results

Estimates are presented in Table 17. Importantly, the legal store coefficient remained relatively consistent across all four models. [38] All models indicated a negative association between legal store quantity and gram price. Thus, prices on average became lower in neighbouring jurisdictions as more Coloradoan stores opened. This pattern occurred with all other factors held constant. Focusing on Model 4, as it explains the most variance (adjusted $r^2 = 0.08032$) while controlling for the most factors, it shows an associated decrease in price of $0.0046 per active license. While the store license coefficient appears small, it represents an associated price decrease per active retail license. For example, if considering the impact of 587 active licenses (the total amount of active licenses at the end of the dataset in April 2020), model 4 indicates an associated decrease in mean gram price of roughly $2.70. Furthermore, this decrease is at the gram, not ounce level, which High Times originally reported the data at (i.e., 28 grams). Converting the gram price gives a decrease of $75.60 per ounce.

Table 17. Multiple Linear Regression Models

	Model 1	Model 2	Model 3	Model 4
Intercept	12.5292	11.9891	13.3257	13.8827
Store License	-0.0058	-0.0059	-0.0056	-0.0046
Time	0.0062	0.0062	0.0082	0.0089
LMCP		1.4172	1.2753	0.3565
CMCP		-0.0356	-0.1608	-0.0784
Distance		0.0007	0.0005	-0.0008
Median Household Income			-0.00002	-0.00004
Possession arrests				0.03412
Sale/production arrests				0.00170
R squared	0.0838	0.088	0.085	0.09620
Adjusted R squared	0.0803	0.0792	0.0742	0.0808
No. Observations	526	526	513	479

A negative association exists between active Coloradoan store licenses and illicit cannabis prices in states bordering Colorado. Importantly, such associations remained

---

[38] Recall, as discussed in section 3.3.6 of the Methodology chapter, multiple models were created to ensure effect size and direction remained consistent when excluding observations due to missing data from certain variables.

present despite including several potential confounder variables. Furthermore, this association occurred between a direct measure of Coloradoan legal cannabis sale (i.e., operating stores) and price, thus offering further evidence of a possible link between the two.

7.3   *Limits*

As discussed in section 3.3.2 of the methodology chapter, these statistical models hold several limitations, a main issue being High Times constituting a non-random sample. As the data comes from a non-random sample, it makes inference impossible as it is unclear whether the High Times prices are representative of the cannabis price population (Spiegelhalter, 2020; Witte and Witte, 2016).

Nonetheless, the common assumptions of linear regression (for both the segmented and multiple linear regressions) for each model were checked (Osborne and Waters, 2002; Tarling, 2009). In all models, plotting the residuals versus fitted showed a linear relationship. A Durbin-Watson test accepted the null hypothesis of no autocorrelation for all models (Durbin and Watson, 1950; Wagner et al., 2002). Observing Q-Q plots indicates most submissions visually followed a normal distribution though with heavier tails on both ends. However, considering the central limit theorem, the samples for each model are large enough that the normality assumption would not be violated regardless (Witte and Witte, 2016). Observing a residuals versus leverage plot for all models showed no value as having a high influence in all models.

Observing the residuals versus fitted plot indicated violation of the constant variance assumption for the multiple linear regression models as systematic differences in residual variance occurred. Attempts to log transform values occurred, however heteroskedasticity remained. Upon closer inspection of the residual variance, it (primarily) changed systematically between cases occurring before and after legal sale began. Some clear patterns also emerged when looking at Cook's distance for each case by certain time periods. Thus, such systematic changes in residual variance may reflect the influence of Coloradoan legal sale beginning, and price submissions occurring, at different times. The residuals versus fitted plot did not indicate a clear violation of the constant variance assumption in the interrupted time series model.

Some specific limitations regarding the independent variable data sources for the multiple linear regression exist. Firstly, two variables lacked data for certain periods and/or city locations (at the time of data collection and analysis). Regarding arrest data, agency response rate was imperfect, as certain cities missed one or more years, while others remain entirely unrepresented and no arrest data existed for the early 2020 months (in total, 34 cases were missing). Likewise, the county median household income data from the US census did not have data for the early 2020 months at time of analysis (13 cases missing). As discussed, listwise deletion was used to handle these missing observations, (i.e., if one case is missing then the entire observation is excluded from the model) and multiple models were constructed to ensure consistent results despite missing data (Allison, 2001; Bryman, 2004b). Also of note, the arrest and median income data are reported yearly, rather than monthly (as High Time does).

Other limitations of High Times as a data source also exist, which section 3.3.2 (of the Methodology chapter) details, though an important limitation to keep in mind is that the present analysis can only indicate associations, as High Times comes from a convenience sample (Battaglia, 2008; Spiegelhalter, 2020). However, a key limitation regarding the price analysis not previously discussed is that it gives only a retail level perspective as prices came from consumer transactions, not supplier to supplier transactions. Thus, the associations identified here can only represent the retail illicit market, i.e., suppliers who sell to consumers. The retail level focus of this analysis means potential diversion (and subsequent consequences) occurring from large-scale cannabis producers or distributors remains unexplored. [39] Secondly, by definition, this price focused analysis ignores the potential role of other factors which may influence cannabis diversion. However, this latter point is elaborated upon when interpreting both the qualitative and quantitative analyses in the discussion chapter of this thesis.

Certain limits exist from the simple lack of data regarding key factors, such as a direct measure (i.e., at the city or at least, the county level) of cannabis usage rates and potency. However, in the following discussion section, reference to available sources

---

[39] Arguably however, as retail consumers and markets monetarily fuel the illicit drug trade, any substantial changes in the retail illicit cannabis market may reverberate upwards.

regarding cannabis usage rates and potency are considered in the context of the present analysis.

7.4   Discussion

Overall, these identified associations are in keeping with a link between Coloradoan legal sale and prices decreasing in neighbouring jurisdictions. Further evidence of a link comes when considering the congruence between the interrupted time series analysis (ITS) and the active legal license data. The ITS model indicated a large sudden price drop occurring in the first quarter of 2014. The first quarter also contained the single biggest increase in active retail licenses, from 0 to 181, of which, 147 occurred in the first month of legal sale. Contrastingly, the ITS analysis indicated onwards the price trend decreasing relatively slower per quarter, which reflects the gradual increase in active licenses (roughly 18 stores per quarter, excluding the first quarter), meaning that the post-legal sale trends from the ITS aligns with the active retail store license data.

Likewise, ancillary evidence of this link also emerges when considering again the price trends in Figure 15 between the High Times and CDOR data (Colorado Department of Revenue, 2021). Specifically, legal prices showed similar patterns to illicit prices in states bordering Colorado, particularly from 2017 onwards. Thus, the present analysis supports the possibility of Coloradoan legal sale being associated with the observed illicit cannabis price decreases in its neighbours. If the former is true, a few potential explanations exist for these price decreases.

Firstly, one possible explanation is supplier-based legal cannabis diversion. A commercialised legal market may hypothetically see illicit cannabis prices lower enough that diversion into non-legal jurisdictions becomes profitable (Caulkins, 2010; Caulkins and Bond, 2012; Caulkins and Kilmer, 2016; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019). Hence, the Coloradoan legal market may have inadvertently created opportunity for individuals to profit off diverting legal cannabis products (Cornish and Clarke, 2017, 2014; Wortley, 2014). Importantly, decreased prices may then reflect local illicit cannabis suppliers (in the neighbouring states) lowering their own prices to compete against diverted legal cannabis and maintain local demand (Gale, 1955; Mankiw, 2011).

Alternatively, or jointly, price changes in nearby jurisdictions may stem from consumer-based legal cannabis diversion. If a proportion of residents in bordering jurisdictions felt incentivised to supply themselves through Coloradoan legal stores (from price or another factor such as cannabis quality or service), local illicit suppliers may (as with supplier-based diversion) have to lower their own prices to maintain demand. Consumer-based diversion from Colorado is clearly possible when considering literature on cannabis drug tourism (i.e., individuals purposely travelling to locales with legal sale to buy legal cannabis). Several studies have examined drug tourism occurring in the Netherlands (Caulkins et al., 2015; Grobe and Lüer, 2011; van Loon and Rouwendal, 2017). More recently, a study identified potential non-state resident legal cannabis purchases in several United States jurisdictions, though it does not consider Colorado (Hansen et al., 2020).

Interestingly, consumer-based diversion becomes more congruent with the bivariate analysis of distance and price (disregarding said discussed methodological issues with the distance variable) seen in Figure 17. If consumers who previously relied on trafficked cannabis from Colorado started self-supplying directly through legal Coloradoan stores, traffickers would lose their customer base, hence, a previous illicit cannabis trafficking trend present during the pre-legal sale period disappearing. Likewise, the post-legal sale period showing no clear gradient at the city level may reflect consumer-based diversion as factors associated with prices increasing across distance, applies to suppliers (as prices may increase to compensate for added risk and travel costs) not consumers (Berlusconi et al., 2017; Giommoni et al., 2017; Reuter, 2014).

Of course, these possibilities may heavily rely on legal market prices lowering enough to satisfy a profit goal for suppliers and/or consumers (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014). Thus, for suppliers, legal prices would need to lower enough to make trafficking profitable. While for consumers, lower legal prices may play a role in incentivising them to partake in drug tourism. As seen in Plot A in Figure 15, Coloradoan legal prices did lower during the examined timeline which supports the above discussed possibilities regarding legal cannabis diversion.

The data also leaves open the possibility of legal sale inadvertently creating opportunity to profit off trafficking out illicit cannabis or offering consumers in bordering jurisdictions cheaper illicit prices. As mentioned, Coloradoan prices in its post-legal sale

period is roughly 20% lower than its neighbours. The price decrease may conceivably stem from illicit cannabis suppliers having to drop prices to compete with their local legal cannabis market (which was a supplier decision-making process qualitatively explored and investigated in the Reddit analysis chapters). Thus, the same underlying rational motives discussed for legal cannabis-diversion apply to illicit Coloradoan cannabis, as arbitrage opportunity existed and potentially increased, in the post-legal sale period. Recall that the difference between mean prices of Colorado and its neighbours increased from $0.99 to $2.08 post-legal sale.

Of course, an alternative possibility is that some other factor or trend affecting illicit cannabis prices coincidently aligned with Coloradoan legal sale. The researcher attempted all feasible methods to appropriately consider other potential influences in the statistical models. The interrupted time series analysis controlled for seasonal effects (Bernal et al., 2017; Hategeka et al., 2020). Similarly, the multiple linear regression controlled for likely confounders (Aiken, 2004; Tarling, 2009; Uyanık and Güler, 2013), which were chosen due to their theoretical, logical, and/or empirical relevance to illicit drug prices.

However, as mentioned, the multiple linear regression model lacks two key factors relating to illicit cannabis prices. Specifically, decreases in potency or demand may be (at least partly) responsible for the illicit price decreases seen in the present research (Caulkins, 2007; Doyle, 2016; Gale, 1955; Mankiw, 2011). While appropriate measures of demand and potency could not be included in the model, discussion can consider other relevant available data and literature regarding both factors at a contextual level, so as not to exclude these factors entirely from the present research.

Figure 25 (see Appendix B) plots NSDUH data (the NSDUH data, provided by SAMHDA, was detailed in section 3.3.6 of the methodology chapter) on reported past-month cannabis usage, for those aged twelve and over, at the state and (relevant) substate locations, and for jurisdictions bordering Colorado in Plot A and B respectively. Usage showed increases following Coloradoan legalisation and legal sale, while available literature and research on illicit cannabis potency in the United States indicates THC levels generally increasing between 2006 to 2019 (Chandra et al., 2019a, 2019b; Potency Monitoring Program, 2019). Meaning, both indicate (all other factors being equal) illicit prices increasing. The economic principles of supply and demand dictate prices would have theoretically increased as demand rose (Gale, 1955; Mankiw, 2011). Likewise,

rising potency indicates increasing illicit cannabis prices (Caulkins, 2007). Thus, the decreased prices seen for Coloradoan neighbours appears, when considering the limited information on usage and potency, less likely to have stemmed from these two factors.

Lastly, it is always possible that some unknown, and difficult to identify, factor may have affected the examined prices despite efforts by the researcher to control, or consider, all possible influences within their means as a sole PHD researcher. For example, a new unknown source of cheap illicit cannabis for states bordering Colorado may have emerged during the examined period.

While this thesis focuses on illicit market responses and trafficking, the present findings also offer an implication for cannabis usage. Recall, the price elasticity of demand describes a relationship where drug usage increases if prices lower, and vice versa (Caulkins, 2007; Caulkins and Reuter, 2010; Gallet, 2014; Kilmer et al., 2015; Pacula and Lundberg, 2013). Thus, as the identified associations indicate prices decreasing in jurisdictions bordering Colorado, by extension, this also indicates the possibility of an association with increased usage.

Interestingly, the NSDUH usage data supports this, particularly, the sub-state bi-annual data in Figure 25 shows clear increases in use from 2012-2014 onwards (recall, substate-estimates are reported bi-annually). Hao and Cowan (2020) does examine NSDUH data at the state level, finding usage increased relatively more in jurisdictions bordering Washington and Colorado than other states. However, their analysis considered usage rates before either state implemented legal sale (i.e., where only use, possession and growing were occurring legally) as Hao and Cowan (2020) compared usage rates from 2009-2012 and 2013-2014.

7.5   *Summary*

In conclusion, statistically modelling the High Times data for jurisdictions bordering Colorado showed clear associations between Coloradoan legal sale and decreased prices. Furthermore, ancillary data from the CDOR supports this possibility as illicit prices showed similarities between it and the High Times data (Colorado Department of Revenue, 2021). These associations are in keeping with the possibility that legal sale may have influenced, in some way, the illicit market in these bordering jurisdictions. Some

possible explanations for these associations include legal cannabis diversion (by consumer or supplier) and/or trafficking of cheaper illicit cannabis.

Chapter 8: Discussion

This chapter first discusses how the present research contributes towards answering the original research questions, alongside considering how it builds upon or adds to the current literature. Furthermore, discussion on how the quantitative and qualitative findings relate takes place. Second, the chapter discusses the implications and relevance of the research findings for locales considering, or currently employing, cannabis legalisation. Lastly, methodological reflections are discussed before concluding.

8.1   Research Questions

Key findings relating to each question are summarised alongside consideration of how the present research adds, expands, and/or relates to the wider literature. Further, in keeping with a mixed methods convergent parallel-databases design, discussion jointly considers the quantitative and qualitive findings together, to gain a more comprehensive understanding of the potential consequences legalisation poses to illicit cannabis markets (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008; Yvonne Feilzer, 2010). The qualitative and quantitative analyses demonstrate congruence and convergence in two key aspects (Creswell and Clark, 2017). Specifically, Reddit user discussions of price alongside cross-border cannabis trafficking, and the High Times price analysis.

8.1.1   Consumer Responses

1.   What influences a cannabis consumer to use the legal or illicit cannabis market?

Thematically analysing Reddit user forum conversations explored how cannabis consumers decided to continue illicit market use or cease in favour of using the legal market. Importantly, several potential factors underpinning the consumer market-choice decision emerged. Cannabis price and quality were key considerations for both choices, alongside unique service factors for using the illicit (accessibility, confidentiality and the consumer-dealer relationship) and legal (convenience, consistency, selection and safety) markets. One hope for legalisation was an ability to shrink or remove the illicit market, which at its crux, relies on legal markets encroaching upon illicit demand (Hall et al.,

2019). Therefore, the Reddit consumer analysis qualitatively examined how, and why, legalisation can take demand away from the illicit market. Specifically, a legal market may incentivise users to desist illicit market use through better satisfying their personally desired goals and market characteristics (as a cannabis purchaser and user) than illicit suppliers (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014).

As of writing, no other published academic study has qualitatively explored the consumer market-choice decision as this thesis has. Other studies have explored illicit demand shifting to legal markets, though using different, and quantitative, methods. The Reddit consumer analysis is distinct to, and expands on, the current literature regarding cannabis user responses to legalisation.

Firstly, several studies identified, and examined, quantitative indicators of illicit consumers turning to commercial legal sale (Bahji and Stephenson, 2019; Burgard et al., 2019; Caulkins et al., 2019; Caulkins and Kilborn, 2019; Goodhart and Ashworth, 2019; Kilmer et al., 2019; Meinhofer and Rubli, 2021; Rotermann, 2020). Therefore, the Reddit analysis offers a qualitative counterpart to these studies which offers explanations for why exactly a consumer may choose the legal over the illicit market.

Secondly, a few studies specifically examined the market-choice decision. However, these studies differed to the Reddit consumer analysis by conducting hypothetical decision-based scenarios rather than exploring actual individual accounts of real consumer experiences. Amlung et al (2019) and Amlung and Mackillop (2019) applied a marijuana purchase task (MPT) which asked their participants to state how many grams of illicit and/or legal cannabis they would hypothetically buy at differing prices. Zhu et al (2020) employed a best-worst scaling experiment in which their participants ranked the most, and least, important attributes of a legal cannabis purchase in a hypothetical scenario. As the analyses in these studies were quantitative, the Reddit consumer analysis offers relatively deeper qualitative elaboration on the reasoning underlying the consumer market-choice decision.

Amlung et al (2019) and Amlung and Mackillop (2019) similarly showed that cheaper, comparable, or slightly more expensive legal prices may encourage users to purchase legal cannabis over illicit. However, analysing Reddit identified several factors besides price that influenced the consumer market-choice decision, alongside demonstrating how and why non-price factors push cannabis users towards legal or illicit

suppliers. Furthermore, analysing Reddit explored underlying reasons for why consumers may purchase cannabis from the more expensive market.

Zhu et al (2020) quantitatively considered a far wider range of factors of which several overlap with the Reddit analysis (such as price, characteristics of cannabis strength, and distance). However, Zhu et al (2020) focused solely on consumer decisions regarding only legal stores, while the Reddit analysis considered both illicit and legal purchasers. Further, as Zhu et al (2020) point out, their study only indicated whether a factor was relatively important compared to others, while how said factor influenced decisions or the direction of any identified associations remained unexplored (Zhu et al., 2020). For example, Zhu et al (2020) identified THC as relatively important but could not identify whether consumers desired higher or lower levels. Contrastingly, while the Reddit analysis contained consumer comments describing desiring higher THC, another more nuanced perspective also emerged which involved desisted consumers preferring to have more accurate knowledge of THC content so they can buy product which suited their preferences.

Fataar et al (2021) surveyed consumer perceptions of the illicit and legal cannabis markets. These perceptions all reflected certain thematic themes which emerged from the Reddit analysis, specifically, perceptions of cannabis quality, price, convenience, safety of use and safety of purchasing. [40] However, Fataar et al (2021) could not (as they pointed out themselves) examine whether certain perceptions were associated with actual consumer purchasing behaviours. The Reddit analysis, contrastingly, directly linked consumer perceptions of cannabis market characteristics to their end market-choice decision. Further, the Reddit analysis identifies other potentially important perceptions (not surveyed) such as consistency, product selection, confidentiality and the consumer-dealer relationship.

Reddit user conversations also offers empirical support for certain discussions in the literature. For instance, the selection subtheme reinforces discussions of the legal market threatening the illicit market through producing more varied cannabis products (Giommoni et al., 2020a; Kilmer et al., 2010a). Likewise, the Reddit analysis, and other research (Amlung et al., 2019; Amlung and MacKillop, 2019) reinforce discussions that

---

[40] These perceptions were measured categorically, for example, respondents reported legal cannabis as more expensive, less expensive, or no difference (Fataar et al., 2021).

competitively priced legal cannabis could challenge or undercut illicitly produced cannabis (Kilmer et al., 2010b; Kleiman, 2017).

As price emerged as an important subtheme during the consumer Reddit analysis, there are clear opportunities to consider whether the Reddit data and High Times price data demonstrate congruence (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008). Firstly, both indicate contrasting illicit cannabis price changes in legalised locales. The descriptive statistics analysis showed differing underlying price trends across time for different states. [41] Consumer comments discussed legal cannabis markets as lowering or not affecting illicit cannabis prices. Potential explanations for these conflicting viewpoints were considered in previous chapters, for instance, the length that legal sale is operational, different regulation policies, state specific factors, differing illicit market contexts (in terms of how extensive and competitive the illicit market is), and methodological issues offer plausible explanations (as discussed in sections 4.2.1, 6.3.1, 6.3.3, 6.3.4).

Secondly, congruence also exists in indicating that the Coloradoan illicit cannabis market may have been more vulnerable to legal market competition than the other examined legalised states (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008). Interpreting the differing price levels seen for Colorado, Washington, Oregon, and California, with the Reddit findings in mind, indicates potentially differing situations for consumers. Colorado had far higher average prices ($11.37) in the previous 4 years before legal sale than Washington ($9.55), Oregon ($7.61) and California ($9.86). [42] Hence, Coloradoan legal prices could hypothetically be relatively higher (than Washington, Oregon and California), whilst still incentivising price conscious consumers towards desisting illicit market use (Cornish and Clarke, 2017).

Further interpretation of the qualitative and quantitative data together is possible from considering consumer comments which explicitly discussed prices for the legalised states that were analysed and discussed in the descriptive statistics analysis chapter. Several points of congruence emerge where the descriptions from Reddit consumer comments aligned with the price trends seen for specific states.

---

[41] For instance, referring to post-legal sale periods, Colorado showed a clear decreasing trend while the Washington data showed the opposite.

[42] See Table 12.

Six comments from the Reddit threads made in 2018 discussed Coloradoan legal prices as becoming cheaper and consequently illicit prices as lowering. Therefore, these comments align with the underlying lowering price trend seen in Figure 13 during the post-legal sale period for Colorado. For Washington, a 2014 comment discussed legal prices as influencing lowered illicit rates, which is in keeping with the initial price drop seen in the trend line during the latter half of 2014 in Figure 19. Further, three 2016 comments discussed the legal market as not impacting illicit prices, which is in keeping with the rising price trend seen in Figure 19. Ten price comments discussed Californian legal sale implementation as not affecting illicit prices in 2018. Therefore, these comments align with the Californian data in Figure 24 which similarly indicated no change, as prices in 2018 are in keeping with the pre-legal sale price trends.

However, discrepancies also emerged for Colorado, Washington and Oregon, where comments contradicted the underlying price trends. Four Coloradoan comments in 2014 indicated illicit prices as unaffected by legal prices. However, as discussed above, the post-legal period trendline in Figure 13 shows a clear price drop and continuing decline in 2014. Nine comments between the 2016 and 2018 Reddit threads indicated the Washington legal market prices as matching, undercutting, and/or pushing down illicit prices. These accounts indicate the Washington illicit price trend should have lowered in these periods, however, Figure 19 shows a clear rising trend. For Oregon, eight comments in 2018 discussed legal prices lowering to, or undercutting, illicit prices. However, in Figure 21, the data shows a sudden increase in higher price submissions from late 2017 and continuing during 2018. Interestingly, these Oregonian Reddit accounts align with the OLCC (Oregon Liquor Control Commission) data discussed in section 6.3.4, where median legal gram prices became lower than median High Times prices from late 2017 (OLCC, 2021, 2019).

Discrepancies between two independent datasets is not unexpected in a mixed methods approach, nonetheless, they should be addressed and suitably explained (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008; Yvonne Feilzer, 2010). While the above discrepancies show the consumer comments and price trends did not always align, arguably, they do not outright contradict each other. Colorado, Washington and Oregon all showed a range of prices in any given year, which is in keeping with the possibility of truthful consumer descriptions of illicit cannabis price that differ from the

underlying price trends seen in the High Times data. Therefore, it is incorrect to say these Reddit accounts necessarily contradict the examined price data.

For example, consider again the nine Washington comments indicating illicit cannabis prices were decreasing despite the clear rising price trend visible in Figure 19. However, also clearly visible in Figure 19 are several relatively low-price submissions occurring in 2016 and 2018. Therefore, the price data is still in keeping with the possibility of a cannabis consumer in Washington experiencing, and observing, low-priced illicit cannabis despite it contrasting against the underlying rising trend.

