

Prohibition, regulation or laissez faire: The policy trade-offs of cannabis policy

Ole Rogeberg

Frisch Centre, Norway



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ABSTRACT

Trade-offs are central to the cannabis policy debate. Prohibition and strict regulation may help reduce the physical, mental and social harms of cannabis consumption, but at the cost of increasing the harms from illegal markets and reducing consumption benefits. An economic model clarifies how these costs and benefits relate to policy and connects them to observable prices and tax-levels given the assumptions of the analysis. These model-based arguments are related to the ongoing academic policy debate. While some arguments from this literature modify the interpretation of the model (e.g., due to dependence, cognitive biases and market structure), the literature often fails to appropriately account for the magnitude of the policy costs and benefits identified. Taking various caveats into account, the framework indicates that a strict regulation would likely be preferable to prohibition given current estimates of excess harms (externalities and internalities) from cannabis use. While cannabis prohibition appears difficult to justify within an economic regulatory framework, risks from industry influence, policy ratchet effects, and human “decision-making flaws” speak to the need for caution and strong regulation when implementing legal regimes.

Introduction

Policy trade-offs are central to the cannabis policy debate, but there is little consensus on what these trade-offs are or how they should be assessed.

To compare policy regimes, we need to specify the set of important outcomes influenced by policy, consider how these outcomes will differ across regimes, and, evaluate the differences with a normative principle specifying the relative importance of different outcomes. Balancing trade-offs, the “best” policy is the one that results in the best “overall” bundle of outcomes.

Fields and disciplines differ in how they approach this task. Some restrict their analysis to a few outcomes, for example narrow public health approaches that only consider population mortality and morbidity. These implicitly assume that no economic or social benefits could justify any reduction in health. Others list and discuss a bundle of important outcomes without a strong stance on their relative importance or comprehensiveness (e.g., Babor, 2010). Other approaches are more systematic: Researchers or policy stakeholders may be guided through Delphic decision-making processes, or we may develop “drug harm metrics” that assign numerical weights to indicators of social costs, policy effectiveness, drug harms etc (Ritter, 2009).

In this article, I discuss central cannabis policy trade-offs using an economic model, drawing on standard regulatory theory and more

recent work in behavioral economics. The analysis is similar to that underlying cost-benefit analyses used across a broad range of policy issues, including greenhouse gas emissions, pollution, road congestion, and alcohol consumption. Abstracting away much detail, this aims to clarify central trade-offs faced and identify how observable magnitudes such as tax levels and drug prices reflect policy-relevant harms and benefits.

Trade-offs between three types of outcomes are highlighted: a) the myriad physical, mental and social harms of drug consumption, b) the subjectively perceived benefits of consumption, and c) the harms from illegal markets. These are largely determined by economic factors: Taxes and regulation shape the supply side and determine prices, availability and illegal activity. Legality, price and availability, in turn, help determine consumption prevalence and patterns, which determine use-related harms.

Economic models are simple theoretical systems that serve as cognitive tools. They help clarify the policy relevance and implications of an established knowledge base, assisting reasoning when there are “adding-up constraint[s], indirect chain[s] of causation, feedback effect [s], etc.” (Krugman, 1998). This helps avoid the human tendency to substitute simpler substitute problems in the face of complexity (Kahneman, 2011). As with any tools, they can – and have been – misused. In particular, economists have at times fetishized models as alchemical machines converting *a priori* assumptions into fact, in effect

E-mail address: ole.rogeberg@frisch.uio.no.

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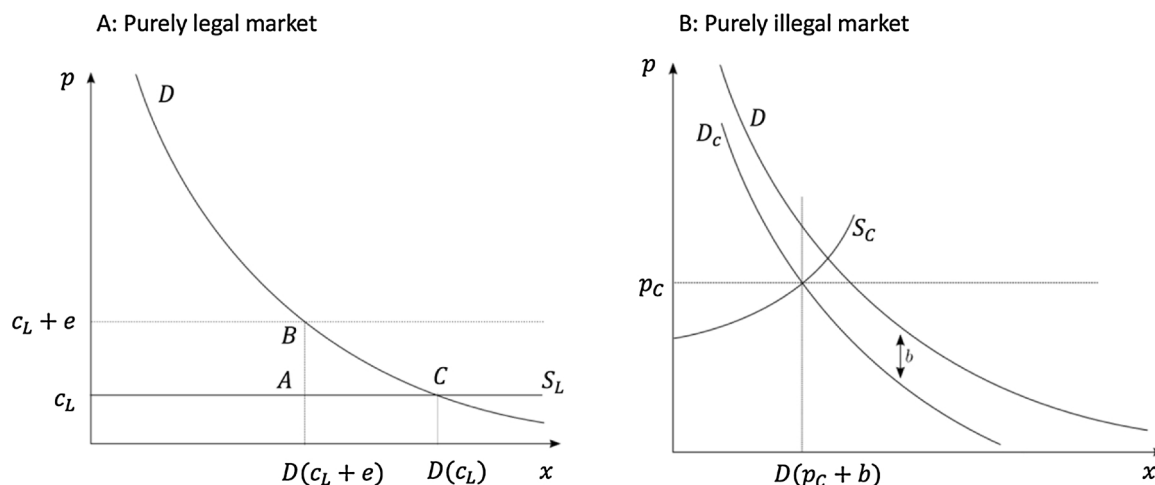


Fig. 1. Pure legal and pure illegal market. In panel A, if the good is untaxed, market volume is equal to the demand at the price $p_L = c_L$. If the good is taxed at a level equal to the excess costs e , demand declines to $D(c_L + e)$. The area between the three points A, B and C are equal to the welfare loss avoided by imposing the tax. In panel B, illegal supply curve is higher, increasing the illegal price p_C , and consumers value the good less by b (law-breaking stigma and risks, quality differences).

mistaking “beauty, clad in impressive-looking mathematics, for truth” (Krugman, 2009). For example, prominent economists have argued that addictive use is the gradual, controlled implementation of a rational, forward-looking, welfare-maximizing plan (see Rogeberg, 2004; Rogeberg & Melberg, 2011 for references and criticism). Such absurd conclusions are due to bad models – often resting on an assumption that all humans are logically omniscient, well-informed creatures that un-faillingly make optimal choices. As two economists put it, “[e]conomists will and should be ignored if we continue to insist that it is axiomatic that constantly trading stocks or accumulating consumer debt or becoming a heroin addict must be optimal for the people doing these things merely because they have chosen to do it” (O’Donoghue & Rabin, 2003).

In summary, the analysis that follows aims to analyse cannabis policy within a standard economic framework built on reasonable, well-supported assumptions regarding cannabis use, harms and markets. The goal is to provide a “high-level” evaluation of whether a prohibition can be justified by the regulatory principles commonly employed in economic policy analysis, and to relate the conclusions to arguments from the ongoing policy debate.

A model of regulatory intensity for a good with negative externalities

The assumptions

An economic model is a formal system capturing a set of assumptions and clarifying their logical implications. In our case, the model is built to capture the following elements:

- **Downward sloping demand curve** If prices decline, cannabis consumption will tend to increase by attracting new consumers or increasing the consumption of current users. The price responsiveness of a good is measured as a price elasticity, the percentage change in purchase volumes following a 1% increase in price. A recent meta-analysis pooled studies and reported low price elasticities for cannabis, in the -0.3 to -0.15 range (Gallet, 2014). This suggests that cannabis use is not strongly influenced by price,¹ but the variability

¹ The elasticities are below those of cigarettes, alcohol and hard drugs, which the authors note may be due to a variety of factors: Cannabis may be more addictive than thought, making it hard to change consumption levels. Alternatively, this may reflect the low budget share of cannabis, less experienced users (with fewer alternative sources of supply) or lower substitutability of cannabis.

in estimates is substantial (see estimates and literature section in Davis, Geisler, & Nichols, 2016)

- **Externalities or internalities** Cannabis use has harmful consequences on average that are not considered by the user, either because they harm others (external effects) or because users are unaware of, excessively discount, or are incapable of taking into consideration future harms to themselves.
- **Dislike/stigma for breaking the law** There are legal, social, and product quality risks associated with buying products in illegal markets. Other things equal, legal goods will tend to be preferred over illegal goods.
- **Inefficient illegal production** Illegal production is targeted by the police, and requires costly and inefficient practices to avoid detection. Costs are further raised to the extent that workers require compensation for risks, stigma and moral scruples to be willing to work in the illegal sector.
- **Constant legal unit production costs** Legal production costs can be viewed as largely unaffected by total market volume, because benefits from scale are limited relative to the size of the total market.
- **Markets tend to move towards equilibrium** As consumers and suppliers adapt to existing market prices, their actions will affect prices and tend to reduce profits. If costs decline, for instance, existing suppliers will raise production and new suppliers may enter the market. This increases the total supply, causing prices to decline until demand and supply match.

Note that the above assumptions do *not* imply that consumers and suppliers are fully rational or always make optimal choices. What we do assume is only that they respond in a predictable way to changes in incentives.