The Reddit analysis also has links with wider contextual factors in Oregon, California and Washington, that support their illicit markets as being more competitive than the Coloradoan illicit market. Reddit posts emphasised generally the illicit-legal market competition, where suppliers experienced difficulty when legal providers offered relatively superior products and services (alongside cheaper prices). Considering that California and Oregon are historically known to have extensive and comprehensive illicit cannabis markets, they may generally constitute a stronger commercial threat for their legal counterparts than the Coloradoan illicit market (DEA, 2018; Hecht, 2014; Hurley et al., 2010; Johnson, 2019, 2017; Kilmer et al., 2010a; Lee, 2012; OLCC, 2021; Silvaggio, 2018; Weisheit, 2013).

Further links exist when considering the subthemes of accessibility and convenience. Poor legal market accessibility disincentivised Reddit users from buying legal cannabis products while convenient access did the opposite. California has had a particularly low quantity of stores per person and a relatively high number of counties prohibiting legal sale (Dorbian, 2019; Schroyer and McVey, 2019; Unger et al., 2020). Similarly, Washington legalisation policy and circumstances indicate hindered accessibility in the past. Washington prohibits personal growing entirely, initially restricting total producible legal cannabis, and capping the total amount of available business licenses (Hall et al., 2019; Lancione et al., 2020). Furthermore, the merging of the medical (which potentially accounted for a third of total cannabis supply in Washington) and recreational cannabis markets together, without appropriate raising of license caps, made obtaining licenses even more competitive (Hunt and Pacula, 2017; Kleiman et al., 2015; O'Connor et al., 2016; WSLCB, 2016a, 2015).

2.   How do illicit cannabis suppliers respond to recreational cannabis legalisation?

Supplier comments discussed varying degrees of conflict when operating amidst legal markets. Conflict occurred for illicit suppliers when the legal market threatened to encroach upon their consumer demand and/or offered increasingly lower prices. Consequently, the above created a situational circumstance where suppliers may struggle to maintain consumer demand and/or must accept lower profit margins if continuing with their pre-legal sale modus operandi. Suppliers had to decide whether continuing their pre-legal sale modus operandi still satisfied their profit-oriented goal with this new situational change, i.e., a competing legal market (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014).

Three supplier choices emerged. The habituation decision occurred when profit satisficing remained possible with previous methods, required minor adjustments (such as lowering prices, improving quality, improving service, and/or lowering their own profit goal aspiration level), or the legal market posed little to no threat. If profit satisficing became impossible, the supplier either chose desistance or adaptation. For the former, some willingly joined the legal market as they considered it more worthwhile to operate legally than working illicitly. While the adaptation choice entailed the most variety (targeting the under-age market, selling other illicit drugs or cross-border trafficking), a unifying rationale motive behind these responses involved evading direct competition with the legal market which allowed them to continue making worthwhile profit. Thus, the analysis demonstrates how a legal cannabis market may affect the criminal involvement decisions of illicit cannabis suppliers through affecting the reward (i.e., the profit), opportunity, and feasibility of illicit cannabis sale (Cornish and Clarke, 2017; Wortley, 2014)

Though supplier responses differed, such variation was not random but reflected them responding rationally to different situational experiences with the legal market, which may predispose certain criminal involvement decisions to be, or appear, more or less feasible (Cornish and Clarke, 2014; Kubrin et al., 2009; Leclerc and Wortley, 2014). For instance, hypothetically, a highly competitive legal market (i.e., containing superior cannabis prices, quality and service) may discourage habituation while making desistance

or adaptation more necessary or appealing. Likewise, an uncompetitive legal market may give little reason for a supplier to drastically change, or end, their illicit methods as their pre-legal sale modus operandi still reaps satisfactory profits.

Therefore, opposing supplier choices may be better understood if considering the different environmental influences (in this case, the commercial competitiveness of the legal market) they are experiencing (Gigerenzer and Selten, 2002; Lockton, 2012; Selten, 2002; Simon, 1978, 1955). Of course, individual differences alongside capabilities would also play an important role in shaping how the supplier interprets and assesses relevant information (Selten, 2002). Unfortunately, the Reddit analysis was limited in providing more personal and demographic characteristics of cannabis users to empirically consider the influence of individual differences.

As in the previous section, supplier discussions of illicit and legal cannabis price offers opportunities to interpret both the qualitative and quantitative data together (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008). The supplier price subtheme and the High Times data show congruence in indicating contrasting illicit cannabis price changes in legalised locales (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008). Supplier comments discussed or indicated having to, or not needing to, lower their own illicit prices to compete against the legal market, while descriptive statistics showed contrasting price trends for different legalised jurisdictions. [43]

Both the price and Reddit findings also demonstrate congruence in indicating Coloradoan illicit cannabis suppliers may have faced key decisions (such as whether to lower their own prices, to adapt their modus operandi or desist) against a relatively more expensive legal market than if operating in Washington, Oregon or California (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008). The available price data showed Coloradoan illicit prices were generally higher in the pre-legal sale period than in Washington, California and Oregon (as discussed in the previous section). Thus, legal

---

[43] Possible explanations for contrasting prices, previously discussed, include length of legal sale, differing regulation policies, state specific factors, the illicit market context (i.e., its competitiveness and extensiveness) and methodological issues (see sections 5.2.1, 6.3.1, 6.3.3, and 6.3.4)

cannabis prices in Colorado may theoretically have been relatively higher, whilst still undercutting or challenging illicit supplier rates established before legal sale.

Further interpretation of both datasets together is possible from considering supplier comments which explicitly discussed illicit prices in Colorado, Washington, Oregon and California. Relevant supplier price comments split into three general categories, two indicated lowered illicit and/or legal prices while the last discussed supplier prices as unaffected. Specifically, the former two discussed suppliers having to lower their own prices to remain competitive or that legal prices were low enough that competing on price was infeasible or unworthwhile. Congruence exists where supplier price comments aligned with the price trends seen in the descriptive statistics analysis chapter.

Twelve comments, across all the Reddit threads, indicated illicit cannabis suppliers in Colorado as having to lower their own prices, or cease their operations due to lowering legal prices. Therefore, these comments align with the decreasing price trend seen for Colorado in Figure 13. Two comments in 2014 discussed suppliers in Washington having to lower their own prices which aligns with the initial price drop seen for 2014 in Figure 19. One comment in 2016 discussed Washington illicit prices as raising steadily which aligns with the rising price trend seen in Figure 19. Further, four comments in 2016 discussed suppliers having no need to lower their own illicit prices, which is in keeping with the rising trendline seen for Washington.

For Oregon, two comments in 2016 discussed suppliers not having to lower their own prices and while this differs to the rising trend in Figure 21, the Oregonian data is unique in showing prices sharply increasing from late 2017. [44] If considering only the prices in 2016 for Oregon, a steady trend becomes clear where prices remained consistent (a trend that was also comparable to the preceding year) which aligns with illicit suppliers not having to lower their prices. In California, two supplier comments (in 2018) discussed the newly legal market having no influence on their illicit prices. Thus, this aligns with the price data in Figure 24 which showed prices in the post-legal sale period were in keeping with previous pre-legal sale trends.

However, discrepancies also emerged where comments contradicted the underlying price trends. Two Coloradoan supplier comments in 2014 and two in 2016

---

[44] Comparable to a right angle.

discussed not having to lower their own prices which contrasts against the initial price drop and lowering trend seen in Figure 13. For Washington, one 2015 comment discussed suppliers not having to lower their own illicit prices, which contrasts against the clear price trend drop seen in 2015 (when compared with the pre-legal sale price trend). For Oregon, three 2018 comments discussed an inability to compete against legal prices, while two discussed having to lower their own illicit prices which contrasts against the sudden rise in prices seen in that year. [45]

While these discrepancies demonstrate the Reddit supplier price comments did not always align with the price trends seen in the High Times data, it is incorrect to say they outright contradict one another. Each state held price submissions which did not follow the underlying trend. Therefore, the price data is in keeping with the possibility of supplier comments describing and indicating illicit cannabis price changes which contrast against the underlying price trends seen in the descriptive statistics chapter. For instance, consider again the four Coloradoan comments indicating illicit cannabis prices as being unaffected in 2014 and 2016 despite the clear price rise visible in Figure 13. However, Figure 13 shows several price submissions in these years that remained comparable to pre-legal sale prices. Hence, the price data is in keeping with the possibility of some Coloradoan illicit cannabis suppliers continuing to sell at pre-legal sale prices.

There is a dearth of relevant empirical academic literature regarding local illicit cannabis supplier perspectives on how legalisation affects their modus operandi. [46] However, analysis offers empirical support for hypothetical discussions in the literature for how legalisation may harm illicit markets (Hall et al., 2019; Kilmer et al., 2010b, 2010a; Kleiman, 2017; Kleiman and Ziskind, 2019). Analysis supports the overall argument that harming the illicit market relies on its ability to take demand away from illicit suppliers. More specifically, that affordable legal prices and superior quality are key factors which may threaten illicit cannabis supplier operations through attracting away their customers. Furthermore, the Reddit supplier analysis highlights the potential importance of legal market service (i.e., greater product consistency, selection, safety and

---

[45] Like the consumer comments, these supplier comments better align with the OLCC data discussed in section 6.3.4, where in late 2017 median, legal gram prices became lower than median High Times prices.

[46] Note, discussion here focuses on illicit suppliers who remained within the legalised locale (those involved in cross-border cannabis movement are discussed in the following section).

convenient access) characteristics in further jeopardising illicit cannabis supplier operations.

Thus, the present research offers unique qualitative insight into how legalisation may impact the modus operandi of local (i.e., those operating in the legalised locale) illicit cannabis suppliers. More specifically, the analysis explored how legalisation may displace illicit suppliers into entering the under-age market and different illicit drug markets. Likewise, it explored how legalisation may influence illicit cannabis suppliers to cease illicit operations and potentially enter the legal cannabis market itself. Lastly, it examined illicit cannabis supplier views on how legalisation may affect law enforcement risk and how this may encourage continued illicit cannabis sale.

8.1.3   Trafficking Flows

3. Do wider illicit cannabis trafficking flows change in response to recreational cannabis legalisation?

Analysing Reddit data contributed to answering the third research question of this thesis in two ways. Firstly, certain supplier comments directly attributed legalisation as their reason for turning to, and/or benefiting from, cannabis trafficking. Secondly, and more importantly, the entire Reddit analysis (including consumer and supplier comments) qualitatively elaborated on the situational contexts which may theoretically incentivise cross-border cannabis movement from a legalised locale (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014). Specifically, if a legal market lowers local illicit prices, alongside taking illicit demand, local sale may become less profitable and feasible for suppliers. Thus, a supplier may rationally assess trafficking outwards as becoming a superior option for satisfying their profit goal. Furthermore, lower local illicit prices may create opportunity for, and incentivise, suppliers to traffic cannabis out from the legal state to capitalise on potential arbitrage between more expensive illicit markets in non-legal locales.

Analysing High Times data showed price differences and changes coinciding with legal sale implementation. Descriptive statistics showed states bordering legalised jurisdictions had lower prices (on average) than non-bordering. Upon closer inspection of legal states and their neighbours, only the Coloradoan subregional group showed

distinct signs of price drops coinciding with legal sale starting. Methodological issues relating to the High Times dataset, the geographical positioning of relevant jurisdictions, and legal sale start dates limited the amount of available data for other bordering groups (which section 6.3.1 of the descriptive statistics chapter details). Consequently, it was not reasonable to make any further conclusion regarding the descriptive stats of these other groups nor was their data suitable for more sophisticated statistical modelling.

Therefore, further statistical analysis focused on states bordering Colorado. An interrupted time series model showed associations between an initial gram price drop ($1.34) in the first quarter of 2014, and subsequent quarterly 10-cent drops in price (as opposed to 3-cent increases before legal sale) once retail selling began. While a multiple linear regression model demonstrated two key points. Firstly, a negative association between the observed gram price decreases and number of Coloradoan active retail store licenses, and secondly, that the former association persisted whilst controlling for other potential influential factors in the model.

When considering how cheap legal cannabis can hypothetically be sold at when mass-produced under a legalised setting, that Coloradoan legal prices did decrease over the examined period (as examined in section 6.3.6), and that the illicit price decreases coincided neatly with Coloradoan legal sale and their number of stores, the price analysis supports the possibility of Coloradoan legal sale influencing the High Times prices in states that bordered Colorado (Caulkins, 2010; Caulkins and Bond, 2012; Caulkins and Kilmer, 2016; Colorado Department of Revenue, 2021; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019).

Several possibilities may explain this cross-border influence. Individuals may have capitalised off the opportunity created by lowering legal prices through diverting legal products into neighbouring jurisdictions. Equally, lowering legal prices may have depressed Coloradoan illicit prices more than its neighbours and consequently increased the reward from trafficking illicitly produced cannabis. Both scenarios entail increased competition, and potentially cheaper cannabis, from Colorado entering its neighbours which may depress local illicit prices.

Alternatively (or additionally), consumer-based diversion may also explain price changes as local suppliers (i.e., those operating in states bordering Colorado) may potentially lose demand from local cannabis users travelling to Colorado to purchase legal cannabis (Caulkins et al., 2015; Grobe and Lüer, 2011; Hansen et al., 2020; van Loon and

206

Rouwendal, 2017). Besides price, consumers from bordering jurisdictions may feasibly prefer legal market products and service to their local illicit market. Suppliers in bordering jurisdictions may potentially have to lower their own illicit prices to help maintain local demand (Gale, 1955; Mankiw, 2011).

Regardless, these price findings are all in keeping with Coloradoan legal sale potentially influencing illicit markets in their bordering states. Of course, it is always possible another factor influenced the illicit price decreases. However, attempts to control for other likely confounders occurred in the multiple linear regression model, while the interrupted time series model accounted for seasonal effects (Aiken, 2004; Bernal et al., 2017; Hategeka et al., 2020; Tarling, 2009; Uyanık and Güler, 2013).

Therefore, when considering the quantitative and qualitative analyses together, both indicate the possibility of recreational cannabis legalisation influencing wider trafficking flows. Analysing prices identified associations which indicated potential instances of cross-border cannabis movement, from Colorado into its neighbours, coinciding with legal sale beginning, while Reddit user comments offered qualitative explanations for why legalisation may encourage cross-border cannabis movement. Further, certain supplier comments directly discussed, and attributed to, legalisation as the reason for trafficking cannabis.

The quantitative and qualitative findings present an opportunity to consider whether the rational decision-making process explored for suppliers aligns with the illicit prices seen, specifically for Colorado and its immediate neighbours. Two areas are of interest, firstly, whether Coloradoan illicit prices reflected the possibility that local suppliers would have hypothetically suffered profit losses (thus representing local illicit sale becoming less viable). Secondly, whether arbitrage between Colorado and its neighbouring states increased (thus representing increased incentive to traffic cannabis).

Mean price for the examined Coloradoan cities dropped by 15% (or $2.76) after legal sale, compared to the four years preceding it which supports the possibility of local suppliers suffering profit losses. While Coloradoan prices were always lower than its neighbouring jurisdictions, the difference increased during its post-legal sale period. Considering the entire dataset timescale, this difference was roughly twice as much per gram ($0.99 compared to $2.08). If only considering the four years preceding legal sale the difference is smaller, though still a circa 32% increase ($1.58 to $2.08).

Therefore, as seen above, the profit-motivated supplier rationale seen in Reddit comments are in keeping with the price changes for the Coloradoan subregional group. Lowering illicit prices in Colorado may 'push' suppliers towards cross-border trafficking through jeopardising local illicit sale profitability. Simultaneously, the corresponding increased arbitrage seen in the post-legal sale period between Colorado and its neighbours indicates increased profitability (and incentive) for trafficking Coloradoan cannabis outwards, creating a 'pull' effect towards trafficking. Thus, both a disincentive and incentive may have simultaneously made cross-border trafficking from Colorado a more appealing choice for illicit cannabis suppliers (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014).

Conversely, applying the same logic to Washington, Oregon and California theoretically indicates a weaker, or non-existent, influence from legal sale on suppliers to traffic cannabis in bordering jurisdictions. Mean Oregonian and Californian prices changed little post-legal sale, a roughly 2% decrease for both (specifically a 15 and 21-cent decrease respectively). While Washington prices experienced a larger 10% decrease (a $0.98 difference), it was lower than seen in Colorado. Furthermore, contrasting Colorado, Washington prices increased gradually as its post-legal sale period continued. Thus, local suppliers in these above locales (compared to Colorado) may have had less reason to perceive local illicit sale as less profitable once legal sale started during the examined period. Unfortunately, considering any 'pull' effect from arbitrage between neighbouring jurisdictions for Washington, Oregon, and California risks stretching the data beyond its limits as their neighbours either lacked information for key periods, they shortly began legal sale themselves, or already bordered a state who which had. [47]

Little published empirical academic literature on legal cannabis diversion or how legalisation may influence illicit flows exists. Hansen et al. (2020) does infer cross-border movement by comparing records of legal store sales on the Washington Oregon border, and by examining Google reviews for legalised jurisdictions in the United States. However, Hansen et al (2020) focused solely on consumer-based diversion (Colorado also goes unconsidered), while the present research also considered supplier-based diversion and trafficking. Ward et al (2019) surveyed, and observed, police officers

---

[47] The latter two points were fully discussed in the methodology chapter in section 3.3.4, whilst the first point is covered in section 6.2 of descriptive statistics chapter.

perceiving greater cannabis trafficking from Colorado after legalisation. However, Ward et al (2019) did not explore illicit cannabis supplier perspectives as the present research has.

Meinhofer and Rubli (2021) similarly examined illicit cannabis prices, also finding that legalised jurisdictions in the United States have lower prices. However, a key distinction between the present price analysis and the former study is the focus on prices in the jurisdictions bordering legal sale states alongside its subsequent implications for cross-border cannabis movement. Lastly, the present findings offer support for predictive analysis and hypothetical discussions of trafficking arising from legalisation through diversion (Caulkins and Bond, 2012; Kleiman, 2017).

Overall, the present research is the first to empirically indicate cross-border cannabis movement through quantitatively associating price changes with legal market regulation. Likewise, it is the first to gain qualitative insight, through analysing a social media source, on how legal markets may influence suppliers towards trafficking cannabis.

The present insights into how traffickers may rationally respond to legalisation has implications for the wider literature. Firstly, the present research indicates that alongside law enforcement, geographical proximity, social ties and corruption, legalisation may constitute another factor which illicit drug suppliers may consider in trafficking route decisions (Giommoni et al., 2017; Reuter, 2014; Toth and Mitchell, 2018). Secondly, through potentially creating arbitrage and making local illicit sale less desirable, legalisation (and specifically a competitive legal market) demonstrates the potential to influence the roles that jurisdictions play in wider trafficking networks (Berlusconi et al., 2017; Boivin, 2014, 2013; Paoli et al., 2009; Reuter, 2014). For instance, a legalised locale may become attractive to traffic cannabis from, hence suppliers may choose to produce in and/or export illicit, or divert legal, cannabis from it.

Impacts on trafficking may also possibly manifest if a locale known for playing a large consumer role commercially legalised. Presumably, if local illicit suppliers are struggling to profit, then so may those who traffic cannabis in. Hence, a legalised locale with a competitive legal market may look increasingly less profitable for outside traffickers and incoming external supply may feasibly decrease (Caulkins and Bond, 2012). A possible example of this comes from the United States southwest border with Mexico, where border control cannabis seizures consistently decreased since Colorado (and subsequent jurisdictions) legalised (Bier, 2018).

However, the extent of any illicit cannabis trafficking consequences may be physically restricted for two reasons. Firstly, illicit cannabis markets are understood to be more subregional than global compared to other drug markets such as cocaine or heroin (Boivin, 2014, 2013; Bouchard, 2007; Bouchard and Dion, 2009; UNODC, 2021). Thus, any impacts legalisation poses may be mostly restricted within these subregional markets. Secondly, trafficking costs generally increase the further product moves from its source (Berlusconi et al., 2017; Giommoni et al., 2017; Reuter, 2014; Reuter and Kleiman, 1986). Consequently, trafficking over further distances may, all other factors being equal, increasingly lower any profitability from legal cannabis diversion or from arbitrage created (or increased) by legalisation. However, the more affordable or cheaper (illicit or legal) cannabis is, the further individuals could feasibly profitably divert or traffic it from the legalised state.

8.1.4 Summary

This thesis is the first to empirically apply a mixed methods approach towards exploring the consequences of an operating recreational legal market for illicit cannabis market participants and trafficking flows. Answering the three research questions underpinning this thesis provided a comprehensive examination of the potential consequences legalisation poses to illicit markets. Altogether, they considered the two key components constituting any market, demand (cannabis consumers) and supply (illicit suppliers). Furthermore, they considered how legalisation may impact other locales alongside the legalised jurisdiction itself.

The present research supports the view that legalisation, under the right circumstances, acts as a situational influence which may disrupt illicit drug markets through incentivising and disincentivising criminal involvement decisions of illicit cannabis market participants (Cornish and Clarke, 2017, 2014; Leclerc and Wortley, 2014). Specifically, a situation in which the legal market commercially out-competes its own, and nearby, illicit cannabis markets. Consequently, understanding the wider contextual factors which constitute the illicit-legal market competition becomes vitally important, as they may theoretically vastly alter the consequences legal markets pose to its illicit counterparts (Caulkins and Kilmer, 2016; Hall et al., 2019; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019; Pacula and Smart, 2017).

8.2   Policy Advisement

The following section focuses upon advising jurisdictions considering, or currently employing, legalisation so more informed and appropriate decisions regarding this policy can occur. Specifically, and in keeping with the focus of this thesis, advice centres around the goal of using legalisation to harm illicit markets (Hall et al., 2019; Kleiman and Ziskind, 2019).

8.2.1   Harming the Illicit Market

Overall, this thesis empirically supports the view that a more commercially competitive market may greater threaten local illicit cannabis suppliers than more restrictive approaches. Therefore, if a jurisdiction wishes to prioritise negatively harming their local illicit cannabis market, employing legalisation policy which facilitates the creation and growth of a competitive legal market whilst limiting any unneeded restrictions may prove most effective. Examples of facilitating commercial competitiveness may include (Caulkins and Kilmer, 2016; Hall et al., 2019; Kilmer et al., 2010b; Kleiman, 2017; Kleiman and Ziskind, 2019):

- Permitting all aspects of cannabis supply, i.e., production, distribution and retail sale.
- Granting freedom to private business to operate without serious hinderances, such as having no restrictions on price, potency or type of cannabis (for instance edibles) a legal supplier can sell.
- Apply lower taxation.
- Enforce the change across all locales to avoid subregional jurisdictions banning legal sale.
- Encourage legal market expansion by streamlining the license obtainment process while avoiding strict limits on the total available number of licenses.

Contrastingly, legalisation regimes that only partially legalise cannabis (such as only allowing personal growing), restrict commercial development, employ higher taxes,

and/or place commercial restrictions on sellers (such as limiting product selection), may theoretically limit its ability to substantially harm local illicit markets.

However, it would arguably be narrow-minded to solely advise policy on harming illicit markets without considering any potential drawbacks. Policy makers should be aware of potential unintended consequences, or trade-offs, from tailoring legalisation policy towards harming the illicit market through facilitating a commercially competitive legal market. The following sections discuss two potential dilemmas which jurisdictions may wish to consider in their decisions.

8.2.2   Public Health Dilemma

As several have discussed hypothetically (Carnevale et al., 2017; Caulkins, 2019; Caulkins et al., 2015; Hall et al., 2019; Kleiman, 2017; Pardo, 2014), and as the Reddit analysis empirically demonstrates, both low priced, high quality and accessible legal cannabis may be key for disrupting illicit markets. However, the above simultaneously may risk public health (Hall et al., 2019; Kleiman and Ziskind, 2019). Lower prices and residing close (i.e., accessibility) to legal stores are associated with increased use (Ambrose et al., 2021; Caulkins, 2019; Everson et al., 2019; Kleiman and Ziskind, 2019; Pacula and Lundberg, 2013; Pardo, 2014). More potent cannabis poses increased health risks (Chan et al., 2017; Chandra et al., 2019b; Di Forti et al., 2009; Freeman and Winstock, 2015). Particularly, there are fears of the consequences that a private legal market may pose for heavy cannabis users and problematic users (Caulkins, 2019). Therefore, a clear goal (remove illicit markets) and a concern (public health) regarding legalisation, may theoretically be at direct odds.