The model

In a legal market with no illegal competition, the demand for cannabis is assumed to increase as prices decline, which can be captured in a supply-demand diagram by a declining demand curve D (Fig. 1, panel A). Legal supply S_L is able to provide any quantity of cannabis at a low price equal to a fixed per-unit production cost c_L , and in the absence of any corrective taxation we would expect a low market price $p_L = c_L$ with high consumption $D(c_L)$.

Standard economic theory uses “individual welfare” as the normative yardstick, typically assuming that willingness to pay for a good reflects the net benefits that a consumer believes he or she will receive from the purchase, and that the production cost of a good reflects the

value we could create by using the labor and resources elsewhere in the economy. In addition, the burden of harms that consumers or producers impose on others is specified as the monetary value that would fully compensate the affected individuals.

Given this normative criterion, the “free market” situation is a poor solution since consumption has a lower value for consumers than the costs it imposes on society. The price is p_L , and consumers buy as long as their perceived value exceeds this, but they ignore the excess harms e . If we could reduce consumption, this would increase welfare: Producing one less unit, we release resources with a value of c_L and avoid excess harms e . Consumption benefits, meanwhile, only decline by $p_L = c_L$, giving a net welfare gain of e .

The standard solution to externalities is a corrective “Pigouvian” tax equal to the excess costs. This raises the consumer price to $p_L = c_L + e$, ensuring that consumers only buy as long as their net benefit is larger than the full costs, which reduces consumption to $D(c_L + e)$. In the diagram, the welfare gain of taxing is shown by the area ABC (Fig. 1, panel A).

While people still experience harms to themselves and others in this solution, raising taxes further would reduce harms too much, with a larger loss in consumption benefits than we save on reduced harm and production costs.

Turning to a fully illegal market (Fig. 1, panel B), this differs from the fully legal case in three ways. First, illegal products cannot be taxed. Second, illegal production is more difficult to scale: large production facilities and complex organizational structures are more easily targeted and exposed by police, and an increased market creates a public and political demand for increased enforcement. As a result, the illegal or criminal supply curve S_C lies higher and slopes upwards. Third, consumers prefer legal goods to equivalent illegal goods by some value b , which means that the demand curve facing the illegal (criminal) market is D_C , equal to the original demand curve shifted down (a constant b is a simplification that does not substantially affect results). As a result, a purely illegal market facing the same population demand has a substantially higher market price – reflecting higher supply costs – and lower consumption – reflecting a higher price and a lower value of the goods produced.

Combining both the legal and illegal market, we get a situation where the two markets compete. The legal price is determined by the constant per-unit cost and the tax, and the (untaxed) illegal market will survive to the extent that it can reduce prices sufficiently. This gives the illegal demand curve a kink where the illegal price $p_C = p_L - b$, since people only buy illegally when this provides more value than legal purchases.

The size of the illegal market will now depend on the tax level, since a higher tax makes the legal product less competitive with the illegal product. A sufficiently high tax will leave the legal market fully out-competed, resulting in a de facto prohibition with only illegal supply.

Embedding both markets in the same diagram, we can illustrate the three possible cases that follow if we impose the classic Pigouvian tax (Fig. 2):

- Purely legal market (panel A) If the legal tax is set sufficiently low, legal production fully outcompetes the illegal market. Illegal supply is minimized at the cost of low prices and high consumption harms.
- Purely illegal market (panel B) If the legal tax is sufficiently high, legal production is fully outcompeted by the illegal market. Prices are high and consumption is low, while illegal supply costs are high.
- Dual markets (panel C) In the remaining cases, supply is divided between legal and illegal markets, with a mix determined by the tax level: A tax t raises the legal price to $p_L = c_L + t$, which means that the less desirable illegal good will have a price of at most of $p_C = p_L - b$. At this illegal price, illegal supply is equal to $S_C(c_L + t - b)$, and the remaining supply ($D(p_L) - S_C(p_C)$) is produced legally.

Policy implications of the model

At this stage, the model provides a structure that identifies three main costs and benefits of regulatory policy: the *consumption value* of the good (measured by the willingness to pay), the *external and internal costs* that are not taken into account (captured in the excess cost e), and the *legal and illegal supply costs*. Optimal policy will balance these to maximize the net benefits. Although the model specifies the structure of the problem, however, empirical information about the relative magnitude and interdependencies of these costs and benefits is required to identify an appropriate policy.