As discussed in section 1.5 of the literature review, empirical research into legalisation and cannabis use has identified increases, decreases or no impacts. While research into usage and legalisation shows differing results, no current research indicates seismic changes in cannabis usage. However, caution is important as the consequences of a fully legalised cannabis industry over a longer-term timescale remains speculative at best. Consider, Colorado and Washington (the first jurisdictions to fully implement an entirely privatised cannabis industry in recent times) only implemented operational sale in 2014 (NCSL, 2021). Clearly, much uncertainty exists for what the future holds as these commercial markets fully mature over a longer timescale, as simply put, such maturation

has yet to fully occur. Unfortunately, any widespread serious public health consequences that may arise from legalisation over a longer timescale will likely only materialise once markets fully develop (Dills et al., 2016; Hall et al., 2019). Once such consequences become noticeable however, it may prove extremely difficult to reverse any engrained public health consequences (Caulkins and Kilmer, 2016; Hall et al., 2019). Hence, maintaining a longer-term mindset when considering unintended public health consequences may prove wise.

Commercial advertisement is another important consideration. Marketers and advertisers having full reign to operate freely may directly increase, and lead to, problematic cannabis use by heavy and dependent users, regardless of other factors like price or potency (Caulkins, 2019; Caulkins and Kilmer, 2016; Kilmer, 2019). Directly banning or severely limiting cannabis advertisement may mitigate the above risk, while still leaving legal products accessible for those who desire it without intrusive marketing persuasion (Hall et al., 2019; Kilmer, 2019).

Displacement of illicit cannabis suppliers to other harder illicit drugs (as identified in the adaptation subtheme) highlights another possible way in which a commercialised market may inadvertently threaten public health. Specifically, if these displaced suppliers begin selling other illicit drugs which have worse health consequences than cannabis (Degenhardt and Hall, 2012; Mark et al., 2001).

Of course, commercial cannabis markets may also offer public health benefits. For instance, cannabis use is widespread regardless of legal status (UNODC, 2021). However, at least under legalised regimes, individuals have the option to obtain cannabis from a regulated (and therefore likely safer than unregulated illicit producers) source. Similarly, users can have more accurate knowledge of the psychoactive effects their purchased cannabis creates (Hall et al., 2019; Kleiman and Ziskind, 2019).

Furthermore, major public health benefits may indirectly arise from whether cannabis use substitutes, or complements, alcohol which has far worse public health consequences than cannabis (Guttmannova et al., 2016; Hall et al., 2019; Pacula and Sevigny, 2014; Subbaraman, 2016). Econometric analyses have explored generally whether cannabis substitutes alcohol. Literature reviews have identified more than half of these econometric analyses concluded cannabis substituted alcohol, while the rest either described them as complements or no relationship (Guttmannova et al., 2016; Risso et al., 2020; Subbaraman, 2016).

A few studies focused specifically on whether recreational cannabis legalisation in the United States influenced alcohol usage, with mixed results. Veligati et al (2020) found no evidence of greater alcohol sale decreases in the United States when comparing legalised, and non-legal, states. Calvert and Erickson's (2021) results similarly showed no strong relationship between legalisation and alcohol purchasing (i.e., it neither complemented nor substituted). While Kim et al (2021) found associations between recreational cannabis legalisation and alcohol-cannabis poly use (i.e., using alcohol and cannabis together). More time and research may be needed to gain a more comprehensive understanding of the cannabis-alcohol use relationship under a legalised setting.

An important question is whether a jurisdiction can, to a degree, balance future public health risks without seriously commercially hindering their legal market. Considering the Reddit analysis, one possible mitigation strategy involves leveraging non-price factors. As the Reddit analysis theoretically indicated, a legal market offering a convenient service, large selection and consistent products, may incentivise consumers to desist illicit purchasing without necessarily requiring legal prices to undercut illicit rates (or at least to not require legal prices to considerably undercut illicit prices). Hence, this may potentially mitigate public health risks associated with cheap legal cannabis while still causing the illicit market some harm (Kleiman and Ziskind, 2019; Pacula and Lundberg, 2013; Pardo, 2014).

Several options exist for maintaining prices. For example, setting a strict lower price limit, higher taxation (though if ad valorem taxes are used then legal prices may still lower as production costs drop from improved efficiency), and restricting licenses to non-profit or for-benefit businesses whose goals align with public, over commercial, interests (Caulkins et al., 2015; Caulkins and Kilmer, 2016; Kilmer, 2019; Kleiman and Ziskind, 2019). Generally, a legalisation regime which gives governments more oversight over the entire legal cannabis industry offers more autonomy to implement such changes. However, balancing future public health concerns as described above, may reduce how effectively legalisation harms local illicit markets. Consumers prioritising price above all else in their market-choice decision may feel disincentivised from the legal market if its prices are far higher than illicit rates (Amlung et al., 2019; Amlung and MacKillop, 2019; Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014). Consequently, these consumers may create opportunity for suppliers

willing to adjust their profit goal aspiration level down to sell cannabis cheaply (Cornish and Clarke, 2017; Selten, 2002; Simon, 1978, 1955).

While a non-price factor, cannabis potency presents its own public health risks (Chan et al., 2017; Chandra et al., 2019b; Di Forti et al., 2009; Freeman and Winstock, 2015). One often discussed option involves factoring THC levels in taxation so more potent products are appropriately priced, though taxing THC levels may be practically difficult (Caulkins and Kilmer, 2016; Kilmer, 2019; Kleiman and Ziskind, 2019). A more restrictive option involves hard capping what THC percentages businesses can legally sell, as Uruguay has done for pharmacy sales (Cerdá and Kilmer, 2017; Hall et al., 2019; Kilmer and Pacula, 2017; Pardal et al., 2019; Queirolo et al., 2016). Again however, the above may limit the commercial competitiveness of a legal market to some degree, whilst giving suppliers the opportunity to attract consumers who desire more potent cannabis.

A jurisdiction could strategically alter their legalisation regulation across time. For instance, a locale could set low taxes immediately following legalisation to harm the illicit market, while raising taxes later to help public health (Caulkins and Kilmer, 2016). However, the illicit market may respond to any subsequent restrictions. If legal prices increase later from heightened taxes, then consumers desiring cheaper prices may again feel attracted to the illicit market, and by extension, create opportunity for illicit suppliers. Though a different type of legalisation regime, the Netherlands offers a possible instance of illicit market responsiveness. When the Netherlands added restrictions to cannabis coffee shops which consumers disliked, illicit market size increased while coffee shop usage decreased (van Ooyen-Houben et al., 2016). [48]

Ultimately, much uncertainty remains over the long-term consequences of a fully commercialised legal market for public health (Hall et al., 2019; Kleiman and Ziskind, 2019). Only with more time and research will the overall picture become clearer. Currently (to the knowledge and logic of the researcher), no perfect solution exists where one can tailor legalisation policies towards maximising illicit market harm whilst not potentially risking (to some degree) future public health. Likewise, employing policies which protect public health may limit the commercial threat a legal market poses to illicit

---

[48] When the Netherlands removed the restrictions, coffee shop usage began increasing again while illicit market size started decreasing (van Ooyen-Houben et al., 2016).

suppliers. Jurisdictions must ultimately give thought to which outcome is most desirable for their unique circumstances.

A hypothetical balanced approach may involve allowing people to obtain legal cannabis with limited restrictions, while keeping the legal cannabis industry outside the clutches of purely profit motivated organisations or individuals, for instance, through offering licenses only to organisations who demonstrate they prioritise public health, having a government monopoly, or applying a public authority model (Caulkins et al., 2015; Kleiman and Ziskind, 2019). Thus, with greater control over the 'moral' direction of the legal cannabis industry, governments can attempt to steer it clear from creating additional harm (i.e., causing more harm than is already present from illicit cannabis use and sale), whilst still allowing it to satisfy the pre-existing demand for cannabis, and by extension, harm the local illicit market.

8.2.3   Desistance and Adaptation

A second dilemma emerges when realising similar reasoning supported the supplier decision to desist or adapt their illicit modus operandi. Both decisions generally stemmed from suppliers struggling to compete against the legal market. Thus, considering the various adaptational responses to legalisation, common displacement criticisms levied at supply-side enforcement may similarly apply to legalisation (Berlusconi et al., 2017; Giommoni et al., 2017; Mazerolle et al., 2007; Seccombe, 1995; Toth and Mitchell, 2018; Windle and Farrell, 2012). Nonetheless, while reasoning for desistance and adaptation appear (from the present research) inextricably linked, it is fruitful to consider how a jurisdiction may incentivise the former while disincentivising the latter (Kubrin et al., 2009; Leclerc and Wortley, 2014; Wortley, 2014).

One interesting strategy emerges when considering the suppliers who willingly desisted to the legal market in the desistance subtheme. Specifically, a jurisdiction could lower disincentives for unlicensed sellers to legitimise, thus making desistance a more feasible and appealing choice for more illicit suppliers from varied circumstances. For example, if license obtainment is relatively affordable, more illicit suppliers may consider legitimising their operations. Likewise, offering relatively affordable cultivation licenses for varying quantities mean illicit suppliers who run smaller illicit grow operations may consider legitimising as a more valid option. Contrastingly, if licensing fees are extremely

high and cultivation licenses cover only mass-scale sizes, then logically, only more affluent individuals or groups can realistically legitimise. Consequently, less well-off, or less successful illicit cannabis suppliers may perceive adapting their illicit operations as the more possible and worthwhile option, as legitimising simply becomes too difficult.

Law enforcement should remain an important consideration in a post-legal era for two reasons. First, it may play an important disincentive role after legal sale begins. Supply-side drug law enforcement methods (such as seizures, crop eradications, crackdowns, raids and undercover operations) have known flaws (Mazerolle et al., 2007). However, the containment hypothesis proposes the illicit drug trade would be far larger had any enforcement never occurred, though knowing the full extent of this difference is impossible (Windle and Farrell, 2012). Similarly, law enforcement (in a legalised locale) may dissuade an unknown number of illicit cannabis suppliers from choosing adaptation or habituation over desistance. Unfortunately, there is no literature currently that has attempted to quantify or estimate the extent of supplier criminal involvement decisions in response to legalisation.

Second, law enforcement may play an important role in protecting the interests of legal cannabis sellers. A competitive illicit market may theoretically hinder the growth of the legal market depending on how effectively it attracts demand. Hence, a potentially useful way to reframe cannabis enforcement may involve shifting its purpose away from a self-contained effort to eradicate the illicit cannabis market, towards giving legal suppliers a (all other factors being equal) competitive edge against their illicit counterparts. Thus, law enforcement may indirectly help the legal market to out-compete, and harm, the illicit market. This also raises the interesting possibility of turning a criticism of supply-side enforcement into a strength. Law enforcement efforts may inadvertently increase supplier profits through raising illicit prices (Caulkins and Reuter, 2010; Kilmer et al., 2015). However, in a legalised locale this may make it easier for legal suppliers to match or undercut illicit prices and encroach upon illicit market demand.

Therefore, a jurisdiction should consider the usefulness of maintaining some focus on cannabis enforcement even if containing a competitive legal cannabis market. At first glance, this suggestion may appear to contradict a commonly discussed benefit of legalisation freeing up law enforcement resources (Dills et al., 2016; Hall et al., 2019; Hughes and Stevens, 2010; Kleiman and Ziskind, 2019; Maccoun, 2011; Williams and Bretteville-Jensen, 2014a). However, it would be unrealistic and optimistic to imagine

local unlicensed cannabis markets disappearing entirely from a legal market. For instance, consider unlicensed alcohol and tobacco markets still exist despite many countries historically permitting their use (Gallagher et al., 2019; Gilmore et al., 2014; Lachenmeier et al., 2011). There is also an argument that once, or if, the legal market develops sufficiently enough to significantly out-compete the illicit market commercially, law enforcement resources could hypothetically ease over the long-term.

An important consideration is whether legalisation may free up law enforcement resources as a whole. Even if unlicensed markets and adaptational responses of suppliers require attention, it is possible a net-benefit for law enforcement resources may still occur. Literature on arrests and police resources in the United States and Canada have indicated the possibility of resources freeing up overall. Two studies in the United States found associated decreases in adult arrests, while a Canadian study found youth arrests decreased after legalisation (Callaghan et al., 2021; Firth et al., 2019; Plunk et al., 2019).[49] Other studies explored whether legalisation was associated with reductions in non-cannabis related crime. Dragone et al (2019) found associated reductions in rapes and property crime in Washington when compared to (the then non-legal) Oregon (note this comparison did not include any period after Washington started legal sale). Makin et al (2019) found legalisation was associated with improvements in certain crime clearance rates, or no impact on others, in Colorado and Washington.

Certain literature indicated associated increases in crime near cannabis stores (Connealy et al., 2020; Hughes et al., 2020). However, these studies focused on neighbourhood crime rather than considering entire legalised jurisdictions as a whole. While local impacts are important, the discussion here is on whether resources may potentially decrease overall for the entire jurisdiction that legalises. Therefore, the available empirical literature indicates that less restrictive legalisation regimes may potentially free up law enforcement resources overall.

Furthermore, one must also factor in the potential desistance influence from legalisation. As detailed in section 5.2.2 (of the Reddit Supplier analysis chapter), desistance through legalisation may offer several unique benefits over supply-side enforcement. Firstly, by economically targeting illicit sale profitability, the desistance

---

[49] Note, the Canadian Cannabis Act permitted small quantity cannabis possession and use for youths (Callaghan et al., 2021)

influence of legalisation becomes amorphous as it only relies on operational legal stores existing in relative vicinity. Secondly, the influence from legalisation may hold more longevity (and by extension any desistance effect) as its economic threat remains if the industry continues out-competing its local illicit market. Contrastingly, supply-side law enforcement methods are relatively more physically constrained as its methods rely strongly on law enforcement manpower being present (at least briefly) and/or investigating illicit drug activity (Mazerolle et al., 2007).

Thirdly, legalisation-based desistance avoids the criticism that supply-side enforcement may inadvertently increase drug dealer revenue by raising drug prices (Caulkins and Reuter, 2010; Kilmer et al., 2015). Though, the previous criticism holds true for cross-border trafficking when considering potential arbitrage creation. Lastly, any legalisation-based desistance avoids for the individual any harms associated with going through a criminal justice system, as the supplier or consumer personally decided to cease illicit activity without experiencing formal punishment (Apel and Sweeten, 2010; Boshier and Johnson, 1974; Pager, 2003; Sampson and Laub, 1997).

Therefore, even though displacement issues may exist (as with supply-side enforcement), legalisation-based desistance may offer additional benefits or improvements in the above areas. Nonetheless, a legal market operating means there is now an additional force (alongside law enforcement) which may encourage desistance and/or harm the local illicit cannabis market.

However, as the present research and other studies demonstrate, consequences of a competitive legal market may possibly spill into other nearby jurisdictions through cross-border cannabis movement (Hao and Cowan, 2020; Ward et al., 2019). Unfortunately for these neighbouring locales, while possibly experiencing negative consequences of legalisation, they may reap little, or none, of the potential benefits (such as tax revenue, economic opportunity, safer access to cannabis, freed up law enforcement resources or illicit market harm) that having a legal market may provide (Caulkins et al., 2015; Dills et al., 2016; Hall et al., 2019; Kleiman and Ziskind, 2019; Williams and Bretteville-Jensen, 2014b). Therefore, it is important to consider how jurisdictions could minimise such consequences.

If the legalised jurisdiction itself wished to limit external consequences of legalisation for their neighbours, several options may exist. For instance, a jurisdiction could employ a policy regime giving governments further control, or influence, over the

entire cannabis industry. For example, employing a government monopoly grants them complete, or increased, oversight of the entire industry (Caulkins et al., 2015; Kleiman and Ziskind, 2019). Alternatively, as a less restrictive option, governments could provide fewer licenses and exercise control through leveraging their removal to steer the industry in a preferred direction (Caulkins et al., 2015). With such approaches, a government may better monitor legal cannabis supply and limit legal cannabis diversion risk (such as requiring a more formal identification system for purchasers, permitting only residents to buy legal cannabis, monitoring growers, etc). Likewise, a government may better influence legal prices to avoid or limit arbitrage opportunity for trafficking into neighbouring states. However, as discussed, employing such restrictive policies may risk hindering any threat the legal market poses to local illicit suppliers

Unfortunately, nearby jurisdictions likely have little influence over how their neighbour legalises and regulates cannabis. Thus, the former may only respond to consequences from the latter. At least, the present research highlights key information that may help a locale better understand the potential risks a legalised neighbour can pose regarding cross-border cannabis movement and why. Broadly, as the present research theoretically links greater legal market commercial competitiveness with increased illicit market displacement and consumer appeal, jurisdictions may consider less restrictive regimes as posing greater diversion risk. Furthermore, even in less restrictive regimes, indicators of commercial competitiveness (such as legal store quantity, prices, etc) may prove useful in further differentiating trafficking risks.

8.2.4   Summary

Exploring these dilemmas highlights a potentially uncomfortable truth, that harming the illicit market through commercial legalisation may incur inevitable costs of its own. Currently, no perfect solution appears where jurisdictions can maximise illicit market harm, whilst entirely avoiding public health costs or displacement from suppliers adapting their illicit modus operandi. Furthermore, whether such a solution even exists is questionable. Nonetheless, if research comprehensively explores these trade-offs, then at least jurisdictions and policy makers can make more informed decisions regarding whether prioritising illicit market harm, or not, is worthwhile for their specific circumstance.

8.3   *Limitations*

Previous discussion in the Methodology chapter detailed the methodological limitations of both the Reddit (in section 3.2.3) and High Times (in section 3.3.2 and 3.3.7) analyses. Therefore, this section focuses upon contextual limitations associated with exploring the consequences legalisation poses to illicit drug markets for the purpose of advising future research.

As discussed, and experienced, by the researcher during the completion of this thesis, a fundamental issue for researching legalisation consequences for the illicit market is the relative lack of accessible data on illicit market measures. Regardless of how skilled, intelligent or creative the researcher, their research process and findings become constrained by the data available. Thus, efforts should focus on designing and creating unique data sources for future research.

For instance, illicit cannabis price data is valuable in inferring illicit market changes for several reasons (Caulkins and Bond, 2012; Caulkins and Reuter, 2010; Giommoni and Gundur, 2018; Pacula and Lundberg, 2013; Reuter and Kleiman, 1986). However, the most contemporary and extensive longitudinal sources on cannabis price (i.e., High Times and Price of Weed) for the United States arose independently of any law enforcement or research interests. Admittingly, there is no reason why these two organisations should have operated any differently, as their goals involved informing cannabis users of prices in the present, rather than serving research purposes. However, consequences may emerge when using data sources not designed with research in mind. For instance, Price of Weed not recording historical records is a clear oversight from a research perspective. Likewise, High Times (and Price of Weed) do not offer data in an easily accessible database, making gathering it extremely inconvenient. Such obstacles may dissuade some researchers from utilising these sources and limit analyses.

Therefore, an illicit cannabis price data collection program or website, designed with research intentions in mind may prove invaluable for analysing illicit market consequences. Price of Weed demonstrates the potential opportunity in crowdsourcing retail illicit drug data. Importantly, one could design the website to record historical records of all submissions alongside improving data accessibility. Of course, doing so would require serious funding for its creation and maintenance. Nonetheless, such an

endeavour, over time, may benefit research into not only the consequences of legalisation, but illicit drug research in general if the website records prices for other drugs.

Likewise, qualitatively researching illicit drug market participants is notoriously difficult in terms of accessibility (Enghoff and Aldridge, 2019; Miller and Sønderlund, 2010). While using online data sources such as Reddit has flaws (as any alternative source would), it importantly lessens accessibility barriers for researchers (Enghoff and Aldridge, 2019; Miller and Sønderlund, 2010). Arguably, it also presents a safer medium for the researcher who sits securely behind a screen. More researchers considering analysing online communities, such as Reddit, for drug research would increase the number of valuable perspectives on the consequences legalisation poses for illicit cannabis users and suppliers.

Websites like Reddit may springboard towards more traditional methods of analysis (a thought the researcher only had retrospectively). For instance, by choosing comments that demonstrated key and/or detailed knowledge of your research questions, the researcher may then privately message the commenter (a feature of Reddit which is also commonplace in many forum websites) requesting a further, more formal, online interview. Of course, doing this entails new ethical and methodological issues to account for, nonetheless, it remains feasible. Furthermore, the above allows the researcher to include active data collection in their methodology design rather than relying solely on what users chose to discuss, which is a common criticism of using naturally occurring online data (Enghoff and Aldridge, 2019).

Researchers acknowledging differences in legalisation policy, alongside practical implementation differences mean more informed analyses and precise findings. In keeping with this, the researcher emphasises that the present thesis has focused on jurisdictions which employ an alcohol-based type regulation where local governments issue licenses to for-profit businesses (Caulkins et al., 2015; Hall et al., 2019; Kleiman and Ziskind, 2019; Lancione et al., 2020). Thus, any findings, interpretations or discussions of this thesis apply to these less restrictive legalisation regimes than for more restrictive regimes such as Uruguay employs.

Importantly, researchers should focus on accounting for wider contextual factors. For instance, obtaining legal market data is important for gauging its threat towards the illicit. Legalised jurisdictions should feel incentivised to offer, and request, in depth information from legal sellers if they understand it means more informed interpretations.

Similarly, one should consider the illicit market context of the location in analysis if possible. For example, California having (historically) played key roles in illicit cannabis trafficking and markets in the United States presents a noteworthy different contextual situation to Colorado (DEA, 2018; Hecht, 2014; Johnson, 2019, 2017; Kilmer et al., 2010a; Lee, 2012; Silvaggio, 2018; Weisheit, 2013).

Lastly, conducting a mixed methods approach highlighted an important methodological point. Potential limits of using illicit prices to infer illicit market changes from legalisation exists. While price serves important roles in illicit market research, Reddit user conversations highlighted several non-price factors that influenced the decisions of illicit cannabis consumers and suppliers (Caulkins and Bond, 2012; Caulkins and Reuter, 2010; Giommoni and Gundur, 2018; Pacula and Lundberg, 2013; Reuter and Kleiman, 1986). Therefore, entirely possible are illicit market changes occurring, which price fluctuations (both legal and illicit) fail to capture as their causes stem from non-price factors.

Hence, solely quantitatively analysing price data without accounting for these unique factors means certain illicit market changes may go unobserved or underestimated. Likewise, even where clear price changes occur, a proportion (stemming from non-price factors) of relevant consequences may remain hidden. For instance, using price data to infer cross-border cannabis movement (as done in this thesis) may fail to observe trafficking occurring from suppliers taking advantage of diverting a more diverse, and high quality, set of cannabis products which consumers desire. Thus, future research into the consequences legalisation poses for the illicit market, should pay equal attention towards the influence of non-price factors.

8.4   Summary

The present research indicates that legalising cannabis may impact illicit cannabis markets through influencing the decision-making processes of illicit cannabis consumers and suppliers (Cornish and Clarke, 2017, 2014, 2011; Kubrin et al., 2009; Leclerc and Wortley, 2014; Selten, 2002; Simon, 1990, 1955; Wortley, 2014). Specifically, the presence of a legal market constitutes a situational change and influence, which

influences the incentivises and disincentives of the criminal involvement decisions for illicit cannabis market participants. Consequently, these individual changes may reflect the potential wider consequences legalisation poses illicit markets.

Theoretically, how commercially competitive the legal market is may reflect the amount of threat it poses to the local illicit market. Specifically, legal suppliers may better threaten illicit market demand through encouraging desistance by better satisfying consumer desired goals (i.e., prices, product quality, and/or improved service). Consequently, suppliers may decide to improve, desist, or adapt their current illicit modus operandi in response to the threat of losing demand to the legal market. Importantly, commercial competitiveness is partly defined by the local illicit market which legal sellers compete with. In other words, how competitive a legal market needs to be for causing serious disruptions depends on how commercially competitive the local illicit market is.

The above has implications for policy discussions as a commonly discussed benefit of legalisation is its potential to harm illicit cannabis markets (Hall et al., 2019; Kleiman and Ziskind, 2019). As the present research tentatively indicates, harming illicit markets ties to legal market competitiveness, and certain policy choices can encourage the latter. Therefore, jurisdictions may hypothetically tailor their policies towards maximising illicit market disruption and harm through using policies that facilitate a commercially competitive legal market.