Some general policy relevant points follow from the model:

1. High prices in the legal and illegal market are not equivalent from a policy standpoint. This point remains poorly understood, with one group of researchers writing that “inefficiency” and “high costs” in the production of cannabis have an “ambiguous” welfare effect when we want high prices to correct for externalities (Pacula, Kilmer, Wagenaar, Chaloupka, & Caulkins, 2014).
 - a A tax raises the *price* without substantially increasing real costs (i.e. use of manpower, raw materials etc). This allows the tax to function as a stand-in for costs that are not priced into the good automatically (e.g., ignored harms to the user or others), forcing consumers to confront the full costs of their decisions.
 - b The higher illegal price reflects high costs in supplying illegal drugs, and does not correct for excess costs. As an illustration, if the excess costs of alcohol were equal to the current legal price X , the externality corrected price would be $2X$. If a prohibition doubled the alcohol price, consumers would only consume alcohol valued at more than $2X$, but $2X$ would now be the illegal production cost and the valuation would still be below the full costs (now $3X$).
2. *The optimal tax is bounded upwards by the size of the excess costs e .* If there is no illegal market, the tax should be equal to the excess costs.
3. Criminal market activity may be reduced by lower taxes. Lowering taxes will improve the relative competitiveness of the legal market and reduce illegal markets. Lower taxes will also grow the total market, increasing use and use-related harms. Whether this is a good “policy deal” or not depends on the relative magnitudes of the two effects.
4. Prohibitions are the best policy when excess costs are sufficiently high relative to the illegal price. In these cases, the excess costs will be high. A lower tax would reduce the illegal market, but this benefit could be undone by increases in total consumption and the additional use-harms generated by this.

Note that the policy conclusion from this framework depends on substance specific details: How big are the harms-from-use? How sensitive is consumption to price? How much does the illegal market shrink when legal prices decline? This makes the framework starkly different from an earlier economic model arguing that all prohibitions are poor policy (Becker, Murphy, & Grossman, 2006). That conclusion, however, rested on the implausible assumption that illegal markets are unavoidable under prohibition and easily extinguished when there is a legal market *no matter the tax level*.²

² Specifically, the authors claimed that severe punishments would be sufficient to deter illegal activity in competition with the legal market “[w]hatever the level of the optimal monetary tax.” Sufficiently severe penalties would deter everyone from breaking the law, making actual enforcement costs low. By this argument, however, an optimal tax that pushed the legal price above the legal demand curve choke point (where legal demand goes to zero) would establish a successful prohibition with no illegal market, while a directly mandated prohibition would be unable to do the same.

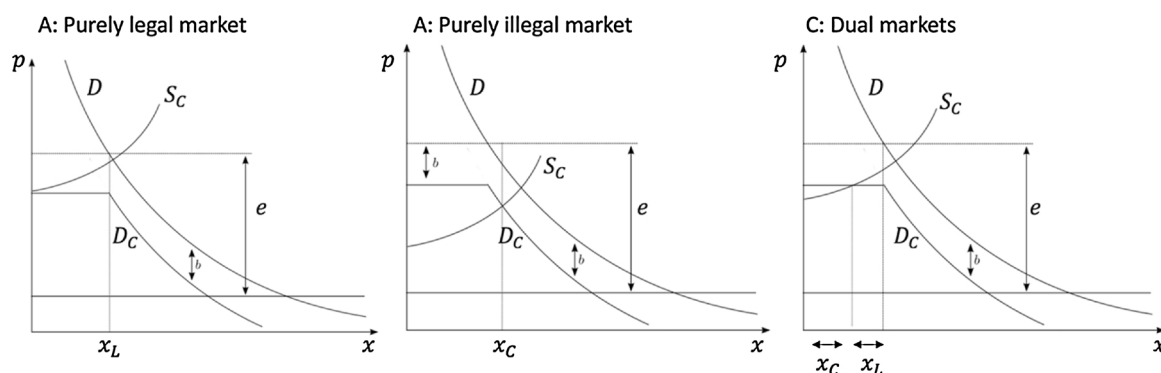


Fig. 2. Possible solutions with two markets. Whether the solution results in a purely legal, purely illegal or dual market solution depends on the illegal supply curve relative to the legal taxed price. If the illegal market is unable to match the legal price at any volume, we get a fully legal market (panel A). If the illegal market can meet all demand at prices lower than $p_L - b$, then the legal market is fully outcompeted (panel B). In the remaining cases (panel C), the market is divided between the two markets, with an illegal price equal to $p_C = p_L - b$.

Policy relevance of identified costs and benefits

The standard assumptions used so far may not be appropriate for all goods and markets. We next examine how the three policy magnitudes are treated in other studies of cannabis policy, and the extent to which this raises arguments suggesting adjustment to the baseline analysis.