However, policy makers must consider the potential unintended consequences of encouraging a commercially competitive market. For instance, more affordable, high quality and accessible legal cannabis may theoretically harm local illicit markets, whilst potentially risking future public health consequences (Caulkins, 2019; Pardo, 2014). Unfortunately, such public health risks may only become clear once said consequences manifest over a longer timescale, fester, and thus become more difficult to reverse (Caulkins and Kilmer, 2016; Hall et al., 2019). Furthermore, policy makers must accept the possibility of suppliers responding to the legal market by adapting their illicit modus operandi alongside desisting.

Conclusion

The past decade has seen substantial changes to cannabis drug policy in jurisdictions that have permitted its use, production and distribution for recreational purposes. Underpinning the drive to legalise cannabis are several proposed benefits such as, improving the economy, providing consumers safer access to cannabis product, and freeing up law enforcement resources (Dills et al., 2016; Hall et al., 2019; Kleiman and Ziskind, 2019). A fourth claimed benefit which this thesis focused upon, is legalisation harming the illicit cannabis market (Hall et al., 2019; Kleiman and Ziskind, 2019). To better understand the consequences legalisation may pose illicit markets, this thesis aimed to empirically explore three research questions:

1. What influences a cannabis consumer to use the legal or illicit market?
2. How do illicit cannabis suppliers respond to recreational cannabis legalisation?
3. Do wider illicit trafficking flows change in response to recreational cannabis legalisation?

To aid in answering the above questions, this thesis used a theoretical framework consisting of Rational Choice Perspective (RCP), bounded rationality concepts and Risk and Prices (R&P) theory. Specifically, this theoretical framework was used to consider, analyse, and interpret how legalisation may affect the criminal involvement decisions of illicit cannabis market participants (Caulkins and Reuter, 2010; Cornish and Clarke, 2014; Reuter and Kleiman, 1986; Selten, 2002; Simon, 1978; Wortley, 2014). As people and their decisions comprise markets, understanding how legalisation impacted the individual decisions of illicit cannabis consumers and suppliers may indicate the wider market consequences legalisation poses illicit markets.

The present thesis is unique in being the first instance of a mixed methods approach to analysing the consequences cannabis legalisation poses to illicit cannabis markets. Specifically, it employed a mixed methods parallel-databases design which utilised both quantitative and qualitative data (Creswell and Clark, 2017; Teddlie and Tashakkori, 2008; Yvonne Feilzer, 2010). This research also made unique use of novel data sources which have, previously, been unexplored for the present research area. Specifically, it thematically analysed perspectives from users of the online social media

website Reddit. Likewise, it makes unique use of a source of illicit cannabis price data from High Times (a monthly magazine which focuses on cannabis-related news) to infer illicit market responses and cannabis movement through analysing price fluctuations (Caulkins and Bond, 2012; Giommoni and Gundur, 2018). [50]

Key Findings and Empirical Contributions

The present thesis paints a comprehensive picture of why, and how, legalisation may impact the illicit cannabis market. The research uniquely considers concurrently the impacts of legalisation on both illicit cannabis consumer and supplier decisions. Thus, an overarching, and empirically supported, narrative of how legalisation may threaten the illicit cannabis market emerged. Legalisation constitutes a situational change for illicit cannabis consumers and suppliers. For the former, a new legal alternative for obtaining cannabis emerges while the latter has new competitors. Such a situational change, through affecting the opportunity, incentives, and disincentives of buying or selling illicit cannabis, may influence the criminal involvement decisions of consumers and suppliers (Cornish and Clarke, 2014).

<div align="center">The consumer market-choice</div>

The market-choice decision is key as it represents the core threat legalisation poses to the illicit cannabis market and its suppliers. Consumer purchasing financially fuels the illicit drug market, and while some drug suppliers may sell to other suppliers, it all ultimately relies upon the suppliers selling directly to consumers.

The Reddit consumer analysis uniquely qualitatively explored, from a rational choice perspective, this crucial decision of whether to continue using the illicit market (habituation) or ceasing in favour of legal purchasing (desistance). Analysis identified several economic and/or practical factors which Reddit users considered when choosing a market such as cannabis price and quality. Further, unique factors emerged depending

---

[50] While other studies have used High Times in the past, no analysis of High Times price data past 2005 has occurred (Bond and Caulkins, 2010; Caulkins and Bond, 2012).

on if the consumer chose habituation (poor legal cannabis accessibility, confidentiality fears, and/or positive past experiences with illicit market use) or desistance (legal market service being more convenient, safer, consistent, and/or offering a greater selection of cannabis products).

Other academic research into illicit cannabis demand shifting to the legal market has been primarily quantitative. For instance, several studies used quantitative indicators to usefully infer demand shifting to legal markets (Bahji and Stephenson, 2019; Burgard et al., 2019; Caulkins et al., 2019; Caulkins and Kilborn, 2019; Goodhart and Ashworth, 2019; Kilmer et al., 2019; Meinhofer and Rubli, 2021; Rotermann, 2020). Hence, the present research offers a unique counterpart to these quantitative studies by providing an empirical qualitative analysis of why, and how, legalisation may rationally incentivise illicit cannabis users to prefer the legal market.

Findings also expand upon other research that specifically focused on consumer decisions regarding the legal market. Firstly, these studies differ from the Reddit analysis as they quantitatively analysed data stemming from hypothetical decision-based scenarios given to their participants, in contrast to qualitatively analysing accounts of real experiences (Amlung et al., 2019; Amlung and MacKillop, 2019; Zhu et al., 2020). Thus, the Reddit consumer analysis could offer deeper qualitative elaboration on the consumer-market choice decision making process. More specifically, Zhu et al (2020) focused attention on consumer decisions between legal cannabis stores, rather than considering the consumer decision between (the illicit or legal) markets as the present thesis has. Amlung et al (2019) and Amlung and Mackillop (2019) did consider the consumer decision between markets. However, they empirically focused on the influence of price while the Reddit analysis (alongside examining price) identified and explored how several other factors influenced consumer decisions.

Supplier reaction

The supplier Reddit analysis uniquely explores qualitatively, from a rational choice perspective, illicit cannabis supplier views and subsequent reaction to an operating legal market. A commercially competitive legal market (i.e., one with cheaper or comparable prices, high quality product, and/or superior services) may jeopardize the satisficing of a

profit-oriented goal for suppliers, through encroaching upon illicit market demand and lowering illicit prices.

Suppliers unable to commercially compete with the legal market, and/or unwilling to accept lower profits ceased illicit activity entirely (desistance) or adapted their modus operandi to continue making satisfiable profits. The habituation decision occurred where the legal market posed little to no threat, the supplier was capable enough to out-compete the legal market, and/or the supplier was willing to accept lower profits.

Analysis also uniquely qualitatively identified and explored several specific supplier responses to legalisation. First, it explored supplier decision making processes which considered law enforcement risk and legalisation, highlighting how it may potentially make retail sale less risky. Second, it illustrated how legalisation may influence suppliers to desist illicit operations entirely, and further, how the legal market itself may incentivise illicit suppliers to proactively, and willingly, work in its industry. Lastly, it explored and explained how legalisation may displace local illicit suppliers towards selling other illicit drugs or to under-age consumers.

Cannabis trafficking flows

Lastly, the present thesis is the first to apply a mixed methods approach towards researching how, and why, illicit cannabis trafficking flows may potentially change from legalisation. The quantitative and qualitative analyses demonstrated congruence, as both support the possibility of legalisation potentially influencing illicit cannabis trafficking flows (Creswell and Clark, 2017; Yvonne Feilzer, 2010).

The High Times analysis is the first to empirically associate cross-border cannabis movement with recreational legal sale through statistically modelling illicit cannabis price data. An interrupted time series model showed a negative association between the beginning of Coloradoan legal sale and illicit cannabis prices in its neighbouring states (Bernal et al., 2017; Schober and Vetter, 2021; Wagner et al., 2002). Likewise, a multiple linear regression model showed a negative association between active Coloradoan retail store licenses and illicit prices in neighbouring states (Aiken, 2004; Tarling, 2009; Uyanık and Güler, 2013). Possible explanations for these negative associations are legal cannabis diversion, trafficking of cheaper illicit Coloradoan cannabis and consumer drug tourism.

228

Attempts to control for seasonal and confounder influences on price occurred for both models.

Analysed Reddit supplier comments directly attributed legalisation as influencing, and/or improving the profitability of, trafficking cannabis out from a legalised state. Further, the Reddit analyses offers empirical explanations for why this may occur. Specifically, the legal market, through making local illicit sale less profitable and feasible, may displace local suppliers towards trafficking. Simultaneously, lowering local illicit prices may create, or increase, arbitrage opportunity and profitability for trafficking cannabis out of the legal jurisdiction. Thus, the present findings show the legal market rationally disincentivising local illicit sale whilst potentially incentivising cross-border cannabis trafficking.

Further, when considering the profit-motivated supplier rationale and the descriptive price data both support the possibility of illicit cannabis trafficking out from Colorado becoming more profitable and appealing after legal sale. Specifically, the arbitrage between average prices in Colorado, and the states bordering it, was larger after legal sale than before, which is in keeping with an increased incentive to traffic illicit cannabis. Likewise, the drop in Coloradoan illicit prices post-legal sale possibly indicates local illicit sale profitability lowering and by extension, trafficking becoming a relatively more profitable modus operandi.

Policy Implications

This thesis has clear implications for jurisdictions considering, or employing, cannabis legalisation, specifically regarding the goal of it harming the illicit cannabis market (Hall et al., 2019; Kleiman and Ziskind, 2019). The present research empirically showed illicit cannabis market participants responding to legalisation in intelligible ways as, rather than being senseless or irrational, their reactions to legalisation proved understandable once their goals became clear. Consequently, analysis supports the possibility that a jurisdiction may feasibly tailor legalisation policy towards harming their local illicit market, through choosing policies which demonstrate the ability to influence the opportunity, choices and goal satisficing of illicit cannabis consumers and suppliers (Cornish and Clarke, 2017, 2014; Selten, 2002; Simon, 1957; Wortley, 2014). More

specifically, the present research demonstrated how a commercially competitive legal market may achieve the above.

However, the impacts of a commercially competitive legal market appear blunt rather than precise as analysis identified both positive and negative consequences. Positively, a competitive legal market may rationally incentivise consumer and supplier desistance while negatively, it may displace and create opportunity for illicit suppliers alongside possibly impacting other nearby jurisdictions. Likewise, while analysis indicated affordable, potent, and accessible legal cannabis may commercially threaten the illicit market, these same factors potentially risk future public health (Ambrose et al., 2021; Caulkins, 2019; Kleiman and Ziskind, 2019; Pardo, 2014).

Thus, a commercially competitive legal market may inevitably incur costs of its own. Furthermore, the real extent and scale of these costs over a longer timescale is unclear as a fully commercialised and operating legal cannabis industry has only functioned for eight years (Colorado began legal sale in 2014). Policy makers must keep in mind this inherent limitation that comes with research on a relatively recent policy change. Consequently, policy makers and legalised jurisdictions must be flexible in adapting their legalisation regime to account for new information and research as it arises (Carnevale et al., 2017; Kleiman and Ziskind, 2019).

Ultimately, if significantly harming the illicit market requires a commercially competitive legal market, trade-offs may be unavoidable. Policy makers must decide how important the above goal is, and by extension, whether they are willing to accept any possible risks associated with facilitating a competitive legal market. Hence, research exploring how legalisation may impact the illicit market is vitally important for helping jurisdictions make informed decisions which suits their specific circumstances. In closing, it is hoped this thesis helps inform policy decision-making regarding recreational cannabis legalisation.

Limitations

The present thesis has limitations. First, the present findings primarily apply to legalisation regimes which permit a privatised commercial industry, as the empirical findings emerged from analysing jurisdictions with such policy. Therefore, this thesis has less relevance for more restrictive legalisation approaches which do not permit a

commercialised cannabis industry. Second, the consequences analysed primarily pertain to the retail illicit cannabis market. High Times prices came from consumers, meaning they could only reflect retail level transactions. Likewise, the contents of the Reddit supplier comments indicated individuals who sold directly to the consumer. Thus, the present thesis offers no direct empirical insight into how legalisation may affect supplier-to-supplier transactions. Nonetheless, the present findings open the possibility of legalisation affecting supplier-to-supplier transactions. If retail illicit cannabis suppliers experience difficulties, then logically those who supplied them may similarly experience issues.

Third, the findings of this thesis are not generalisable as the Reddit analysis was qualitative, and the quantitative analysis involved a convenience, not random, sample of illicit cannabis prices (Battaglia, 2008; Phua, 2004; Spiegelhalter, 2020). However, this thesis aimed not to generalise its findings but to empirically analyse why, and how, recreational cannabis legalisation may impact the decisions and behaviours of illicit cannabis market participants. Unfortunately, the lack of generalisability means it is unclear whether the current findings are applicable to all current or future, instances of comparable legalisation policy regimes (i.e., one which legalised a privatised cannabis industry). Nonetheless, the present research gives policy makers unique empirically supported examples, and possible explanations, of the potential consequences that legalising may pose to illicit cannabis markets. Further, as more research in this area grows, the present thesis will serve a useful role as collaborating with findings from other studies.

Lastly, as detailed in section 3.2.3 and 3.3.2 of the methodology chapter, there are specific limitations of the data sources used in this thesis. Regarding both Reddit and High Times, verifying the accuracy of the data is impossible and there was a lack of demographic information. For Reddit specifically, social desirability may exist, only what the users chose to discuss became known, and only online internet users are represented (Caplan and Purser, 2019; Enghoff and Aldridge, 2019). Concerning High Times, only cannabis bud is represented, no quality information is given, all transactions were reported at the ounce level, and only certain substate locales in the United States were represented.

Arguably, the above limits stem from neither data source being specifically designed for academic research. Nonetheless, their existence allowed access to a

notoriously difficult-to-reach population which made this thesis possible (Aldridge and Bouchard, 2019; Duncan et al., 2003; Shaghaghi et al., 2011). Particularly, High Times offered a unique longitudinal sample of illicit cannabis price data stretching back to 2005 on the United States, no other comparable or usable illicit price data source existed. Further, as detailed in section 3.2.3, the Reddit data holds several strengths that should be acknowledged alongside its weaknesses. Reddit offered access to illicit cannabis market participants who avoided law enforcement detection, its data was unimpacted by researcher effects, and its internet-granted anonymity encouraged individuals to freely discuss stigmatising behaviour regarding the illicit market (Caplan and Purser, 2019; Duncan et al., 2003; Enghoff and Aldridge, 2019; Robinson, 2001).

Further Research

Several areas deserve further research. For instance, more qualitative research into the supplier-decision making processes is needed. While this thesis explored supplier responses in this thesis, it represents just one instance of qualitative research. Other qualitative explorations would prove valuable in offering other unique perspectives from populations besides Reddit, and importantly offline ones. Quantitative studies would also prove beneficial, for instance, in estimating the prevalence of desistance, habituation, or decisions of illicit cannabis market participants. The former research would usefully contribute towards evaluating the overall costs and benefits of legalisation, as assessment could consider the extent of habituation, desistance or adaptation decisions stemming from legalisation.

A more specific area of interest is exploring the potential influence of non-price factors on legal cannabis diverter decisions. For instance, would a trafficker divert more expensive legal cannabis product because it was more convenient, higher quality, and/or offered a greater selection? Similarly, useful research would also involve somehow quantifying associations between such non-price factors from legal markets with trafficking indicators, thus accounting for trafficking occurring that may go unnoticed if solely relying on price as an indicator or proxy.

Empirical academic research on the consequences of Uruguayan legalisation on its own, and nearby, illicit markets is lacking. Hence, there is research opportunity in firstly, exploring potential consequences in the former, and secondly, comparing findings

to similar research in the United States alongside Canada. As Uruguay employs a far more restrictive legalisation regime, one could contrast its illicit market consequences with the United States and Canada who employ less restrictive policies (Hall et al., 2019; Kilmer, 2019).

The multiple linear regression models depicted in Table 17 show relatively low explanatory power. Therefore, a worthwhile area of future research may involve exploring how, and putting into practice methods, to raise explanatory power when modelling the impacts of legalisation on illicit cannabis price. A possible explanation for low explanatory power was the inability to include direct cannabis usage rates and cannabis potency or strength directly into the model, as variation in these variables correlate with changing prices (Caulkins, 2007; Doyle, 2016; Gale, 1955; Mankiw, 2011). Naturally, research that can incorporate these variables into a model would better isolate the impacts of legalisation and legal sale on illicit price.

However, as discussed in section 3.3.6, appropriate (to the needs of this thesis) longitudinal potency and usage data was (to the knowledge of the researcher) unavailable. Hence, a fruitful endeavour may involve collection of such data, though this comes with some problematic issues. Alongside standard considerations relating to cost and the feasibility of collecting this data, time would need to pass before any researcher could use the data for modelling the impacts of legal sale on illicit price. Further, the usage and potency data could not be used on price data that emerged prior to their collection.

Alternatively, using a multi-level model may improve explanatory power without necessarily requiring the collection and creation of new data (Baumer and Arnio, 2012; Gelman and Hill, 2006). Within the criminological literature are examples of studies using these models which can better account for spatial and temporal differences in outcomes of interest (Baumer and Arnio, 2012). If illicit cannabis price data offers geographical and/or time information, then a multi-level model may be appropriate. For example, a multi-level model of illicit cannabis price data from the United States may better control for illicit price variation across different geographical levels like city, county and state. Further, these multi-models can be used on historical price data (Baumer and Arnio, 2012).

Lastly, consider that current legalised locales are constantly maturing and developing, alongside new jurisdictions legalising. Research must keep up with these constant developments. Thankfully, more instances and longer timescales of legalisation

will be valuable as it creates more opportunity for research. With more points of observation and inquiry, a more comprehensive and informed collective understanding of the consequences legalisation poses illicit markets can occur.

Appendix A

This appendix contains the full descriptive statistics analysis of Washington, Oregon, Nevada and California.

Washington

Table 18 below shows summary statistics of High Times price submissions for Washington, before and after its legal sale began. Both the mean and median show that average High Times price submissions after legal sale are lower. There is a difference between mean values of $1.99, a roughly 19% decrease, and a median difference in values of $1.07, a roughly 10% decrease. The standard deviation values indicate the distribution of the pre-legal sale period data is slightly more variable. The range of prices is smaller after legal sale ($10.72 in the first period compared to $8.79).

Table 18. Washington price submissions before and after Washington legal sale

Washington	Count	Mean	Median	Std	Min	Max
Pre legal sale	111	$10.56	$10.00	$2.33	$7.14	$17.86
Post legal sale	72	$8.57	$8.93	$1.95	$3.71	$12.50

Figure 19 below plots the data from Table 18. The pre-legal sale trend line shows Washington price submissions decreasing from roughly $12.00 to roughly $9.00 over roughly 9 years. The post-legal sale trend line indicates an initial drop in prices following legal sale starting from roughly $9.00 to $8.00. The post-trend line indicates prices increasing again and ending at a slightly lower point than where the pre-legal trend line stopped. Only in this post-trend period did price submissions below $7.00 occur following legal sale. Overall, while drops in prices coincided with the early period following Washington beginning legal sale, Figure 19 also indicates High Times prices subsequently increasing during the post-legal sale period.
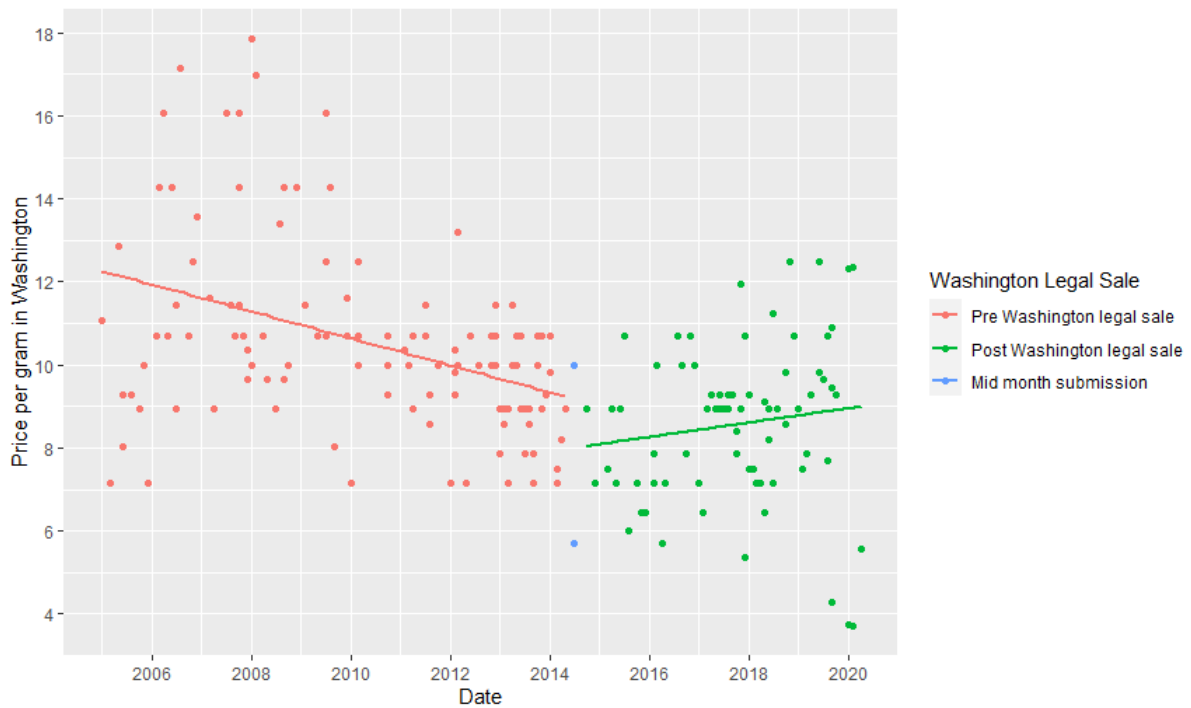
Figure 19. Washington price submissions before and after Washington legal sale

Table 19 below shows summary statistics of High Times price submissions for the two states bordering Washington, Oregon and Idaho, before and after legal sale started in Washington. Note, submissions for Oregon past July 2015 are excluded because the state implemented legal sale itself that month making it impossible to differentiate between the possible impact of Washingtonian and Oregonian legal sale.

Both the mean and median in Table 19 show that average High Times price submissions after legal sale are lower. There is a difference between mean values of $0.20 (a marginal 2% decrease) and median decrease of $0.54 (a roughly 6% decrease). The range of prices is larger after legal sale ($12.50 for the pre-legal sale, compared to $14.64 for the post-legal sale). The decrease in average prices from the pre-legal and post-legal periods for bordering states is far smaller, with a mean decrease of 19% for Washington submissions compared to only 2% for bordering states, and a median decrease of roughly 10% in Washington compared to 6% in bordering states.