Perceived consumer benefits

The economist's baseline assumption is that people believe they get a value from their goods at least equal to the price they pay. This assumption seems to be uncommon in the academic policy debate. In the public health literature, in particular, such benefits are at times entirely ignored (Rogeberg, 2015). In defence of this, it has been argued that “[i]f there were evidence that the pleasures of drug use could be experienced without the pain, we would have perhaps shown more interest in the policy implications of this fascinating topic” (Babor, 2015). Alternatively, it has been argued that subjectively perceived benefits of use involves a welfare economic framing that “ignores how the markets in [alcohol, tobacco, salt, saturated fats and sugar] have been constructed, and consumer preferences motivated by market forces” (Room, 2015).

If market forces could determine consumer preferences, we should clearly wish for them to “construct” desires for goods without social, personal or health risks. This, however, presupposes an unrealistic “blank slate” perspective on human psychology. Why are commercial actors and cultural forces that promote vegetables, jogging shoes and hiking equipment less successful in constructing or motivating preferences? Likely because evolution has shaped human tastes and preferences to make sugar, fat, love, status, intoxicants, etc. more intrinsically desired.

Researchers from social science backgrounds seem more likely to note the potential relevance of consumer benefits from cannabis, but rarely give them much weight in the analysis. While a standard cost-benefit analysis accepts prices as a measure of consumer benefit in the absence of evidence to the contrary, the burden of proof seems reversed when the topic is cannabis. A prominent group of researchers note that some intoxicated hours are “intensely pleasurable and cause no harm to the user or anyone else; others contribute to dysfunction and personal failure” (Caulkins et al., 2015). They note consumption benefits as a major issue that it is “entirely unclear” how we should score. This arguably exaggerates the uncertainty involved, suggesting that any personal belief regarding the net welfare of cannabis consumption is equally tenable. In line with this, a recent article at one point claims that “if both those who love and those who hate cannabis would monetize its use at something like \$1–5 per hour of intoxication, albeit with different signs”, then this valuation would largely determine the

conclusion of a cost-benefit analysis of legalization (Caulkins, 2017).³ This seems to suggest that our ignorance with regards to consumption benefits is so fundamental that analysts can base their valuation on their personal feelings towards cannabis.

This latter stance is excessive, but skepticism regarding the magnitude of consumption benefits is reasonable: consumption of intoxicants tends to be strongly skewed, with 10% of drinkers consuming more than 50% of all alcohol (Kerr & Greenfield, 2007) and some 20% of cannabis users smoking about 70% of all cannabis (Light, Orens, Lewandowski, & Pickton, 2014). For cannabis, use is also on the increase, with the US seeing a 30% increase in adult users from 2002 to 2014, a near doubling in daily or near-daily adult use (from 1.9% of all adults to 3.5%), though interestingly no growth in the share of adults with cannabis use disorders (1.5%) (Compton, Han, Jones, Blanco, & Hughes, 2016).

To deal with the different types of users, one approach is to split total consumption volumes into use by people with dependence issues, daily or frequent users, teenagers, etc. (Caulkins, 2017). It is suggested that all cannabis use by people with dependence issues (whether to cannabis, alcohol or other substances) is “bad use”. Frequent use is viewed as being of questionable value, since “denial is a hallmark of addiction” and since even non-dependent frequent use may prevent people from “maximizing their income potential.” In conclusion, the “pessimistic view” is that only the remainder – 10% of consumption – is “good use.”

This approach seems overly crude, categorizing whole user groups based on whether their use may be problematic. The “bad use” categories as such are reasonable, however, in that frequent use and use by people with substance use issues is more likely to involve control issues or substantial harm from use. Experiencing undesired harm or control issues, however, is not sufficient to make consumption a net-loss: a worker may want a 20-h week, but prefer a job with 40-h weeks to being unemployed. Similarly, a cannabis user may want to use in the weekends, in practice be tempted to use daily – yet prefer this to not using at all.

Focusing more directly on harms due to dependence and the attitudes of users towards their own use, I have elsewhere suggested an indicative approach that uses estimates of entry- and exit-rates into and out of dependence to calculate an “expected duration as dependent” for a new user, combining this with estimates of the harm imposed by the substance in question and the attitudes of users towards their own use (see Rogeberg, 2015 for sources of estimates). Comparing four substances, this places cigarettes at one extreme with about 13 dependent years per ever-user, physical (social) harms of 1.9 (1.4) on a 0–3 scale,

³ Caulkins himself is on record with his belief that “[i]t is clear we would all be better off if marijuana did not exist” (Caulkins, 2016).

and some 70–90% of users expressing regrets over use. For alcohol, the expected dependence period is 3.9 years with harms of 2.2 (2.2), and a majority of consumers likely positive to their own use. For cannabis, the expected duration is 1.1 years, harms are 1.5 (1.5), and the majority of consumers likely positive to their own use. The harm differentials for cannabis and alcohol are also in line with the DALY weights used to score dependence and abuse, which range from 0.11 (harmful use) to 0.55 (manifest alcoholism) for alcohol, and which are estimated at 0.11 for both dependence and harmful use of cannabis (Mathers, Vos, & Stevenson, 1999).