Table 19. High Times prices in bordering Washington jurisdictions before and after Washington legal sale

Bordering WA	Count	Mean	Median	Std	Min	Max
Pre legal sale	82	$9.47	$9.29	$2.32	$3.57	$16.07

236

Post legal sale	28	$9.27	$8.75	$3.47	$5.36	$20.00

Figure 20 below plots the data from Table 19. The pre-legal sale trend line shows a decrease in prices of High Times cannabis submissions, comparable to that seen in Washington. However, Figure 20 reveals serious issues with the data for this sub-regional group. Data is missing for a large period (late 2015 to 2018), making any further analysis unsuitable. This gap of data is partly due to Oregon implementing legal sale themselves in 2015. Also, Idaho is unfortunately poorly represented in the data with only 49 price submissions and inconvenient large gaps of data in the Washington post-legal period. Due to the above, this data is too poor in the post-legal sale period to reasonably argue for, or against, the possibility that Washington legal sale influenced illicit cannabis prices in its neighbouring states.
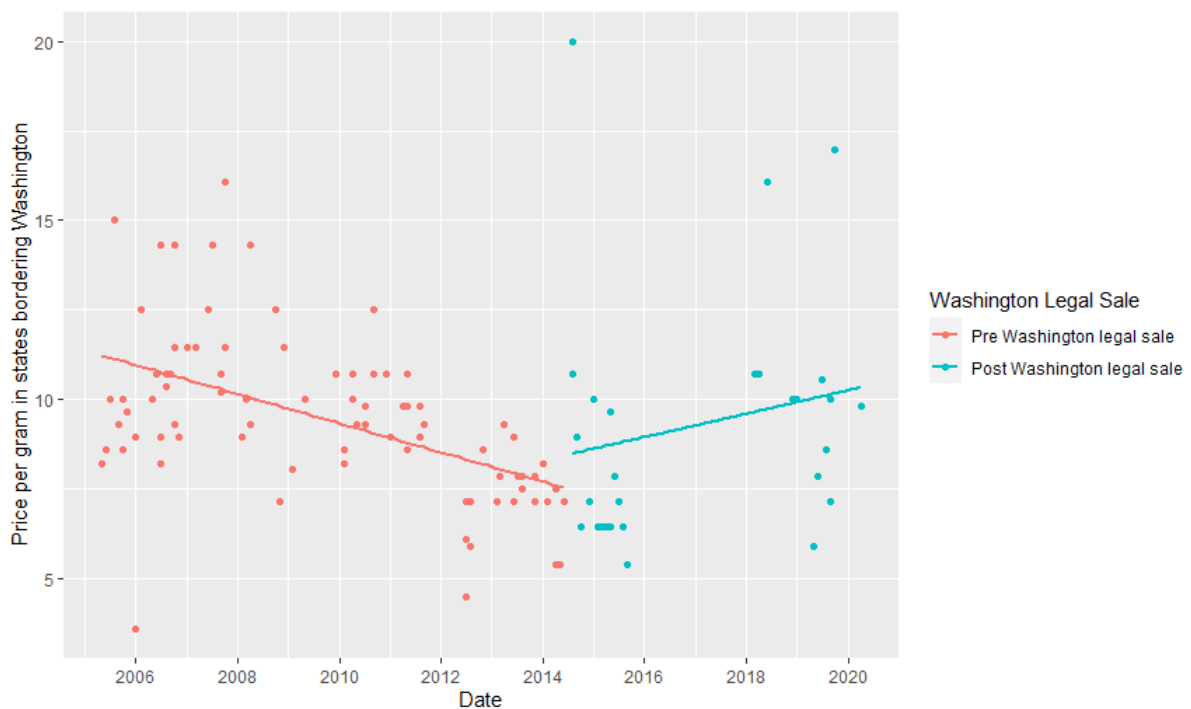
Figure 20. Bordering Washington jurisdictions price submissions before and after Washington legal sale

Table 20 below depicts Oregon and Idaho price submissions before and after Oregon legal sale. Oregon price is lower in the post-legal era (by roughly 17%) while Idaho shows no real change.

237

Table 20. High Times prices in Bordering Washington jurisdictions before and after Washington legal sale

State	Legal sale	Count	Mean
Oregon	Pre	59	$8.91
	Post	13	$7.36
Idaho	Pre	23	$10.92
	Post	15	$10.93

Oregon

Table 21 below shows summary statistics of High Times price submissions for Oregon, before and after recreational legal sale started. Both the mean and median show that average High Times price submissions after legal sale are lower. There is a difference between mean values of $1.74, a roughly 19% decrease, and a median difference of $2.15, a roughly 23% decrease in gram price. The standard deviation values indicate the distribution of the pre-legal sale period data is more variable. The range of prices is smaller after legal sale ($15.18 in the first period compared to $7.57).

Table 21. High Times prices in Oregon before and after Oregon legal sale

Oregon	Count	Mean	Median	Std	Min	Max
Pre legal sale	103	$9.20	$9.29	$2.31	$4.46	$19.64
Post legal sale	60	$7.46	$7.14	$1.65	$3.57	$11.14

Figure 21 below plots Oregon price submissions by time. The pre-legal sale period trendline indicates a continuing decline in price from roughly $11.00 to $7.00. The post-legal sale trend line indicates a drop of roughly $1.00 coinciding with Oregon beginning legal sale. The gradient of the post-legal sale trend line indicates an overall increase in prices. However, examining the submission points in Figure 21 show reported prices remaining low from 2015 (whilst Oregonian legal sale began in October of that year) to mid-2017, with few price submissions rising above $7.10. Late 2017 sees an increase in higher priced submissions resulting in a similar pattern of prices resembling the pre-legal sale period of 2012-2015.
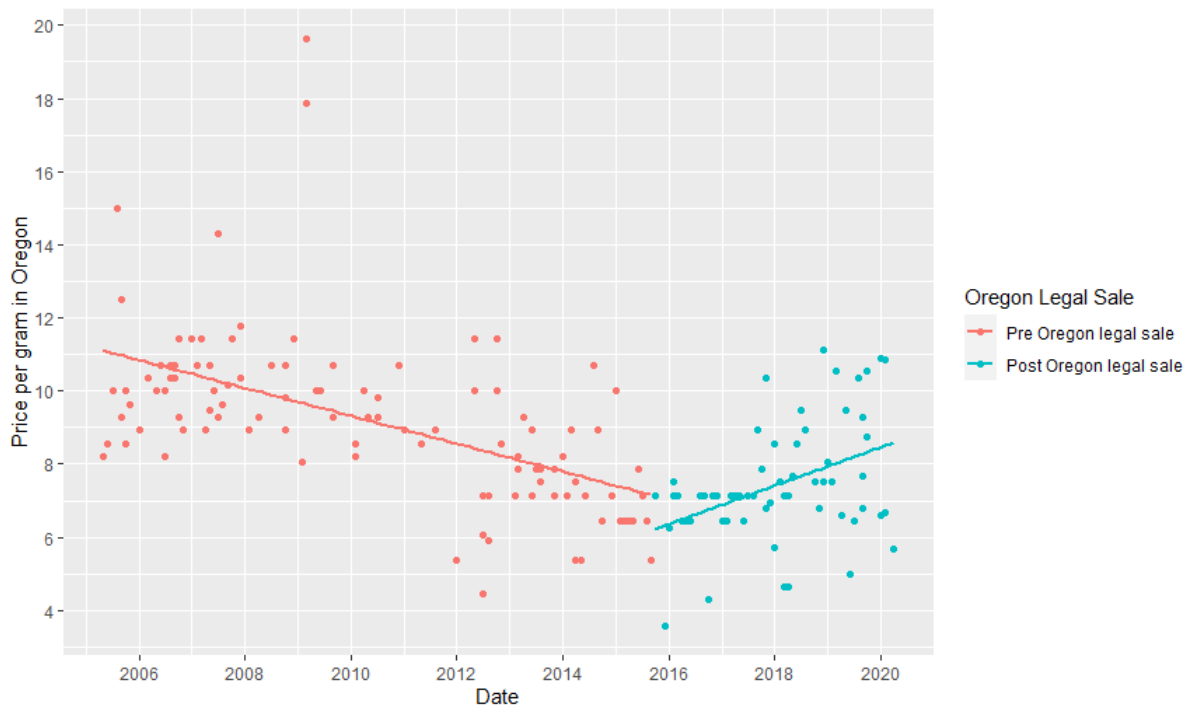
Figure 21. Oregon cannabis prizes before and after Oregon legal sale

Table 22 below shows summary statistics of High Times price submissions for states bordering Oregon before and after recreational legal sale started. As Oregon borders California and Nevada, who both legalised recreational cannabis themselves, price submissions past the respective legal sale start dates for these states are excluded. Also, while Oregon borders Idaho, Idaho has previously bordered Washington, so it is excluded from this grouping. Both the mean and median show that average High Times price submissions after legal sale are lower. There is a difference between the mean values of $1.89, a roughly 15% decrease, and a median difference of $0.90, a roughly 8% decrease. The average prices in the bordering states are higher than Oregon itself, both in the pre- and post-legal period. The standard deviation values indicate the pre-legal sale period had more variance in prices. The range of prices is smaller after legal sale, with the range of the pre-Oregon legal sale period being $26.78 and the post Oregon legal sale period being $10.72.

Table 22. High Times prices in jurisdictions bordering Oregon before and after Oregon legal sale

Bordering OR	Count	Mean	Median	Std	Min	Max
Pre legal sale	295	$12.23	$11.61	$3.13	$1.79	$28.57
Post legal sale	52	$10.34	$10.71	$2.78	$3.57	$14.29

239

Figure 22 below shows that these bordering states demonstrated a gradual decrease in High Times price submissions, indicating that these average price decreases in the post-legal period is in keeping with the pre-legal sale trend line.
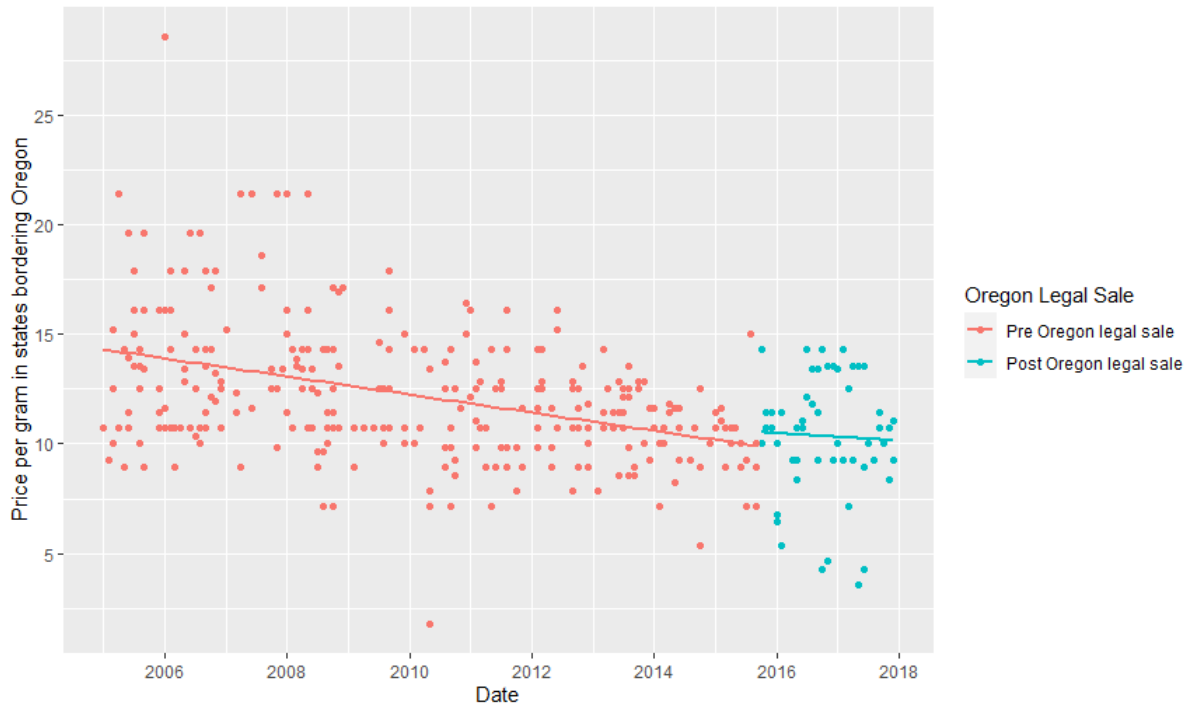

Figure 22. High Times prices in jurisdictions bordering Oregon before and after Oregon legal sale

Table 23 below shows the pre- and post-prices of California and Nevada. Californian prices are lower in the post-legal era by $2.71 (roughly a 23% decrease). Nevada shows a marginal decrease of only $0.03.

Table 23. High Times prices Oregon before and after Oregon legal sale

State	Legal sale	Count	Mean	Median	Std	Min	Max
California	Pre	233	$11.88	$11.43	$3.04	$1.79	$28.57
	Post	38	$9.17	$9.65	$2.29	$3.57	$12.14
Nevada	Pre	62	$13.54	$13.13	$3.15	$7.14	$21.43
	Post	14	$13.51	$13.57	$0.78	$11.43	$14.29

California and Nevada

240

Table 24 below shows summary statistics of High Times price submissions for Nevada, before and after recreational legal sale started. Both the mean and median show that average High Times price submissions after legal sale are lower. There is a mean difference between values of $2.01, a roughly 15% decrease, and a median difference is $1.96, a roughly 15% decrease also. The range of prices is smaller after Nevada legal sale, with the pre-sale period range being $14.29 and the post-sale period being $8.75.

Table 24. Nevada High Times prices before and after Nevada legal sale

Locale	Legal sale	Count	Mean	Median	Std	Min	Max
Nevada	Pre	80	$13.30	$13.39	$2.97	$7.14	$21.43
	Post	32	$10.80	$10.71	$2.12	$5.89	$14.64

Figure 23 below plots the price submissions from Table 24. A gradual decrease in price occurs from 2006 to mid-2012. Unfortunately, much data is missing from 2013 to mid-2016. Examining the data from when price submissions resume allows some comparison of this post-legal sale trend with the pre-legal sale trend. Cannabis price submissions to High Times show a sharper decrease once legal sale began. The post-legal sale trend line also goes lower than the pre-legal trend line at any point (below roughly $11.00) from late 2018.
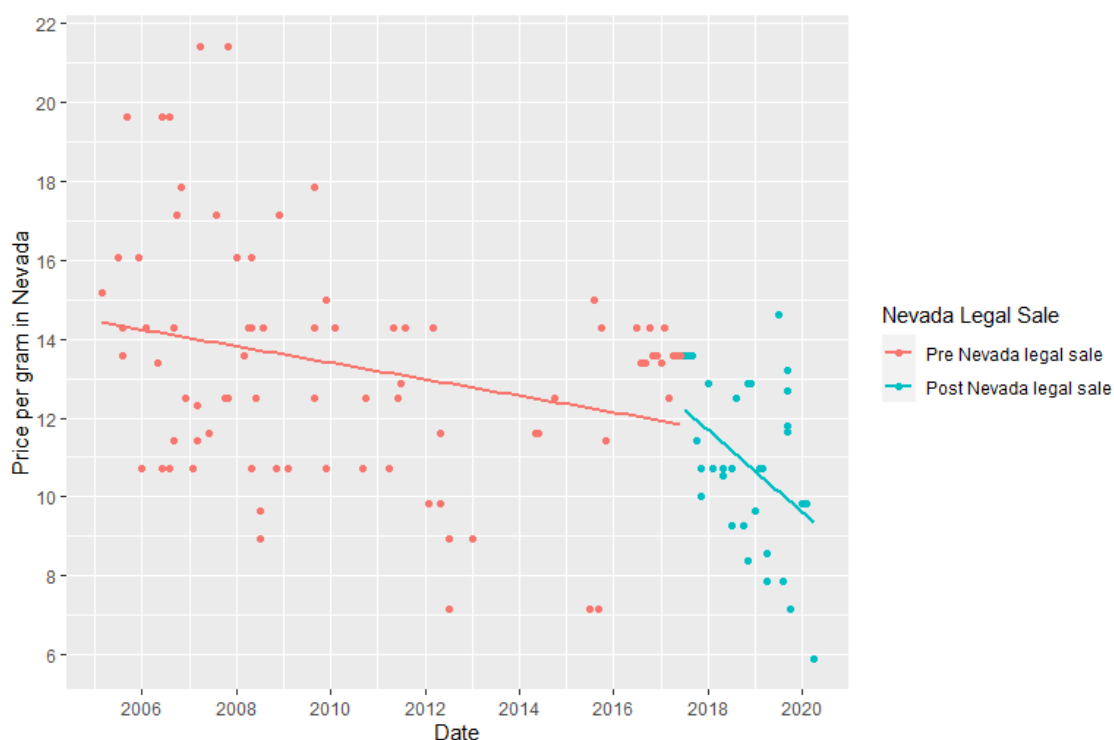

Figure 23. Nevada High Times prices before and after legal sale

Table 25 below shows summary statistics of High Times price submissions for California, before and after recreational legal sale started. Both the mean and median show that average High Times price submissions after legal sale in California are lower. There is a difference between mean values of $2.09, a roughly 18% decrease, and a median difference of $1.25, a roughly a 11% decrease. The range of prices is smaller after legal sale, with the pre-legal sale period range being $24.28 and the post-legal sale period being $10.00.

Table 25. California High Times prices before and after California legal sale

Locale	Legal sale	Count	Mean
California	Pre	322	$11.74
	Post	42	$9.65

Figure 24 below indicates that the average price decrease seen in Table 25 is in keeping with a previous price decline in cannabis occurring in the observed Californian cities, rather than a sudden change coinciding with Californian legal sale starting.
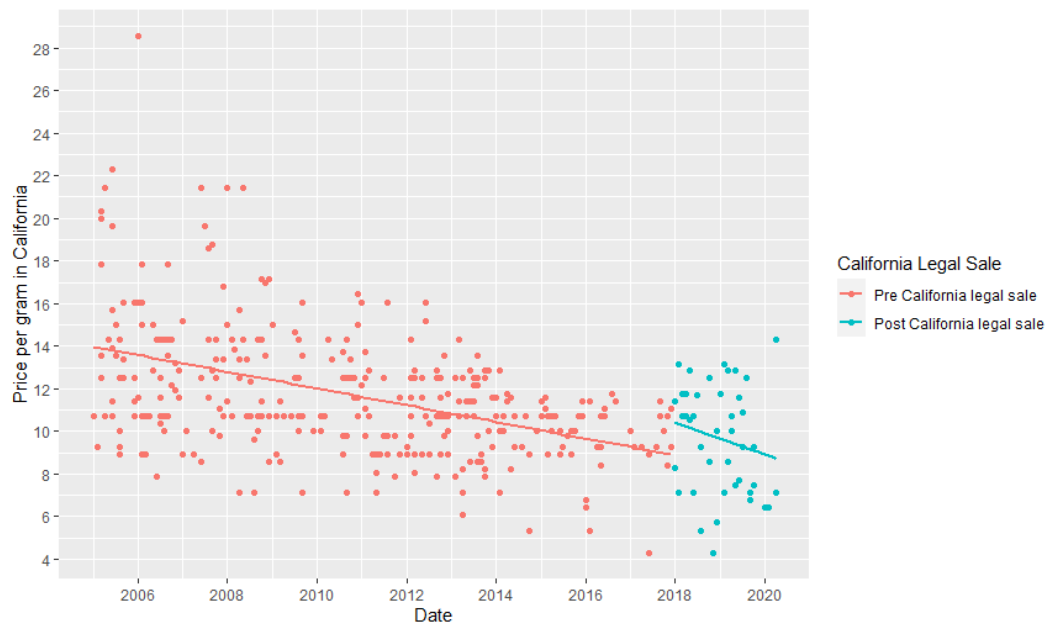

Figure 24. California High Times prices before and after California legal sale

Neither California nor Nevada has any neighbouring states that first experienced bordering a legal state with them, hence no analysis of prices in bordering jurisdictions occurred.

Appendix B

NSDUH (National Survey on drug use and health) data, conducted by SAMHDA (Substance Abuse and Mental Health Services Administration) offers a valuable opportunity in viewing cannabis use rates at a contextual level for the states bordering Colorado. Figure 25 plots past month average cannabis usage rates for each state. Plot A indicates average state usage rates all being below 6% pre-2012, jumping from 2012 to 2013, before remaining stable for three years around 7%, then finally increasing consecutively from 2016 to 2018. While plot B similarly shows the substate groupings remaining consistent between 2004-2012 (all remaining below 6%) before consecutive increases in the following biannual periods. Considering the economic principles of supply and demand (Gale, 1955; Mankiw, 2011), increased demand should theoretically coincide with increasing prices. However, as explored extensively, price submissions in bordering jurisdictions lowered.
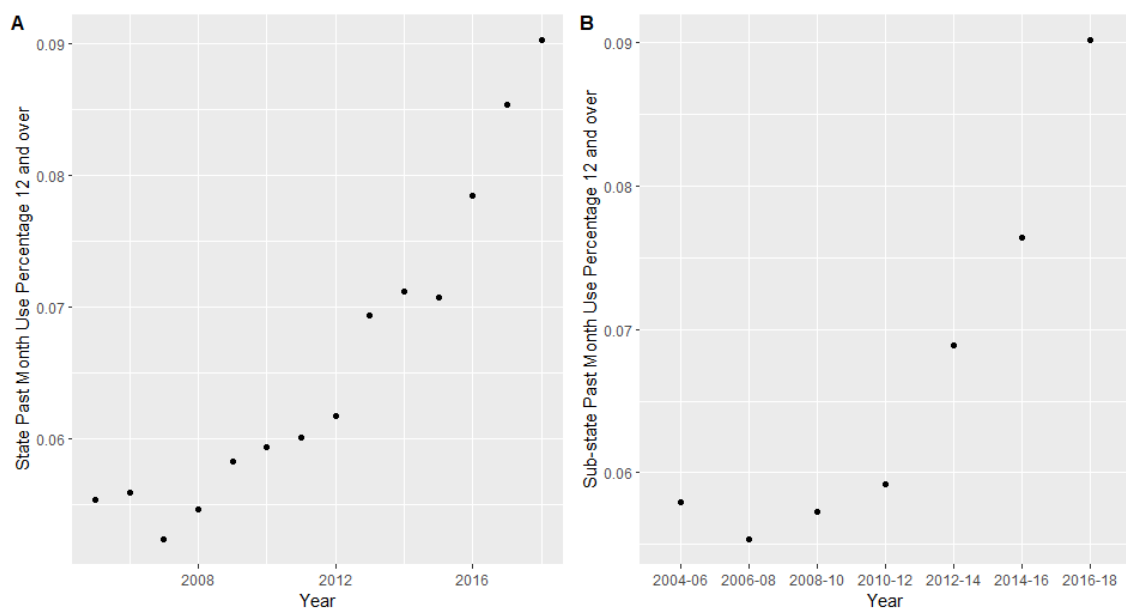

Figure 25. Past Month Cannabis Usage rates (aged 12 and older) for states bordering Colorado, source: SAMHDA.

Bibliography

Aiken, L.S., 2004. Multiple Regression Analysis, in: The SAGE Encyclopedia of Social Science Research Methods. Sage Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America. https://doi.org/10.4135/9781412950589.n601

Aldridge, J., Askew, R., 2017. Delivery dilemmas: How drug cryptomarket users identify and seek to reduce their risk of detection by law enforcement. Int. J. Drug Policy 41, 101–109. https://doi.org/10.1016/j.drugpo.2016.10.010

Aldridge, J., Bouchard, M., 2019. Leveraging the value of online data and methods: Drug policy research at the cutting edge. Int. J. Drug Policy 73, 208–209. https://doi.org/10.1016/j.drugpo.2019.09.005

Alexa, 2021. The top 500 sites on the web [WWW Document]. Alexa. URL https://www.alexa.com/topsites (accessed 5.12.21).

Allison, P.D., 2001. Missing Data (Quantitative Applications in the Social Sciences): 136, 1st edition. ed. SAGE Publications, Inc, Thousand Oaks, Calif.

Ambrose, C.A., Cowan, B.W., Rosenman, R.E., 2021. Geographical access to recreational marijuana. Contemp. Econ. Policy coep.12518. https://doi.org/10.1111/coep.12518

Amlung, M., MacKillop, J., 2019. Availability of legalized cannabis reduces demand for illegal cannabis among Canadian cannabis users: evidence from a behavioural economic substitution paradigm. Can. J. Public Health. 110, 216–221. https://doi.org/10.17269/s41997-018-0160-4

Amlung, M., Reed, D.D., Morris, V., Aston, E.R., Metrik, J., MacKillop, J., 2019. Price elasticity of illegal versus legal cannabis: a behavioral economic substitutability analysis. Addiction 114, 112–118. https://doi.org/10.1111/add.14437

Anthony, J.C., Petronis, K.R., 1995. Early-onset drug use and risk of later drug problems. Drug Alcohol Depend. 40, 9–15. https://doi.org/10.1016/0376-8716(95)01194-3

Apel, R., Sweeten, G., 2010. The Impact of Incarceration on Employment during the Transition to Adulthood. Soc. Probl. 57, 448–479. https://doi.org/10.1525/sp.2010.57.3.448

Asbridge, M., Hayden, J.A., Cartwright, J.L., 2012. Acute cannabis consumption and motor vehicle collision risk: systematic review of observational studies and meta-analysis. Bmj 344, e536.

AskReddit, 2021. About Community [WWW Document]. URL https://www.redditinc.com/press (accessed 5.12.21).