This admittedly crude analysis is clearly not the final word, but suggests there is a stronger case for substantial user benefit from cannabis than for alcohol. If this is the case, we should give these benefits a weight equal to or higher than the weight we assign consumption benefits of alcohol in alcohol policy. As Krugman wrote, expressing his agreement with the legalization stance of the New York Times, “I do drink alcohol, and I see no reason to accord special privilege to my recreational drug of choice” (Krugman, 2014).

Excess harms: harms to others

The excess costs, as we have defined them, combine two kinds of harm: Harms that affect people other than the user, and harms that affect the user but which the user fails to take into account.

Harms that affect others are labelled externalities, as when consumption of a substance increases the risk of other-harming behavior (violence, rape, crime, impaired driving), or when consumption harms the user mentally or physically and triggers publicly funded health treatments or social security payments.

For cannabis, such harms are seen as modest (Caulkins et al., 2015). While there is evidence of “some clear acute and chronic health effects, especially of frequent, high-dose marijuana use”, the main “health and safety consequences of marijuana use” are held to lie in how cannabis use affects the use of other substances such as alcohol and cigarettes. This view of cannabis seems reasonably prevalent in the research community, with harms of cannabis typically scored below either of these legal substances (Babor, 2010; Nutt, King, & Phillips, 2010; van Amsterdam & van den Brink, 2010).

An exception to this is impaired driving, which has been highlighted as one of “the three primary reasons for concern about legalized cannabis” (Huestis, 2015). The empirical evidence, however, suggests that the presence of THC (the main psychoactive component in cannabis) in drivers is – on average – associated with only minor increases (20–30%) in traffic crash risk (Rogeberg & Elvik, 2016b), while an upper-bound analysis suggests that acute intoxication on average at most doubles the baseline risk (Rogeberg & Elvik, 2016a). To place this in context, such risk increases are below those associated with blood alcohol concentration (BAC) at or below the US legal limit of 0.08 (Babor et al., 2003). This suggests that impaired driving is not a danger relating to cannabis use in particular, and a danger better addressed by impaired driving policies than by a blanket prohibition.

While the above sources indicate that the harms from cannabis use are moderate, they do not quantify the total net harm involved. One recent attempt to sum up the harms estimated the disability-adjusted lifeyears (DALY) lost due to cannabis use in Canada (Imtiaz et al., 2016). Based on their review of the literature, the authors included effects on the risk of schizophrenia, lung cancer and road traffic crashes and estimated an annual burden of 66 346 DALYs (95% CI = 47 785, 87 207).⁴ Using the per-capita GDP as the economic value of a DALY and

combining this with the Canadian government’s estimate of cannabis consumption pre-legalization (about 600 t), this gives an average harm per gram of cannabis of about 5 USD. A related attempt from Australia estimated the “social cost” per gram at 11 Australian dollars in 2007 (Moore, 2007), which included health, crime and road traffic costs. Converting to USD and correcting for inflation gives us an estimate of about 10 USD per gram.

These numbers provide an inflated estimate of “harms to others,” since some of these harms fall on the user. They do, however, provide a useful upper bound or indication of the scale of the total harms.

Excess harms: harms to self

While cannabis does not seem to impose substantial harms on third parties, and while medical harms are moderate, its use may nonetheless be harmful to users themselves in other ways.

One view holds that the “real danger” with cannabis is that it is a “performance-degrading” drug and a “temptation commodity with habituating tendencies” that poses threats to “nebulous objectives like ‘achieving one’s potential’ and bourgeois totems like academic and career success” (Caulkins, 2016). Such harms have been labelled “non-medical internalities” (Caulkins, 2017), i.e. harms on people’s future selves that they fail to take into account.

Internalities are an important topic given increasing attention in economics. Traditionally, economists held to a “revealed preferences” paradigm where any choice made was thereby “proven” to be the welfare-maximizing choice. Behavioral economics has since then provided substantial evidence that choices are influenced by habit, psychological “rules of thumb” (heuristics) and social pressure (cfr. Kahneman 2011). This distorts choices, and these distortions can be targeted by what we may call “therapeutic regulation” that identifies specific behavioral issues and designs policies to address them. If people are biased towards immediate pleasure and find themselves consistently consuming more temptation-goods than they want, this can justify a policy of self-determined quotas for future purchases, allowing consumers to tie their future selves to the mast (Beshears, Choi, Laibson, & Madrian, 2005). If advertising and public consumption presents dependent individuals with environmental cues that trigger strong urges, welfare may be improved by stricter regulations on advertising and public consumption (Bernheim & Rangel, 2005; Laibson, 2001). A popular concept from this literature is that of a “nudge” (Thaler & Sunstein, 2008), which is a non-invasive policy that helps consumers make better choices by improving the design of information on risks or costs, making “typically good” options the default, placing temptation goods out of sight in stores (as in the Norwegian display bans that places cigarettes out of sight in stores), etc.

Although this literature provides new justifications for policy, the literature also expresses a *regulatory caution*: spotting some human limitation or bias does not allow us to ignore preferences; harms generated by human biases and limitations will differ across people and contexts, and policy needs to be weigh the positive effects of restrictions on those who need it against the negative effects on those who do not (O’Donoghue & Rabin, 2005); policies should be designed to specifically address identified shortcomings, and there are principles we should follow to reduce the risk that we are simply “imposing the regulator’s preferences on individuals” (Allcott & Sunstein, 2015).

To ensure that the preferences we describe are preferences of the individual rather than the analyst, one approach suggests that we look for ways that the same individuals choose differently in different contexts, and place higher weights on the preferences expressed in calm states and bias-reducing contexts (Allcott & Sunstein, 2015). If cigarette smokers regularly request help quitting, buy nicotine-replacement

⁴ Issues can be raised regarding the high risk coefficients used for these outcomes, but this is beyond the scope of the current article. Note for instance, that while lung cancer is included as a cannabis-related harm, a recent research review reported moderate evidence of “no statistical association” on this outcome (Committee on the Health Effects of Marijuana: An Evidence Review and Research Agenda, Board on Population Health and Public, Health Practice, Health and Medicine Division, & National Academies of Sciences,

(footnote continued)
Engineering, and Medicine, 2017).

therapy, quit and relapse repeatedly, and express strong regret over their smoking— then this is credible evidence that their smoking choices are not in line with their own considered interests. There is little evidence that cannabis users have the same ambivalence, with research suggesting that experience with cannabis makes people more positive towards the substance and its legalization, with effects persisting after they themselves cease using (Palali & Van Ours, 2014; Williams, Ours, & Grossman, 2011).

This raises the question of how far the consequences noted by Caulkins are harms in the eyes of the individuals themselves. Defining cannabis as a “temptation good,” he compares it to “moral temptations” (e.g., gambling, pornography), “time sinks” (e.g., video games, reality shows) and “diet busters” (e.g., fattening foods), and notes that frequent cannabis users may be “having fun but are also not maximizing their income potential; they are happy at that moment but at long-term cost to their success” (Caulkins, 2017). He provides little evidence that cannabis users express strong regret or have strongly shifting views on their own cannabis use, and seems skeptical that cannabis users themselves can judge the issue, raising the “question whether daily or near-daily use by adults is a problem only if those users themselves describe it as such?”

Many activities and goods absorb sufficient time and energy to make people fall short of their full academic, career or income potential – an activity list that extends to hobbies, entertainment, socializing, or the decision to establish a family. If people are happy with their choices in these matters, it is unclear why we should view the reduced future income reduction a “harm” that needs correction. Without a principle to justify treating some income reducing choices (e.g., cannabis use) differently from others (e.g., learning the piano or birdwatching), we risk making policy prescriptions that reflect our personal distaste for deviance from personal or social ideals more than a concern for people’s own experiences and subjectively evaluated welfare.

Even accepting income-reduction as a harm, we may question how substantial these effects are. A widely noted study identifying a negative causal impact on educational outcomes also notes that the impact of legal access to cannabis was almost identical to earlier estimates for legal access to alcohol, with effect sizes slightly lower than the effect of sleeping an hour less in the morning (Marie & Zölitz, 2017). A recent review found “limited evidence” of causal effects on educational achievements and employment outcomes, noting that much of the available research consists of cross-sectional or observational studies plagued by selection issues, confounding and limited opportunities for causal inference (Committee on the Health Effects of Marijuana: An Evidence Review and Research Agenda, Board on Population Health and Public, Health Practice, Health and Medicine Division, & National Academies of Sciences, Engineering, and Medicine, 2017). This is similar to the conclusions of a WHO report, which considered it likely that strong correlations between cannabis use and negative social and educational outcomes are substantially inflated due to selection and confounding (Hall, Renstrom and Poznyak, 2016).

Finally, even if we *do* identify significant and important internalities, this may speak to subtle legal regulations rather than a policy of prohibition, as shown by four proposed principles for regulating internalities (Allcott & Sunstein, 2015): 1) taxes and subsidies will tend to be better than mandates or bans, as a “one size-fits all” solution is unlikely to be appropriate in the face of differences in preferences, values and abilities; 2) policies should target the distortion generating the problem, ideally avoiding large burdens on those in no need of help; 3) policies should minimize losses from regulators’ imperfect information, and 4) policies should aim to maximize net benefits.