Auxier, B., Anderson, M., 2021. Social Media Use in 2021. Pew Research Center.

Bae, H., Kerr, D.C., 2019. Marijuana use trends among college students in states with and without legalization of recreational use: initial and longer-term changes from 2008 to 2018. Addict. Abingdon Engl.

Bahji, A., Stephenson, C., 2019. International Perspectives on the Implications of Cannabis Legalization: A Systematic Review & Thematic Analysis. Int. J. Environ. Res. Public. Health 16, 3095. https://doi.org/10.3390/ijerph16173095

Bailey, C.R., 2017. A Guide to Qualitative Field Research, 3rd edition. ed. SAGE Publications, Inc.

Barratt, M.J., Aldridge, J., 2016. Everything you always wanted to know about drug cryptomarkets* (*but were afraid to ask). Int. J. Drug Policy, Drug Cryptomarkets 35, 1–6. https://doi.org/10.1016/j.drugpo.2016.07.005

Battaglia, M.P., 2008. Nonprobability Sampling, in: Encyclopedia of Survey Research Methods. Sage Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America. https://doi.org/10.4135/9781412963947.n337

Baumer, E.P., Arnio, A.N., 2012. Multi-Level Modeling and Criminological Inquiry, in: David Gadd, Karstedt, S., Messner, F.S. (Eds.), The SAGE Handbook of Criminological Research Methods. SAGE Publications Ltd, London. https://doi.org/10.4135/9781446268285.n7

Bentham, J., 1998. An Introduction to the Principles of Morals and Legislation, New edition. ed. Oxford University Press, Oxford : New York.

Berlusconi, G., Aziani, A., Giommoni, L., 2017. The determinants of heroin flows in Europe: A latent space approach. Soc. Netw. 51, 104–117. https://doi.org/10.1016/j.socnet.2017.03.012

Bernal, J.L., Cummins, S., Gasparrini, A., 2017. Interrupted time series regression for the evaluation of public health interventions: a tutorial. Int. J. Epidemiol. 46, 348–355. https://doi.org/10.1093/ije/dyw098

Best, D., Beswick, T., Gossop, M., Rees, S., Coomber, R., Witton, J., Strang, J., 2004. From the deal to the needle: Drug purchasing and preparation among heroin users in drug treatment in South London. Addict. Res. Theory 12, 539–548. https://doi.org/10.1080/16066350412331323065

Bier, D.J., 2018. How Legalizing Marijuana Is Securing the Border: The Border Wall, Drug Smuggling, and Lessons for Immigration Policy. CATO Institute.

Bijlsma, L., Burgard, D.A., Been, F., Ort, C., Matias, J., Yargeau, V., 2020. Chapter Fifteen - The estimation of cannabis consumption through wastewater analysis, in: Ferrer, I., Thurman, E.M. (Eds.), Comprehensive Analytical Chemistry, Analysis of Cannabis. Elsevier, pp. 453–482. https://doi.org/10.1016/bs.coac.2020.04.005

Boesen, U., 2020. A Road Map to Recreational Marijuana Taxation. Tax Found. URL https://taxfoundation.org/recreational-marijuana-tax/ (accessed 2.9.21).

Boidi, M.F., Queirolo, R., Cruz, J.M., 2016. Cannabis consumption patterns among frequent consumers in Uruguay. Int. J. Drug Policy 34, 34–40. https://doi.org/10.1016/j.drugpo.2016.05.008

Boivin, R., 2014. Risks, prices, and positions: A social network analysis of illegal drug trafficking in the world-economy. Int. J. Drug Policy 25, 235–243. https://doi.org/10.1016/j.drugpo.2013.12.004

Boivin, R., 2013. Drug trafficking networks in the world-economy. Crime Netw. https://doi.org/10.4324/9781315885018

Boles, S.M., Miotto, K., 2003. Substance abuse and violence: A review of the literature. Aggress. Violent Behav. 8, 155–174. https://doi.org/10.1016/S1359-1789(01)00057-X

Bond, B.M., Caulkins, J.P., 2010. Potential for Legal Marijuana Sales in California to Supply Rest of U.S.

Boshier, R., Johnson, D., 1974. Does conviction affect employment opportunities. Br. J. Criminol. 14, 264–268.

Bouchard, M., 2007. On the Resilience of Illegal Drug Markets. Glob. Crime 8, 325–344. https://doi.org/10.1080/17440570701739702

Bouchard, M., Dion, C.B., 2009. Growers and facilitators: probing the role of entrepreneurs in the development of the cannabis cultivation industry. J. Small Bus. Entrep. 22, 25–37.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3, 77–101. https://doi.org/10.1191/1478088706qp063oa

Brooks-Russell, A., Ma, M., Levinson, A.H., Kattari, L., Kirchner, T., Anderson Goodell, E.M., Johnson, R.M., 2019. Adolescent Marijuana Use, Marijuana-Related Perceptions, and Use of Other Substances Before and After Initiation of Retail Marijuana Sales in Colorado (2013–2015). Prev. Sci. 20, 185–193. https://doi.org/10.1007/s11121-018-0933-2

Brunt, T.M., van Genugten, M., Höner-Snoeken, K., van de Velde, M.J., Niesink, R.J.M., 2014. Therapeutic Satisfaction and Subjective Effects of Different Strains of Pharmaceutical-Grade Cannabis. J. Clin. Psychopharmacol. 34, 344–349. https://doi.org/10.1097/JCP.0000000000000129

Bryman, A., 2004a. Listwise Deletion, in: Lewis-Beck, M., Futing Liao, T. (Eds.), The SAGE Encyclopedia of Social Science Research Methods. Sage Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America. https://doi.org/10.4135/9781412950589.n502

Bryman, A., 2004b. Pairwise Deletion, in: Lewis-Beck, M., Futing Liao, T. (Eds.), The SAGE Encyclopedia of Social Science Research Methods. Sage Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America. https://doi.org/10.4135/9781412950589.n682

Burgard, D.A., Williams, J., Westerman, D., Rushing, R., Carpenter, R., LaRock, A., Sadetsky, J., Clarke, J., Fryhle, H., Pellman, M., Banta-Green, C.J., 2019. Using wastewater-based analysis to monitor the effects of legalized retail sales on cannabis consumption in Washington State, USA. Addiction 114, 1582–1590. https://doi.org/10.1111/add.14641

Burns, C.P., 2019. I Was Gonna Get a Job, but Then I Got High: An Examination of Cannabis and Employment in the Post-Barbuto Regime Notes. Boston Univ. Law Rev. 99, 643–682.

Burstein, S., 2015. Cannabidiol (CBD) and its analogs: a review of their effects on inflammation. Bioorg. Med. Chem. 23, 1377–1385. https://doi.org/10.1016/j.bmc.2015.01.059

Callaghan, R.C., Vander Heiden, J., Sanches, M., Asbridge, M., Hathaway, A., Kish, S.J., 2021. Impacts of Canada's cannabis legalization on police-reported crime among youth: early evidence. Addiction. https://doi.org/10.1111/add.15535

Calvert, C.M., Erickson, D., 2021. Recreational cannabis legalization and alcohol purchasing: a difference-in-differences analysis. J. Cannabis Res. 3, 27. https://doi.org/10.1186/s42238-021-00085-x

Calvin, A.J., Bellmore, A., Xu, J.-M., Zhu, X., 2015. #bully: Uses of Hashtags in Posts About Bullying on Twitter. J. Sch. Violence 14, 133–153. https://doi.org/10.1080/15388220.2014.966828

Cambron, C., Guttmannova, K., Fleming, C.B., 2017. State and National Contexts in Evaluating Cannabis Laws: A Case Study of Washington State. J. Drug Issues 47, 74–90. https://doi.org/10.1177/0022042616678607

Cammenga, J., 2020. How High Are Taxes on Recreational Marijuana in Your State? Tax Found. URL https://taxfoundation.org/state-excise-taxes-on-recreational-marijuana-2020/ (accessed 2.9.21).

Caplan, M.A., Purser, G., 2019. Qualitative inquiry using social media: A field-tested example. Qual. Soc. Work 18, 417–435. https://doi.org/10.1177/1473325017725802

Caplan, M.A., Purser, G., Kindle, P.A., 2017. Personal Accounts of Poverty: A Thematic Analysis of Social Media. J. Evid.-Inf. Soc. Work 14, 433–456. https://doi.org/10.1080/23761407.2017.1380547

Carnevale, J.T., Kagan, R., Murphy, P.J., Esrick, J., 2017. A practical framework for regulating for-profit recreational marijuana in US states: lessons from Colorado and Washington. Int. J. Drug Policy 42, 71–85.

Casad, B.J., 2007. Confirmation Bias, in: Encyclopedia of Social Psychology. SAGE Publications, Inc., Thousand Oaks, pp. 163–164. https://doi.org/10.4135/9781412956253

Caulkins, J.P., 2019. Legalising drugs prudently: The importance of incentives and values. J. Illicit Econ. Dev. 1, 279–287.

Caulkins, J.P., 2017. Recognizing and regulating cannabis as a temptation good. Int. J. Drug Policy 42, 50–56. https://doi.org/10.1016/j.drugpo.2017.01.012

Caulkins, J.P., 2010. Estimated cost of production for legalized cannabis. RAND Corporation, WR-764, Santa Monica, CA: RAND; 2010.

Caulkins, J.P., 2007. Price and purity analysis for illicit drug: Data and conceptual issues. Drug Alcohol Depend. 90, S61–S68. https://doi.org/10.1016/j.drugalcdep.2006.08.014

Caulkins, J.P., Bond, B.M., 2012. Marijuana Price Gradients: Implications for Exports and Export-Generated Tax Revenue for California After Legalization. J. Drug Issues 42, 28–45. https://doi.org/10.1177/0022042612436650

Caulkins, J.P., Davenport, S., Doanvo, A., Furlong, K., Siddique, A., Turner, M., Kilmer, B., 2019. Triangulating web & general population surveys: Do results match legal cannabis market sales? Int. J. Drug Policy 73, 293–300. https://doi.org/10.1016/j.drugpo.2019.06.010

Caulkins, J.P., Kilborn, M.L., 2019. Cannabis legalization, regulation, & control: a review of key challenges for local, state, and provincial officials. Am. J. Drug Alcohol Abuse 45, 689–697. https://doi.org/10.1080/00952990.2019.1611840

Caulkins, J.P., Kilmer, B., 2016. Considering marijuana legalization carefully: insights for other jurisdictions from analysis for Vermont: Considering marijuana legalization carefully. Addiction 111, 2082–2089. https://doi.org/10.1111/add.13289

Caulkins, J.P., Kilmer, B., Kleiman, M., MacCoun, R., Midgette, G., Oglesby, P., Pacula, R., Reuter, P., 2015. Considering Marijuana Legalization: Insights for Vermont and Other Jurisdictions. RAND Corporation. https://doi.org/10.7249/RR864

Caulkins, J.P., MacCoun, R., 2003. Limited Rationality and the Limits of Supply Reduction. J. Drug Issues 33, 433–464. https://doi.org/10.1177/002204260303300208

Caulkins, J.P., Reuter, P., 2010. How Drug Enforcement Affects Drug Prices. Crime Justice 39, 213–271. https://doi.org/10.1086/652386

Caulkins, J.P., Reuter, P., 1998. What price data tell us about drug markets. J. Drug Issues 28, 593–612. https://doi.org/10.1177/002204269802800302

Cerdá, M., Kilmer, B., 2017. Uruguay's middle-ground approach to cannabis legalization. Int. J. Drug Policy 42, 118–120. https://doi.org/10.1016/j.drugpo.2017.02.007

Cerdá, M., Mauro, C., Hamilton, A., Levy, N.S., Santaella-Tenorio, J., Hasin, D., Wall, M.M., Keyes, K.M., Martins, S.S., 2020. Association Between Recreational Marijuana Legalization in the United States and Changes in Marijuana Use and

Cannabis Use Disorder From 2008 to 2016. JAMA Psychiatry 77, 165–171. https://doi.org/10.1001/jamapsychiatry.2019.3254

Cerdá, M., Wall, M., Feng, T., Keyes, K.M., Sarvet, A., Schulenberg, J., O'Malley, P.M., Pacula, R.L., Galea, S., Hasin, D.S., 2017. Association of State Recreational Marijuana Laws With Adolescent Marijuana Use. JAMA Pediatr. 171, 142–149. https://doi.org/10.1001/jamapediatrics.2016.3624

Chan, G.C., Hall, W., Freeman, T.P., Ferris, J., Kelly, A.B., Winstock, A., 2017. User characteristics and effect profile of Butane Hash Oil: An extremely high-potency cannabis concentrate. Drug Alcohol Depend. 178, 32–38. https://doi.org/10.1016/j.drugalcdep.2017.04.014

Chandra, S., Barkell, M., 2013. What the price data tell us about heroin flows across Europe. Int. J. Comp. Appl. Crim. Justice 37, 1–13. https://doi.org/10.1080/01924036.2012.708120

Chandra, S., Barkell, M., Steffen, K., 2011. Inferring Cocaine Flows across Europe: Evidence from Price Data. J. Drug Policy Anal. 4. https://doi.org/10.2202/1941-2851.1029

Chandra, S., Joba, J., 2015. Transnational cocaine and heroin flow networks in western Europe: A comparison. Int. J. Drug Policy 26, 772–780. https://doi.org/10.1016/j.drugpo.2015.04.016

Chandra, S., Peters, S., Zimmer, N., 2014. How Powdered Cocaine Flows Across the United States: Evidence From Open-Source Price Data. J. Drug Issues 44, 344–361. https://doi.org/10.1177/0022042614522621

Chandra, S., Radwan, M.M., Majumdar, C.G., Church, J.C., Freeman, T.P., ElSohly, M.A., 2019a. Correction to: New trends in cannabis potency in USA and Europe during the last decade (2008–2017). Eur. Arch. Psychiatry Clin. Neurosci. 269, 997–997. https://doi.org/10.1007/s00406-019-01020-1

Chandra, S., Radwan, M.M., Majumdar, C.G., Church, J.C., Freeman, T.P., ElSohly, M.A., 2019b. New trends in cannabis potency in USA and Europe during the last decade (2008–2017). Eur. Arch. Psychiatry Clin. Neurosci. 269, 5–15. https://doi.org/10.1007/s00406-019-00983-5

Chen, C.-Y., Lin, K.-M., 2009. Health consequences of illegal drug use: Curr. Opin. Psychiatry 22, 287–292. https://doi.org/10.1097/YCO.0b013e32832a2349

Chou, W.-Y.S., Hunt, Y., Folkers, A., Augustson, E., 2011. Cancer Survivorship in the Age of YouTube and Social Media: A Narrative Analysis. J. Med. Internet Res. 13. https://doi.org/10.2196/jmir.1569

Coleman, Jill.S.M., 2018. Interquartile Range, in: The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks, California 91320. https://doi.org/10.4135/9781506326139.n343

Coley, R.L., Kruzik, C., Ghiani, M., Carey, N., Hawkins, S.S., Baum, C.F., 2021. Recreational Marijuana Legalization and Adolescent Use of Marijuana, Tobacco, and Alcohol. J. Adolesc. Health 69, 41–49. https://doi.org/10.1016/j.jadohealth.2020.10.019

Colorado Department of Revenue, 2021. Average Market Rate for Unprocessed Retail Marijuana | Department of Revenue - Taxation [WWW Document]. Aver. Mark. Rate Unprocessed Retail Marijuana. URL https://tax.colorado.gov/average-market-rate (accessed 2.18.21).

Connealy, N., Piza, E., Hatten, D., 2020. The Criminogenic Effect of Marijuana Dispensaries in Denver, Colorado: A Microsynthetic Control Quasi-Experiment

and Cost-Benefit Analysis. Justice Eval. J. 3, 69–93.
https://doi.org/10.1080/24751979.2019.1691934

Coomber, R., 2003. There's No Such Thing as a Free Lunch: How "Freebies" and
"Credit" Operate as Part of Rational Drug Market Activity. J. Drug Issues 33,
939–962. https://doi.org/10.1177/002204260303300408

Cooper, H.L., Bonney, L.E., Ross, Z., Karnes, C., Hunter-Jones, J., Kelley, M.E.,
Rothenberg, R., 2013. The aftermath of public housing relocation: Relationship
to substance misuse. Drug Alcohol Depend. 133, 37–44.
https://doi.org/10.1016/j.drugalcdep.2013.06.003

Cooper, H.L.F., West, B., Linton, S., Hunter-Jones, J., Zlotorzynska, M., Stall, R.,
Wolfe, M.E., Williams, L., Hall, H.I., Cleland, C., Tempalski, B., Friedman,
S.R., 2016. Contextual Predictors of Injection Drug Use Among Black
Adolescents and Adults in US Metropolitan Areas, 1993-2007. Am. J. Public
Health 106, 517–526.
http://dx.doi.org.abc.cardiff.ac.uk/10.2105/AJPH.2015.302911

Cornish, D.B., Clarke, R.V., 2017. The rational choice perspective, in: Wortley, R.,
Townsley, M. (Eds.), Environmental Criminology and Crime Analysis, Crime
Science Series. Routledge, Taylor & Francis Group, London ; New York, pp.
21–44.

Cornish, D.B., Clarke, R.V. (Eds.), 2014. The reasoning criminal: rational choice
perspectives on offending. Transaction Publishers, New York.

Cornish, D.B., Clarke, R.V., 2011. Rational Choice, in: Paternoster, R., Bachman, R.
(Eds.), Explaining Criminals and Crime: Essays in Contemporary
Criminological Theory. OUP USA, Oxford, pp. 23–42.

Cornish, D.B., Clarke, R.V., 1985. Modeling offenders' decisions: A framework for
research and policy. Crime Justice 6, 147–185.

Creswell, J.W., 2008. Research Design: Qualitative, Quantitative, and Mixed Methods
Approaches, Third Edition. ed. SAGE Publications, Inc, Thousand Oaks, Calif.

Creswell, J.W., Clark, V.L.P., 2017. Designing and Conducting Mixed Methods
Research, Third Edition. ed. SAGE Publications, Inc, Los Angeles London New
Delhi Singapore Washington DC Melbourne.

Dai, F., 2017. Kruskal–Wallis Test, in: Allen, M. (Ed.), The SAGE Encyclopedia of
Communication Research Methods. SAGE Publications, Inc, 2455 Teller
Road, Thousand Oaks California 91320.
https://doi.org/10.4135/9781483381411.n285

Davey, Z., Schifano, F., Corazza, O., Deluca, P., Group, on behalf of the P.W.M.,
2012. e-Psychonauts: Conducting research in online drug forum communities. J
Ment Health 21, 386–394. https://doi.org/10.3109/09638237.2012.682265

De Kort, M., Cramer, T., 1999. Pragmatism versus ideology: Dutch drug policy
continued. J. Drug Issues 29, 473–492.

de la Fuente, A., Zamberlan, F., Sánchez Ferrán, A., Carrillo, F., Tagliazucchi, E.,
Pallavicini, C., 2020. Relationship among subjective responses, flavor, and
chemical composition across more than 800 commercial cannabis varieties. J.
Cannabis Res. 2, 21. https://doi.org/10.1186/s42238-020-00028-y

DEA, 2018. 2018 National Drug Threat Assessment. Drug Enforcement Administration.

DEA, 2017. 2017 National Drug Threat Assessment. Drug Enforcement Administration.

Décary-Hétu, D., Aldridge, J., 2015. Sifting through the net: Monitoring of online
offenders by researchers. Eur. Rev. Organised Crime 2, 122–141.

Decker, S.H., Chapman, M.T., 2008. Drug Smugglers on Drug Smuggling: Lessons
from the Inside, 1st edition. ed. Temple University Press.

Decorte, T., 2011. Stories, facts and myths: Perceptions of deomestic cultivators on potency and quality of cannabis, in: World Wide Weed: Global Trends in Cananbis Cultivation and Its Control. Farnham: Ashgate, pp. 91–108.

Decorte, T., Pardal, M., Queirolo, R., Boidi, M.F., Sánchez Avilés, C., Parés Franquero, Ò., 2017. Regulating Cannabis Social Clubs: A comparative analysis of legal and self-regulatory practices in Spain, Belgium and Uruguay. Int. J. Drug Policy 43, 44–56. https://doi.org/10.1016/j.drugpo.2016.12.020

Decorte, T., Potter, G.R., 2015. The globalisation of cannabis cultivation: A growing challenge. Int. J. Drug Policy, Domestic Cannabis Cultivation 26, 221–225. https://doi.org/10.1016/j.drugpo.2014.12.011

Degenhardt, L., Hall, W., 2012. Extent of illicit drug use and dependence, and their contribution to the global burden of disease. The Lancet 379, 55–70. https://doi.org/10.1016/S0140-6736(11)61138-0

Denscombe, M., 2008. Communities of Practice: A Research Paradigm for the Mixed Methods Approach. J. Mix. Methods Res. 2, 270–283. https://doi.org/10.1177/1558689808316807

Di Forti, M., Marconi, A., Carra, E., Fraietta, S., Trotta, A., Bonomo, M., Bianconi, F., Gardner-Sood, P., O'Connor, J., Russo, M., 2015. Proportion of patients in south London with first-episode psychosis attributable to use of high potency cannabis: a case-control study. Lancet Psychiatry 2, 233–238.

Di Forti, M., Morgan, C., Dazzan, P., Pariante, C., Mondelli, V., Marques, T.R., Handley, R., Luzi, S., Russo, M., Paparelli, A., Butt, A., Stilo, S.A., Wiffen, B., Powell, J., Murray, R.M., 2009. High-potency cannabis and the risk of psychosis. Br. J. Psychiatry 195, 488–491. https://doi.org/10.1192/bjp.bp.109.064220

Dilley, J.A., Hitchcock, L., McGroder, N., Greto, L.A., Richardson, S.M., 2017. Community-level policy responses to state marijuana legalization in Washington State. Int. J. Drug Policy 42, 102–108. https://doi.org/10.1016/j.drugpo.2017.02.010

Dills, A.K., Goffard, S., Miron, J., 2016. Dose of Reality: The Effect of State Marijuana Legalizations (SSRN Scholarly Paper No. ID 2842278). Social Science Research Network, Rochester, NY.

DiMaggio, P., Louch, H., 1998. Socially Embedded Consumer Transactions: For What Kinds of Purchases Do People Most Often use Networks? Am. Sociol. Rev. 63, 619–637. https://doi.org/10.2307/2657331

Dolan, K., Moazen, B., Noori, A., Rahimzadeh, S., Farzadfar, F., Hariga, F., 2015. People who inject drugs in prison: HIV prevalence, transmission and prevention. Int. J. Drug Policy 26, S12–S15.

Doran, N., Strong, D., Myers, M.G., Correa, J.B., Tully, L., 2021. Post-legalization changes in marijuana use in a sample of young California adults. Addict. Behav. 115, 106782. https://doi.org/10.1016/j.addbeh.2020.106782

Dorbian, I., 2019. California Is World's Biggest Legal Pot Market, Says New Report [WWW Document]. Forbes. URL https://www.forbes.com/sites/irisdorbian/2019/08/15/california-is-worlds-biggest-legal-pot-market-says-new-report/ (accessed 2.10.21).

Doyle, C., 2016. A Dictionary of Marketing, 4th edition. ed. OUP Oxford, Oxford ; New York.

Dragone, D., Prarolo, G., Vanin, P., Zanella, G., 2019. Crime and the legalization of recreational marijuana. J. Econ. Behav. Organ. 159, 488–501. https://doi.org/10.1016/j.jebo.2018.02.005

Duggan, M., Smith, A., 2013. 6% of online adults are reddit users. Pew Research Center.

Duncan, D.F., White, J.B., Nicholson, T., 2003. Using Internet-based Surveys to Reach Hidden Populations: Case of Nonabusive Illicit Drug Users. Am. J. Health Behav. 27, 208–218. https://doi.org/10.5993/AJHB.27.3.2

Durbin, J., Watson, G.S., 1950. TESTING FOR SERIAL CORRELATION IN LEAST SQUARES REGRESSION. I. Biometrika 37, 409–428. https://doi.org/10.1093/biomet/37.3-4.409

Ekblom, P., 1994. Proximal circumstances: A mechanism-based classification of crime prevention. Crime Prev. Stud. 2, 185–232.

ElSohly, M.A., Mehmedic, Z., Foster, S., Gon, C., Chandra, S., Church, J.C., 2016. Changes in Cannabis Potency Over the Last 2 Decades (1995–2014): Analysis of Current Data in the United States. Biol. Psychiatry, Cannabinoids and Psychotic Disorders 79, 613–619. https://doi.org/10.1016/j.biopsych.2016.01.004

Enghoff, O., Aldridge, J., 2019. The value of unsolicited online data in drug policy research. Int. J. Drug Policy. https://doi.org/10.1016/j.drugpo.2019.01.023

Epstein, M., Bailey, J.A., Kosterman, R., Furlong, M., Hill, K.G., 2020. Evaluating the effect of retail marijuana legalization on parent marijuana use frequency and norms in U.S. States with retail marijuana legalization. Addict. Behav. 111, 106564. https://doi.org/10.1016/j.addbeh.2020.106564

Estellés-Arolas, E., González-Ladrón-de-Guevara, F., 2012. Towards an integrated crowdsourcing definition. J. Inf. Sci. 38, 189–200. https://doi.org/10.1177/0165551512437638

Everson, E.M., Dilley, J.A., Maher, J.E., Mack, C.E., 2019. Post-Legalization Opening of Retail Cannabis Stores and Adult Cannabis Use in Washington State, 2009–2016. Am. J. Public Health Wash. 109, 1294–1301. http://dx.doi.org.abc.cardiff.ac.uk/10.2105/AJPH.2019.305191

Evrard, I., Legleye, S., Cadet-Taïrou, A., 2010. Composition, purity and perceived quality of street cocaine in France. Int. J. Drug Policy 21, 399–406. https://doi.org/10.1016/j.drugpo.2010.03.004

Fataar, F., Goodman, S., Wadsworth, E., Hammond, D., 2021. Consumer perceptions of 'legal' and 'illegal' cannabis in US states with legal cannabis sales. Addict. Behav. 112, 106563. https://doi.org/10.1016/j.addbeh.2020.106563

Firth, C.L., Maher, J.E., Dilley, J.A., Darnell, A., Lovrich, N.P., 2019. Did marijuana legalization in Washington State reduce racial disparities in adult marijuana arrests? Subst. Use Misuse 54, 1582–1587. https://doi.org/10.1080/10826084.2019.1593007

Freeman, T.P., Winstock, A.R., 2015. Examining the profile of high-potency cannabis and its association with severity of cannabis dependence. Psychol. Med. 45, 3181–3189. https://doi.org/10.1017/S0033291715001178

Gale, D., 1955. THE LAW OF SUPPLY AND DEMAND. Math. Scand. 3, 155–169.

Gallagher, A.W.A., Evans-Reeves, K.A., Hatchard, J.L., Gilmore, A.B., 2019. Tobacco industry data on illicit tobacco trade: a systematic review of existing assessments. Tob. Control 28, 334–345. https://doi.org/10.1136/tobaccocontrol-2018-054295

Gallet, C.A., 2014. Can Price Get the Monkey Off Our Back? A Meta-Analysis of Illicit Drug Demand. Health Econ. 23, 55–68. https://doi.org/10.1002/hec.2902

Gelman, A., Hill, J., 2006. Data Analysis Using Regression and Multilevel/Hierarchical Models, 1st edition. ed. Cambridge University Press, Cambridge ; New York.

Gibbons, J.D., 2004. Wilcoxon Test, in: Lewis-Beck, M., Bryman, A., Futing Liao, T. (Eds.), The SAGE Encyclopedia of Social Science Research Methods. Sage Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America. https://doi.org/10.4135/9781412950589.n1087

Gigerenzer, G., Selten, R., 2002. Rethinking Rationality, in: Bounded Rationality The Adaptive Toolbox. MIT Press, pp. 13–37.

Giglietto, F., Rossi, L., Bennato, D., 2012. The Open Laboratory: Limits and Possibilities of Using Facebook, Twitter, and YouTube as a Research Data Source. J. Technol. Hum. Serv. 30, 145–159. https://doi.org/10.1080/15228835.2012.743797

Gilmore, A.B., Rowell, A., Gallus, S., Lugo, A., Joossens, L., Sims, M., 2014. Towards a greater understanding of the illicit tobacco trade in Europe: a review of the PMI funded 'Project Star' report. Tob. Control 23, e51–e61. https://doi.org/10.1136/tobaccocontrol-2013-051240

Giommoni, L., Aziani, A., Berlusconi, G., 2017. How Do Illicit Drugs Move Across Countries? A Network Analysis of the Heroin Supply to Europe. J. Drug Issues 47, 217–240. https://doi.org/10.1177/0022042616682426

Giommoni, L., Gundur, R.V., 2018. An analysis of the United Kingdom's cannabis market using crowdsourced data. Glob. Crime 19, 85–106. https://doi.org/10.1080/17440572.2018.1460071

Giommoni, L., Gundur, R.V., Cheekes, E., 2020a. International Drug Trafficking: Past, Present, and Prospective Trends. Oxford Research Encyclopedia of Criminology and Criminal Justice.

Giommoni, L., Gundur, R.V., Cheekes, E., 2020b. International Drug Trafficking: Past, Present, and Prospective Trends, in: Oxford Research Encyclopedia of Criminology and Criminal Justice.

Goldstein, P.J., 1985. The drugs/violence nexus: A tripartite conceptual framework. J. Drug Issues 15, 493–506.

Goodhart, C., Ashworth, J., 2019. Canadian Legalization of Cannabis Reduces Both its Cash Usage and "Black" Economy (SSRN Scholarly Paper No. ID 3319762). Social Science Research Network, Rochester, NY.

Goodman, S., Wadsworth, E., Leos-Toro, C., Hammond, D., 2020. Prevalence and forms of cannabis use in legal vs. illegal recreational cannabis markets. Int. J. Drug Policy 76, 102658. https://doi.org/10.1016/j.drugpo.2019.102658

Gorsuch, R.L., Butler, M.C., 1976. Initial drug abuse: a review of predisposing social psychological factors. Psychol. Bull. 83, 120.

Gould, J., Donnelly, R., Innacchione, B., 2019. Turning over a new leaf in Colorado: an exploration of legalized recreational marijuana preferences, leisure interests, and leisure motivations in a sample of young adults. World Leis. J. 61, 113–130. https://doi.org/10.1080/16078055.2018.1521866

Granovetter, M., 2005. The Impact of Social Structure on Economic Outcomes. J. Econ. Perspect. 19, 33–50.

Green, G., 2009. Cannabis Grow Bible, The: Definitive Guide to Growing Marijuana for Recreational and Medical Use, 2 edition. ed. GREEN CANDY PRESS, San Francisco, CA.

Grobe, A., Lüer, J., 2011. Drug tourism: Going on a holiday 'trip,' in: Papathanassis, A. (Ed.), The Long Tail of Tourism. Gabler, Wiesbaden, pp. 137–147. https://doi.org/10.1007/978-3-8349-6231-7_15

Grolemund, G., Wickham, H., 2016. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, 1st edition. ed. O'Reilly Media, Sebastopol, CA.

Guttmannova, K., Lee, C.M., Kilmer, J.R., Fleming, C.B., Rhew, I.C., Kosterman, R., Larimer, M.E., 2016. Impacts of Changing Marijuana Policies on Alcohol Use in the United States. Alcohol. Clin. Exp. Res. 40, 33–46. https://doi.org/10.1111/acer.12942

Hall, W., Stjepanović, D., Caulkins, J.P., Lynskey, M., Leung, J., Campbell, G., Degenhardt, L., 2019. Public health implications of legalising the production and sale of cannabis for medicinal and recreational use. The Lancet 394, 1580–1590. https://doi.org/10.1016/S0140-6736(19)31789-1

Hammond, D., Goodman, S., Wadsworth, E., Rynard, V., Boudreau, C., Hall, W., 2020. Evaluating the impacts of cannabis legalization: The International Cannabis Policy Study. Int. J. Drug Policy 77, 102698. https://doi.org/10.1016/j.drugpo.2020.102698

Hansen, B., Miller, K., Weber, C., 2020. Federalism, partial prohibition, and cross-border sales: Evidence from recreational marijuana. J. Public Econ. 187, 104159. https://doi.org/10.1016/j.jpubeco.2020.104159

Hansen, B., Miller, K., Weber, C., 2017. The Taxation of Recreational Marijuana: Evidence from Washington State (Working Paper No. 23632), Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w23632

Hao, Z., Cowan, B.W., 2020. The Cross-Border Spillover Effects of Recreational Marijuana Legalization. Econ. Inq. 58, 642–666. https://doi.org/10.1111/ecin.12764

Hategeka, C., Ruton, H., Karamouzian, M., Lynd, L.D., Law, M.R., 2020. Use of interrupted time series methods in the evaluation of health system quality improvement interventions: a methodological systematic review. BMJ Glob. Health 5, e003567. https://doi.org/10.1136/bmjgh-2020-003567

Hawkins, J.D., Catalano, R.F., Miller, J.Y., 1992. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: implications for substance abuse prevention. Psychol. Bull. 112, 64.

Hawkins, J.M., 2017. Thematic Analysis, in: The SAGE Encyclopedia of Communication Research Methods. SAGE Publications, Inc, 2455 Teller Road, Thousand Oaks California 91320. https://doi.org/10.4135/9781483381411.n624

Hecht, P., 2014. Weed Land: Inside America's Marijuana Epicenter and How Pot Went Legit. University of California Press, Berkeley.

Hewson, C., Vogel, C., Laurent, D., 2016. Internet Research Methods, Second edition. ed. SAGE Publications Ltd, Los Angeles.

Hughes, C.E., Stevens, A., 2010. What Can We Learn From The Portuguese Decriminalization of Illicit Drugs? Br. J. Criminol. 50, 999–1022. https://doi.org/10.1093/bjc/azq038

Hughes, L.A., Schaible, L.M., Jimmerson, K., 2020. Marijuana Dispensaries and Neighborhood Crime and Disorder in Denver, Colorado. Justice Q. 37, 461–485. https://doi.org/10.1080/07418825.2019.1567807

Hunt, P., Pacula, R.L., 2017. Early Impacts of Marijuana Legalization: An Evaluation of Prices in Colorado and Washington. J. Prim. Prev. 38, 221–248. https://doi.org/10.1007/s10935-017-0471-x

Hurley, J.M., West, J.B., Ehleringer, J.R., 2010. Tracing retail cannabis in the United States: Geographic origin and cultivation patterns. Int. J. Drug Policy 21, 222–228. https://doi.org/10.1016/j.drugpo.2009.08.001

Jackson, K., Bazeley, P., 2019. Qualitative Data Analysis with NVivo, Third edition. ed. SAGE Publications Ltd, Thousand Oaks, CA.

Jacques, S., Allen, A., Wright, R., 2014. Drug dealers' rational choices on which customers to rip-off. Int. J. Drug Policy 25, 251–256. https://doi.org/10.1016/j.drugpo.2013.11.010

Jacques, S., Bernasco, W., 2014. Drug dealing: Amsterdam's Red Light District, in: Wortley, R., Leclerc, B. (Eds.), Cognition and Crime : Offender Decision Making and Script Analyses. Routledge, pp. 120–139. https://doi.org/10.4324/9780203083482-17

Jacques, S., Wright, R., 2011. Informal Control and Illicit Drug Trade*. Criminology 49, 729–765. https://doi.org/10.1111/j.1745-9125.2011.00234.x

Jick, T.D., 1979. Mixing Qualitative and Quantitative Methods: Triangulation in Action. Adm. Sci. Q. 24, 602–611. https://doi.org/10.2307/2392366

Johnson, N., 2019. American Weed: A History of Cannabis Cultivation in the United States. EchoGéo. https://doi.org/10.4000/echogeo.17650

Johnson, N., 2017. Grass Roots: A History of Cannabis in the American West, Illustrated edition. ed. Oregon State University, Corvallis.

Jones, J., Nicole Jones, K., Peil, J., 2018. The impact of the legalization of recreational marijuana on college students. Addict. Behav. 77, 255–259. https://doi.org/10.1016/j.addbeh.2017.08.015

Jürgens, P., 2012. Communities of Communication: Making Sense of the "Social" in Social Media. J. Technol. Hum. Serv. 30, 186–203. https://doi.org/10.1080/15228835.2012.746079

Kerr, D.C.R., Bae, H., Phibbs, S., Kern, A.C., 2017. Changes in undergraduates' marijuana, heavy alcohol and cigarette use following legalization of recreational marijuana use in Oregon: Effects of marijuana legalization. Addiction 112, 1992–2001. https://doi.org/10.1111/add.13906

Kerr, W.C., Ye, Y., Subbaraman, M.S., Williams, E., Greenfield, T.K., 2018. Changes in Marijuana Use Across the 2012 Washington State Recreational Legalization: Is Retrospective Assessment of Use Before Legalization More Accurate? J. Stud. Alcohol Drugs 79, 495–502. https://doi.org/10.15288/jsad.2018.79.495

Kilmer, B., 2019. How will cannabis legalization affect health, safety, and social equity outcomes? It largely depends on the 14 Ps. Am. J. Drug Alcohol Abuse 45, 664–672. https://doi.org/10.1080/00952990.2019.1611841

Kilmer, B., Caulkins, J.P., Bond, B.M., Reuter, P., 2010a. Reducing drug trafficking revenues and violence in Mexico: Would legalizing marijuana in California help? Rand Corporation.

Kilmer, B., Caulkins, J.P., Pacula, R.L., MacCoun, R.J., Reuter, P., 2010b. Altered state?: assessing how marijuana legalization in California could influence marijuana consumption and public budgets. RAND Santa Monica, CA.

Kilmer, B., Davenport, S., Smart, R., Caulkins, J.P., Midgette, G., 2019. After the Grand Opening: Assessing Cannabis Supply and Demand in Washington State (Product Page). RAND Corporation.

Kilmer, B., Pacula, R.L., 2017. Understanding and learning from the diversification of cannabis supply laws: Learning from diversification of cannabis laws. Addiction 112, 1128–1135. https://doi.org/10.1111/add.13623

Kilmer, B., Reuter, P., Giommoni, L., 2015. What can be learned from cross-national comparisons of data on illegal drugs?

Kim, J.H., Weinberger, A.H., Zhu, J., Barrington-Trimis, J., Wyka, K., Goodwin, R.D., 2021. Impact of state-level cannabis legalization on poly use of alcohol and cannabis in the United States, 2004–2017. Drug Alcohol Depend. 218, 108364. https://doi.org/10.1016/j.drugalcdep.2020.108364

Kim, S., Colwell, S.R., Kata, A., Boyle, M.H., Georgiades, K., 2018. Cyberbullying Victimization and Adolescent Mental Health: Evidence of Differential Effects by Sex and Mental Health Problem Type. J. Youth Adolesc. 47, 661–672. http://dx.doi.org.abc.cardiff.ac.uk/10.1007/s10964-017-0678-4

Klassen, M., Anthony, B.P., 2019. The effects of recreational cannabis legalization on forest management and conservation efforts in U.S. national forests in the Pacific Northwest. Ecol. Econ. 162, 39–48. https://doi.org/10.1016/j.ecolecon.2019.04.029

Kleiman, M., Davenport, S., Rowe, B., Ziskind, J., Mladenovic, N., Manning, C., Jones, T., 2015. Estimating the size of the medical cannabis market in Washington State. BOTEC.

Kleiman, M.A., 2017. Legal Commercial Cannabis Sales in Colorado and Washington: What Can We Learn? J. Drug Policy Anal. Berl. 10, 601–8. http://dx.doi.org.abc.cardiff.ac.uk/10.1515/jdpa-2015-0020

Kleiman, M.A.R., Caulkins, J.P., Hawken, A., 2011. Drugs and Drug Policy: What Everyone Needs to Know®. Oxford University Press.

Kleiman, M.A.R., Ziskind, J., 2019. Lawful Access to Cannabis: Gains, Losses and Design Criteria. J. Illicit Econ. Dev. 1, 272–278. https://doi.org/10.31389/jied.41

Kollock, P., 1994. The Emergence of Exchange Structures: An Experimental Study of Uncertainty, Commitment, and Trust. Am. J. Sociol. 100, 313–345.

Korf, D.J., 2002. Dutch coffee shops and trends in cannabis use. Addict. Behav. 27, 851–866. https://doi.org/10.1016/S0306-4603(02)00291-5

Kovera, M., 2010. Confounding, in: Salkind, N. (Ed.), Encyclopedia of Research Design. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States. https://doi.org/10.4135/9781412961288.n70

Kozinets, R.V., 2002. The field behind the screen: Using netnography for marketing research in online communities. JMR J. Mark. Res. 39, 61–72.

Kubrin, C.E., Stucky, T.D., Krohn, M.D., 2009. Researching Theories of Crime and Deviance. Oxford University Press.

Kuhn, T.S., 2012. The Structure of Scientific Revolutions: 50th Anniversary Edition. University of Chicago Press.

Kuziemko, I., Levitt, S.D., 2004. An empirical analysis of imprisoning drug offenders. J. Public Econ. 88, 2043–2066. https://doi.org/10.1016/S0047-2727(03)00020-3

Lachenmeier, D.W., Taylor, B.J., Rehm, J., 2011. Alcohol under the radar: Do we have policy options regarding unrecorded alcohol? Int. J. Drug Policy 22, 153–160. https://doi.org/10.1016/j.drugpo.2010.11.002

Ladegaard, I., 2019. Crime displacement in digital drug markets. Int. J. Drug Policy 63, 113–121. https://doi.org/10.1016/j.drugpo.2018.09.013

Lahaie, E., Janssen, E., Cadet-Taïrou, A., 2016. Determinants of heroin retail prices in metropolitan France: Discounts, purity and local markets. Drug Alcohol Rev. 35, 597–604.

Lancione, S., Wade, K., Windle, S.B., Filion, K.B., Thombs, B.D., Eisenberg, M.J., 2020. Non-medical cannabis in North America: an overview of regulatory approaches. Public Health 178, 7–14. https://doi.org/10.1016/j.puhe.2019.08.018

Laqueur, H., Rivera-Aguirre, A., Shev, A., Castillo-Carniglia, A., Rudolph, K.E., Ramirez, J., Martins, S.S., Cerdá, M., 2020. The impact of cannabis legalization in Uruguay on adolescent cannabis use. Int. J. Drug Policy 80, 102748. https://doi.org/10.1016/j.drugpo.2020.102748

Latessa, E.J., Listwan, S.L., Koetzle, D., 2013. What Works (and Doesn't) in Reducing Recidivism, 1st edition. ed. Routledge, Waltham, MA.

Leclerc, B., Wortley, R. (Eds.), 2014. The Reasoning Criminal: Twenty-Five Years on, in: Cognition and Crime: Offender Decision-Making and Script Analyses, Crime Science Series. Routledge, New York, pp. 1–12.

Lee, M.A., 2012. Smoke Signals: A Social History of Marijuana--Medical, Recreational, and Scientific, 1st edition. ed. Scribner, New York.

Levine, H.G., 2003. Global drug prohibition: its uses and crises. Int. J. Drug Policy 14, 145–153. https://doi.org/10.1016/S0955-3959(03)00003-3

Levitt, S.D., Venkatesh, S.A., 2000. An Economic Analysis of a Drug-Selling Gang's Finances. Q. J. Econ. 115, 755–789.

Literat, I., van den Berg, S., 2019. Buy memes low, sell memes high: vernacular criticism and collective negotiations of value on Reddit's MemeEconomy. Inf. Commun. Soc. 22, 232–249. https://doi.org/10.1080/1369118X.2017.1366540

Lockton, D., 2012. Simon's scissors and ecological psychology in design for behaviour change. Available SSRN 2125405.

MacCoun, R., Reuter, P., 1997. Interpreting Dutch cannabis policy: reasoning by analogy in the legalization debate. Science 278, 47–52.

Maccoun, R.J., 2011. What can we learn from the Dutch cannabis coffeeshop system? Addiction 106, 1899–1910. https://doi.org/10.1111/j.1360-0443.2011.03572.x

MacCoun, R.J., 2011. What can we learn from the Dutch cannabis coffeeshop system? Addiction 106, 1899–1910. https://doi.org/10.1111/j.1360-0443.2011.03572.x

MacCoun, R.J., Reuter, P., 2001. Drug war heresies: Learning from other vices, times, and places. Cambridge University Press.

Maclver, B., 2016. What Happened to Washington's Medical Marijuana Market? [WWW Document]. Cannabis Bus. Times. URL https://www.cannabisbusinesstimes.com/article/what-happened-to-washingtons-medical-marijuana-market/ (accessed 2.9.21).

Mahamad, S., Wadsworth, E., Rynard, V., Goodman, S., Hammond, D., 2020. Availability, retail price and potency of legal and illegal cannabis in Canada after recreational cannabis legalisation. Drug Alcohol Rev. 39, 337–346. https://doi.org/10.1111/dar.13069

Makin, D.A., Willits, D.W., Wu, G., DuBois, K.O., Lu, R., Stohr, M.K., Koslicki, W., Stanton, D., Hemmens, C., Snyder, J., Lovrich, N.P., 2019. Marijuana Legalization and Crime Clearance Rates: Testing Proponent Assertions in Colorado and Washington State. Police Q. 22, 31–55. https://doi.org/10.1177/1098611118786255

Mankiw, N., 2011. Principles of Economics, 6th edition. ed. South-Western College Pub, Mason, OH.

Marconi, A., Di Forti, M., Lewis, C.M., Murray, R.M., Vassos, E., 2016. Meta-analysis of the association between the level of cannabis use and risk of psychosis. Schizophr. Bull. 42, 1262–1269.

Mark, T.L., Woody, G.E., Juday, T., Kleber, H.D., 2001. The economic costs of heroin addiction in the United States. Drug Alcohol Depend. 61, 195–206. https://doi.org/10.1016/S0376-8716(00)00162-9

Mayberry, M.L., Espelage, D.L., Koenig, B., 2009. Multilevel Modeling of Direct Effects and Interactions of Peers, Parents, School, and Community Influences on Adolescent Substance Use. J. Youth Adolesc. 38, 1038–49. http://dx.doi.org.abc.cardiff.ac.uk/10.1007/s10964-009-9425-9

Mazerolle, L., Soole, D., Rombouts, S., 2007. Drug Law Enforcement: A Review of the Evaluation Literature. Police Q. 10, 115–153. https://doi.org/10.1177/1098611106287776

McDowall, D., 2004. Interrupted Time-Series Design, in: The SAGE Encyclopedia of Social Science Research Methods. Sage Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America. https://doi.org/10.4135/9781412950589.n446

Medvedev, A.N., Lambiotte, R., Delvenne, J.-C., 2017. The anatomy of Reddit: An overview of academic research, in: Dynamics on and of Complex Networks. Springer, pp. 183–204.

Meinhofer, A., Rubli, A., 2021. Illegal drug market responses to state recreational cannabis laws. Addiction add.15517. https://doi.org/10.1111/add.15517

Miller, A.M., Rosenman, R., Cowan, B.W., 2017. Recreational marijuana legalization and college student use: Early evidence. SSM - Popul. Health 3, 649–657. https://doi.org/10.1016/j.ssmph.2017.08.001

Miller, P.G., Sønderlund, A.L., 2010. Using the internet to research hidden populations of illicit drug users: a review. Addiction 105, 1557–1567. https://doi.org/10.1111/j.1360-0443.2010.02992.x

Mitchell, J.T., Sweitzer, M.M., Tunno, A.M., Kollins, S.H., McClernon, F.J., 2016. "I Use Weed for My ADHD": A Qualitative Analysis of Online Forum Discussions on Cannabis Use and ADHD. PLoS ONE 11. https://doi.org/10.1371/journal.pone.0156614

Molzahn, C., Ríos, V., Shirk, D.A., 2012. Drug violence in Mexico: Data and analysis through 2011. Trans-Bord. Inst. Univ. San Diego San Diego.

Morse, J.M., 1991. Approaches to Qualitative-Quantitative Methodological Triangulation. Nurs. Res. 40, 120–123.

Myran, D.T., Brown, C.R.L., Tanuseputro, P., 2019. Access to cannabis retail stores across Canada 6 months following legalization: a descriptive study. CMAJ Open 7, E454–E461. https://doi.org/10.9778/cmajo.20190012

Nadia, S., Robert, B., 2007. The Chronic Effects of Cannabis on Memory in Humans: A Review. Curr. Drug Abuse Rev. 1, 81–98.

Naylor, R.T., 2003. Towards a General Theory of Profit-Driven Crimes. Br. J. Criminol. 43, 81–101.

NCSL, 2021. NCSL, 2021. Marijuana Overview. [Online]. National Conference of State Legislatures. [WWW Document]. URL https://www.ncsl.org/research/civil-and-criminal-justice/marijuana-overview.aspx (accessed 7.30.21).

NCSL, 2019a. State Medical Marijuana Laws. [Online]. National Conference of State Legislatures [WWW Document]. URL http://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx (accessed 5.25.18).

NCSL, 2019b. NCSL, 2019. Marijuana Overview. [Online]. National Conference of State Legislatures. [WWW Document]. URL https://www.ncsl.org/research/civil-and-criminal-justice/marijuana-overview.aspx (accessed 6.3.20).

Newcomb, M.D., Maddahian, E., Bentler, P.M., 1986. Risk factors for drug use among adolescents: concurrent and longitudinal analyses. Am. J. Public Health 76, 525–531. https://doi.org/10.2105/AJPH.76.5.525

O'Connor, S.M., Mendez, S., Danelo, A., Fukano, H., Johnson, K., Law, C., Shortt, D., 2016. Estimating canopy size for the Washington medical marijuana market. Cannabis Law & Policy Project, University of Washington School of Law.

OLCC, 2021. Oregon Liquor Control Commission : State of Oregon. Oregon Liquor Control Commission.

OLCC, 2019. Oregon Liquor Control Commission : State of Oregon. Oregon Liquor Control Commission.

Olmstead, T.A., Alessi, S.M., Kline, B., Pacula, R.L., Petry, N.M., 2015. The price elasticity of demand for heroin: Matched longitudinal and experimental evidence. J. Health Econ. 41, 59–71. https://doi.org/10.1016/j.jhealeco.2015.01.008

Osborne, G.B., Fogel, C., 2008. Understanding the Motivations for Recreational Marijuana Use Among Adult Canadians. Subst. Use Misuse 43, 539–572. https://doi.org/10.1080/10826080701884911

Osborne, J.W., Waters, E., 2002. Four assumptions of multiple regression that researchers should always test. Pract. Assess. Res. Eval. 8, 2.

Oyaas, T., 2016. Reefer Madness: How Tennessee Can Provide Cannabis Oil Patients Protection from Workplace Discrimination Notes. Univ. Memphis Law Rev. 47, 935–980.

Pacula, R.L., Lundberg, R., 2013. Why changes in price matter when thinking about marijuana policy: A review of the literature on the elasticity of demand. Public Health Rev. 35, 2.

Pacula, R.L., Powell, D., Heaton, P., Sevigny, E.L., 2015. Assessing the Effects of Medical Marijuana Laws on Marijuana Use: The Devil is in the Details. J. Policy Anal. Manage. 34, 7–31. https://doi.org/10.1002/pam.21804

Pacula, R.L., Sevigny, E.L., 2014. Marijuana Liberalization Policies: Why We Can't Learn Much from Policy Still in Motion. J. Policy Anal. Manage. 33, 212–221.

Pacula, R.L., Smart, R., 2017. Medical Marijuana and Marijuana Legalization. Annu. Rev. Clin. Psychol. 13, 397–419. https://doi.org/10.1146/annurev-clinpsy-032816-045128

Pager, D., 2003. The Mark of a Criminal Record. Am. J. Sociol. 108, 937–975. https://doi.org/10.1086/374403

Paoli, L., Greenfield, V.A., Reuter, P., 2009. The world heroin market: can supply be cut?, Studies in crime and public policy. Oxford University Press, Oxford ; New York.

Paoli, L., Reuter, P., 2008. Drug Trafficking and Ethnic Minorities in Western Europe. Eur. J. Criminol. 5, 13–37. https://doi.org/10.1177/1477370807084223

Paoli, L., Spapens, T., Fijnaut, C., 2010. Drug Trafficking, in: Brookman, F., Maguire, M., Pierpoint, H., Bennett, T. (Eds.), Handbook on Crime. Willan, Cullompton, UK ; Portland, Or, pp. 626–650.

Pardal, M., Queirolo, R., Álvarez, E., Repetto, L., 2019. Uruguayan Cannabis Social Clubs: From activism to dispensaries? Int. J. Drug Policy 73, 49–57. https://doi.org/10.1016/j.drugpo.2019.06.022

Pardo, B., 2014. Cannabis policy reforms in the Americas: A comparative analysis of Colorado, Washington, and Uruguay. Int. J. Drug Policy 25, 727–735. https://doi.org/10.1016/j.drugpo.2014.05.010

Parker, H., Measham, F., Aldridge, J., 1998. Illegal Leisure: Normalization of Adolescent Recreational Drug Use, 1st edition. ed. Routledge, London ; New York.

Parkin, M., 2015. Economics, 12 edition. ed. Pearson, Boston.

Parnes, J.E., Smith, J.K., Conner, B.T., 2018. Reefer madness or much ado about nothing? Cannabis legalization outcomes among young adults in the United States. Int. J. Drug Policy 56, 116–120. https://doi.org/10.1016/j.drugpo.2018.03.011

Paschall, M.J., Grube, J.W., 2020. Recreational Marijuana Availability in Oregon and Use Among Adolescents. Am. J. Prev. Med. 58, e63–e69. https://doi.org/10.1016/j.amepre.2019.09.020

Patton, D.U., Hong, J.S., Ranney, M., Patel, S., Kelley, C., Eschmann, R., Washington, T., 2014. Social media as a vector for youth violence: A review of the literature. Comput. Hum. Behav. 35, 548–553. https://doi.org/10.1016/j.chb.2014.02.043

Patton, M.Q., 2002. Qualitative Research & Evaluation Methods, Third edition. ed. SAGE Publications, Inc, Thousand Oaks, Calif.

Phua, V., 2004. Convenience Sample, in: Lewis-Beck, M., Bryman, A., Futing Liao, T. (Eds.), The SAGE Encyclopedia of Social Science Research Methods. Sage Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States of America. https://doi.org/10.4135/9781412950589

Piomelli, D., Russo, E.B., 2016. The Cannabis sativa Versus Cannabis indica Debate: An Interview with Ethan Russo, MD. Cannabis Cannabinoid Res. 1, 44–46. https://doi.org/10.1089/can.2015.29003.ebr

Plunk, A.D., Peglow, S.L., Harrell, P.T., Grucza, R.A., 2019. Youth and Adult Arrests for Cannabis Possession After Decriminalization and Legalization of Cannabis. JAMA Pediatr. 173, 763–769. https://doi.org/10.1001/jamapediatrics.2019.1539

Potency Monitoring Program, 2019. Delta-9-tetrahydrocannabinol (THC) and Cannabidiol (CBD) Potency of Cannabis Samples Seized by the Drug Enforcement Administration (DEA), Percent Averages from 1995-2019 (No. Quarterly Report #146). National Center for Natural Products Research.

Potter, G., Bouchard, M.M., Decorte, M.T., 2013. The Globalization of Cannabis Cultivation, in: World Wide Weed: Global Trends in Cannabis Cultivation and Its Control. Ashgate Publishing, Ltd.

Prestemon, J.P., Koch, F.H., Donovan, G.H., Lihou, M.T., 2019. Cannabis legalization by states reduces illegal growing on US national forests. Ecol. Econ. 164, 106366. https://doi.org/10.1016/j.ecolecon.2019.106366

Queirolo, R., Boidi, M.F., Cruz, J.M., 2016. Cannabis clubs in Uruguay: The challenges of regulation. Int. J. Drug Policy 34, 41–48. https://doi.org/10.1016/j.drugpo.2016.05.015

Record, R.A., Silberman, W.R., Santiago, J.E., Ham, T., 2018. I Sought It, I Reddit: Examining Health Information Engagement Behaviors among Reddit Users. J. Health Commun. 23, 470–476. https://doi.org/10.1080/10810730.2018.1465493

Reddit, 2020. Reddit by the Numbers [WWW Document]. URL https://www.redditinc.com/press (accessed 5.12.21).

Reinarman, C., Levine, H.G., 1997. Crack in America: Demon drugs and social justice. Univ of California Press.

Reppetto, T.A., 1976. Crime Prevention and the Displacement Phenomenon. Crime Delinquency 22, 166–177. https://doi.org/10.1177/001112877602200204

Reuter, P., 2014. The mobility of drug trafficking, in: Ending the Drug Wars. LSE IDEAS, London School of Economics and Political Science, pp. 33–40.

Reuter, P., 2009. Systemic violence in drug markets. Crime Law Soc. Change 52, 275–284. https://doi.org/10.1007/s10611-009-9197-x

Reuter, P., Caulkins, J.P., 2004. Illegal "lemons": price dispersion in cocaine and heroin markets. Bull. Narc. 25.

Reuter, P., Kleiman, M.A., 1986. Risks and prices: An economic analysis of drug enforcement. Crime Justice 7, 289–340.

Risso, C., Boniface, S., Subbaraman, M.S., Englund, A., 2020. Does cannabis complement or substitute alcohol consumption? A systematic review of human and animal studies. J. Psychopharmacol. (Oxf.) 34, 938–954. https://doi.org/10.1177/0269881120919970

Robinson, K.M., 2001. Unsolicited Narratives from the Internet: A Rich Source of Qualitative Data. Qual. Health Res. 11, 706–714. https://doi.org/10.1177/104973201129119398

Rosen, J.D., Zepeda, R., 2016. Organized Crime, Drug Trafficking, and Violence in Mexico: The Transition from Felipe Calderon to Enrique Pena Nieto. Lexington Books, Lanham.

Rotermann, M., 2020. What has changed since cannabis was legalized? Health Rep. 31, 12.

Rup, J., Goodman, S., Hammond, D., 2020. Cannabis advertising, promotion and branding: Differences in consumer exposure between 'legal' and 'illegal' markets in Canada and the US. Prev. Med. 133, 106013. https://doi.org/10.1016/j.ypmed.2020.106013

Rusby, J.C., Westling, E., Crowley, R., Light, J.M., 2018. Legalization of recreational marijuana and community sales policy in Oregon: Impact on adolescent willingness and intent to use, parent use, and adolescent use. Psychol. Addict. Behav. 32, 84–92. https://doi.org/10.1037/adb0000327

Sampson, R.J., Laub, J.H., 1997. A life-course theory of cumulative disadvantage and the stability of delinquency. Dev. Theor. Crime Delinquency 7, 133–161.

Sandberg, S., 2008. Black Drug Dealers In A White Welfare State: Cannabis Dealing and Street Capital in Norway. Br. J. Criminol. 48, 604–619. https://doi.org/10.1093/bjc/azn041

Schober, P., Vetter, T.R., 2021. Segmented Regression in an Interrupted Time Series Study Design. Anesth. Analg. 132, 696–697. https://doi.org/10.1213/ANE.0000000000005269

Schroyer, J., McVey, E., 2019. Majority of California municipalities prohibit commercial cannabis activity [WWW Document]. Marijuana Bus. Dly. URL https://mjbizdaily.com/chart-most-of-california-municipalities-ban-commercial-cannabis-activity/ (accessed 2.9.21).

Seccombe, R., 1995. Squeezing the balloon: international drugs policy*. Drug Alcohol Rev. 14, 311–316. https://doi.org/10.1080/09595239500185401

Selten, R., 2002. What is Bounded Rationality, in: Bounded Rationality The Adaptive Toolbox. MIT Press, pp. 13–37.

Selten, R., 1998. Aspiration Adaptation Theory. J. Math. Psychol. 42, 191–214. https://doi.org/10.1006/jmps.1997.1205

Shaghaghi, A., Bhopal, R.S., Sheikh, A., 2011. Approaches to Recruiting 'Hard-To-Reach' Populations into Re-search: A Review of the Literature. Health Promot. Perspect. 1, 86–94. https://doi.org/10.5681/hpp.2011.009

Sharma, R., Wigginton, B., Meurk, C., Ford, P., Gartner, C., 2017. Motivations and limitations associated with vaping among people with mental illness: A qualitative analysis of reddit discussions. Int. J. Environ. Res. Public. Health 14, 7.

Shukla, R.K., 2006. Using Marijuana in Adulthood: The Experience of a Sample of Users in Oklahoma City. J. Ethn. Subst. Abuse. 4, 153–181. https://doi.org/10.1300/J233v04n03_07

Shukla, R.K., 2005. An examination of decision making and desistance from marijuana use. Their Own Words Crim. Crime 330–340.

Shukla, R.K., Kelley, M.S., 2007. Investigating How Decisions to Use Marijuana Change Over Time. Subst. Use Misuse 42, 1401–1425. https://doi.org/10.1080/10826080701212485

Silvaggio, A., 2018. Cannabis Agriculture in California: The Environmental Consequences of Prohibition, in: Miller, C. (Ed.), Where There's Smoke: The Environmental Science, Public Policy, and Politics of Marijuana. University Press of Kansas, Lawrence, Kansas.

Simon, H.A., 1990. Invariants of Human Behavior. Annu. Rev. Psychol. 41, 1–20. https://doi.org/10.1146/annurev.ps.41.020190.000245

Simon, H.A., 1978. Rationality as process and as product of thought. Am. Econ. Rev. 68, 1–16.

Simon, H.A., 1957. Models of Man. Social and Rational. Mathematical Essays on Rational Human Behavior in a Social Setting., 1st edition. ed. Wiley.

Simon, H.A., 1955. A Behavioral Model of Rational Choice. Q. J. Econ. 69, 99–118. https://doi.org/10.2307/1884852

Simons-Morton, B., Pickett, W., Boyce, W., ter Bogt, T.F.M., Vollebergh, W., 2010. Cross-national comparison of adolescent drinking and cannabis use in the United States, Canada, and the Netherlands. Int. J. Drug Policy 21, 64–69. https://doi.org/10.1016/j.drugpo.2009.02.003

Solymosi, R., Bowers, K.J., Fujiyama, T., 2018. Crowdsourcing Subjective Perceptions of Neighbourhood Disorder: Interpreting Bias in Open Data. Br. J. Criminol. 58, 944–967. https://doi.org/10.1093/bjc/azx048

Spiegelhalter, D., 2020. The Art of Statistics: Learning from Data. Pelican, Place of publication not identified.

Struik, L.L., Baskerville, N.B., 2014. The Role of Facebook in Crush the Crave, a Mobile- and Social Media-Based Smoking Cessation Intervention: Qualitative Framework Analysis of Posts. J. Med. Internet Res. 16, e3189. https://doi.org/10.2196/jmir.3189

Su, J., Supple, A.J., Kuo, S.I.-C., 2018. The Role of Individual and Contextual Factors in Differentiating Substance Use Profiles among Adolescents. Subst. Use Misuse 53, 734–743. https://doi.org/10.1080/10826084.2017.1363237

Subbaraman, M.S., 2016. Substitution and Complementarity of Alcohol and Cannabis: A Review of the Literature. Subst. Use Misuse 51, 1399–1414. https://doi.org/10.3109/10826084.2016.1170145

Tarling, R., 2009. Statistical modelling for social researchers: principles and practice, Social research today. Routledge, London ; New York.

Tashakkori, A.M., Teddlie, C.B., 2010. SAGE Handbook of Mixed Methods in Social & Behavioral Research, Second edition. ed. SAGE Publications, Inc, Los Angeles.

Teddlie, C., Tashakkori, A., 2008. Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences, 1st edition. ed. SAGE Publications, Inc, Los Angeles.

Toth, A.G., Mitchell, O., 2018. A qualitative examination of the effects of international counter-drug interdictions. Int. J. Drug Policy 55, 70–76. https://doi.org/10.1016/j.drugpo.2018.02.012

Turna, J., Belisario, K., Balodis, I., Van Ameringen, M., Busse, J., MacKillop, J., 2021. Cannabis use and misuse in the year following recreational cannabis legalization in Canada: A longitudinal observational cohort study of community adults in

Ontario. Drug Alcohol Depend. 225, 108781.
https://doi.org/10.1016/j.drugalcdep.2021.108781

Unger, J.B., Vos, R.O., Wu, J.S., Hardaway, K., Sarain, A.Y.L., Soto, D.W., Rogers, C., Steinberg, J., 2020. Locations of licensed and unlicensed cannabis retailers in California: A threat to health equity? Prev. Med. Rep. 19, 101165. https://doi.org/10.1016/j.pmedr.2020.101165

UNODC, 2021. World Drug Report 2021. United Nations Office on Drugs and Crime, Vienna.

UNODC, 2017. United Nations Office on Drugs and Crime. 2017. World Drug Report 2017. United Nations Publication.

UNODC, 2016. United Nations Office on Drugs and Crime 2016. World Drug Report 2016 United Nations publication.

UNODC, 2015. Drug Money: the illicit proceeds of opiates trafficked on the Balkan route. U. N. Off. Drugs Crime UNODC Vienna.

Uyanık, G.K., Güler, N., 2013. A Study on Multiple Linear Regression Analysis. Procedia - Soc. Behav. Sci. 106, 234–240. https://doi.org/10.1016/j.sbspro.2013.12.027

van Loon, R., Rouwendal, J., 2017. Travel purpose and expenditure patterns in city tourism: evidence from the Amsterdam Metropolitan Area. J. Cult. Econ. 41, 109–127. https://doi.org/10.1007/s10824-017-9293-1

van Ooyen-Houben, Bieleman, B., Korf, D.J., 2016. Tightening the Dutch coffee shop policy: Evaluation of the private club and the residence criterion. Int. J. Drug Policy 31, 113–120. https://doi.org/10.1016/j.drugpo.2016.01.019

Veligati, S., Howdeshell, S., Beeler-Stinn, S., Lingam, D., Allen, P.C., Chen, L.-S., Grucza, R.A., 2020. Changes in alcohol and cigarette consumption in response to medical and recreational cannabis legalization: Evidence from U.S. state tax receipt data. Int. J. Drug Policy 75, 102585. https://doi.org/10.1016/j.drugpo.2019.10.011

Wadsworth, E., Driezen, P., Hammond, D., 2021. Retail availability and legal purchases of dried flower in Canada post-legalization. Drug Alcohol Depend. 225, 108794. https://doi.org/10.1016/j.drugalcdep.2021.108794

Wadsworth, E., Hammond, D., 2020. Out-of-state cannabis purchases in the United States. Drug Alcohol Depend. 207, 107822.

Wagner, A.K., Soumerai, S.B., Zhang, F., Ross-Degnan, D., 2002. Segmented regression analysis of interrupted time series studies in medication use research. J. Clin. Pharm. Ther. 27, 299–309.

Wall, M.B., Pope, R., Freeman, T.P., Kowalczyk, O.S., Demetriou, L., Mokrysz, C., Hindocha, C., Lawn, W., Bloomfield, M.A., Freeman, A.M., Feilding, A., Nutt, D., Curran, H.V., 2019. Dissociable effects of cannabis with and without cannabidiol on the human brain's resting-state functional connectivity. J. Psychopharmacol. (Oxf.) 33, 822–830. https://doi.org/10.1177/0269881119841568

Wang, L., Zhan, Y., Li, Q., Zeng, D.D., Leischow, S.J., Okamoto, J., 2015. An Examination of Electronic Cigarette Content on Social Media: Analysis of E-Cigarette Flavor Content on Reddit. Int. J. Environ. Res. Public. Health 12, 14916–14935. https://doi.org/10.3390/ijerph121114916

Ward, K.C., Lucas, P.A., Murphy, A., 2019. The Impact of Marijuana Legalization on Law Enforcement in States Surrounding Colorado. Police Q. 22, 217–242. https://doi.org/10.1177/1098611118819902

Weisheit, R.A., 2013. Cannabis Cultivation in the United States, in: Potter, G., Bouchard, M.M., Decorte, M.T. (Eds.), World Wide Weed: Global Trends in Cannabis Cultivation and Its Control. Ashgate Publishing, Ltd.

Weninger, T., 2014. An exploration of submissions and discussions in social news: mining collective intelligence of Reddit. Soc. Netw. Anal. Min. 4, 173. https://doi.org/10.1007/s13278-014-0173-9

Werb, D., Rowell, G., Guyatt, G., Kerr, T., Montaner, J., Wood, E., 2011. Effect of drug law enforcement on drug market violence: A systematic review. Int. J. Drug Policy 22, 87–94. https://doi.org/10.1016/j.drugpo.2011.02.002

Wilkinson, D., Thelwall, M., 2011. Researching Personal Information on the Public Web: Methods and Ethics. Soc. Sci. Comput. Rev. 29, 387–401. https://doi.org/10.1177/0894439310378979

Williams, J., Bretteville-Jensen, A.L., 2014a. Does liberalizing cannabis laws increase cannabis use? J. Health Econ. 36, 20–32. https://doi.org/10.1016/j.jhealeco.2014.03.006

Williams, J., Bretteville-Jensen, A.L., 2014b. Does liberalizing cannabis laws increase cannabis use? J. Health Econ. 36, 20–32. https://doi.org/10.1016/j.jhealeco.2014.03.006

Windle, J., Farrell, G., 2012. Popping the balloon effect: Assessing drug law enforcement in terms of displacement, diffusion, and the containment hypothesis. Subst. Use Misuse 47, 868–876.

Witte, R.S., Witte, J.S., 2016. Statistics, 11th Edition, 11th edition. ed. John Wiley & Sons Inc, Hoboken, NJ.

Wortley, R., 2014. Rational choice and offender decision making: lessons from the cognitive sciences, in: LeClerc, B., Wortley, R. (Eds.), Cognition and Crime: Offender Decision-Making and Script Analyses, Crime Science Series. Routledge, New York, pp. 237–253.

Wortley, R., 2013. Exploring the Person-Situation Interaction in Situational Crime Prevention, in: Tilley, N., Farrell, G. (Eds.), The Reasoning Criminologist: Essays in Honour of Ronald V. Clarke. Routledge, pp. 184–193.

Wouters, M., Benschop, A., van Laar, M., Korf, D.J., 2012. Cannabis use and proximity to coffee shops in the Netherlands. Eur. J. Criminol. 9, 337–353.

WSLCB, 2016a. Licensed marijuana canopy enough to meet State recreational and medical marijuana market | Washington State Liquor and Cannabis Board [WWW Document]. URL https://lcb.wa.gov/pressreleases/licensed-marijuana-canopy-enough (accessed 2.17.21).

WSLCB, 2016b. Board to close marijuana retail license application window March 31, 2016 | Washington State Liquor and Cannabis Board [WWW Document]. URL https://lcb.wa.gov/pressreleases/board_to_close_mj_retail_license_app_window_march31_2016 (accessed 2.17.21).

WSLCB, 2015. Annual Report Fiscal Year 2015. Washington State Liquor and Cannabis Board.

Wu, Z.H., Eschbach, K., Grady, J.J., 2008. Contextual Influences on Polydrug Use among Young, Low-Income Women: Effects of Neighborhood and Personal Networks. Am. J. Addict. 17, 135–144. https://doi.org/10.1080/10550490701863025

Yvonne Feilzer, M., 2010. Doing Mixed Methods Research Pragmatically: Implications for the Rediscovery of Pragmatism as a Research Paradigm. J. Mix. Methods Res. 4, 6–16. https://doi.org/10.1177/1558689809349691

Zhu, B., Guo, H., Cao, Y., An, R., Shi, Y., 2020. Perceived Importance of Factors in Cannabis Purchase Decisions: A Best-worst Scaling Experiment. Int. J. Drug Policy 102793. https://doi.org/10.1016/j.drugpo.2020.102793

Zook, M., Graham, M., Stephens, M., 2012. Data shadows of an underground economy: Volunteered geographic information and the economic geographies of marijuana. Unpubl. Manuscr.

Zuckermann, A.M.E., Battista, K.V., Bélanger, R.E., Haddad, S., Butler, A., Costello, M.J., Leatherdale, S.T., 2021. Trends in youth cannabis use across cannabis legalization: Data from the COMPASS prospective cohort study. Prev. Med. Rep. 22, 101351. https://doi.org/10.1016/j.pmedr.2021.101351