In conclusion, the issue of internalities and cognitive biases seems to caution strongly against a legal system of commercialized sales with heavy advertisements geared towards promoting heavy use of a habituating substance. In terms of the main trade-offs discussed, however, they do not provide strong arguments for a prohibition when overall excess costs are low.

Crime and policy

In a standard economic analysis, illegal prices serve as a proxy for the costs incurred on the illegal supply side. This economic loss reflects the social waste of people spending their lives trying to produce, distribute and sell cannabis without being caught.

Two caveats are in place as concerns this interpretation. The first involves the illegal market structure. We have implicitly assumed that the illegal market is close to a perfectly competitive market, where competition amongst a large group of suppliers drives prices down to the cost of supplying one additional unit (“marginal costs”). This assumption may not hold for cannabis markets (Storti & De Grauwe, 2008), which are argued to organize themselves in stable, trust-based networks of buyers and sellers to reduce detection and product fraud risks. This gives each seller a bit of market power, allowing them to earn excess profits by cutting output and raising prices without losing all their customers. Counteracting this, technological change makes small-scale indoor growing operations more competitive, increasing the number of suppliers and the market competition: over time, if excess profits are high, additional suppliers enter and take their piece of the market, gradually lowering the excess profit of each supplier to the point where it matches the costs of setting up shop. In the long run equilibrium, the illegal price equals the average (rather than marginal) supply costs.

This kind of monopolistic competition market alters the dynamics of our model, allowing for a paradoxical response to the establishment of a legal market. Theoretically, the introduction of a legal good priced below the illegal variant may now result in a larger illegal market: illegal suppliers need to match the legal price to keep their customers, and they will stay in the market and increase supply as long as the marginal cost remains below the new price ceiling. This results in a lower excess profit than before, a shake-out of the market ensues, and a lower number of larger, more efficiently scaled illegal firms remains. In sum, the illegal market volume could increase, even though the market would employ fewer people and use less resources.

This theoretical possibility is unlikely to matter much. For one thing, the experience in legalizing US states is that the legal market grows rapidly, indicating that the possibility is largely theoretical. Even if it were not, however, the legal price would still reduce illegal supply costs, but now through a different mechanism. Since the illegal price will equal long run average illegal supply costs, the total illegal market revenue will measure total illegal supply costs. If cannabis demand is inelastic, lowering the illegal price by 1% would grow the market by less than 1%, reducing total revenue and thus *total* long run supply costs even if volume increases. A numerical example: assume that illegal prices are initially \$15 per gram and illegal volume some amount X , giving initial total supply costs of \$ $15X$. A legal taxed price is set that reduces the illegal price to \$10, roughly a 30% decline in illegal prices. With a price elasticity around -0.5 , this would only grow the total market to $1.15X$. Total illegal supply costs fall from \$ $15X$ to \$ $10 * 1.15X$, a 23% reduction, despite a 15% increase in volume produced. To evaluate this outcome, we add the increased consumption value of the new units. Valuing this at the new lower price gives \$ $10 * 0.15X$ in consumer value. Finally, we add the excess harms from the new market units, equal to $e * 0.15X$. In sum, this results in a net social gain as long as $e < \frac{3.5 + 1.5}{0.15} \approx \33 per gram. The estimates of total social harms from cannabis use referenced earlier were in the \$5–10 range.⁵

The second caveat to the “illegal price as cost” interpretation is that this is only the case if the individuals in the market behave rationally.

⁵ Note that even if we set the consumer benefits to 0, the shift would still be net positive as long as excess harms were below \$23. In reality, we may be skeptical that the marginal cost of illegal firms is sufficiently low relative to illegal prices for this scenario to occur. In that case, the illegal market would not be able to cover total demand and we would shift back towards the baseline model with growth in low-cost legal production.

As discussed above, prices will over-estimate the benefits from consumption if cognitive biases and limitations nudge people to buy more than they would want in a “cool” and careful mental state. This, as noted, is an argument for stricter policies. These same biases and limitations will also impel people to make shortsighted and self-harming decisions by entering the illegal supply side, overly swayed by easy cash and status, and underestimating the long term risks and stigma. This means that illegal prices *underestimate* the true costs of the illegal market, which argues for *less* restrictive policies. Whether the net-result of ignorance and short-sightedness is to make optimal policy more or less strict is not obvious, but the symmetric role of cognitive flaws in this respect is rarely noted.

Turning to how this cost component is treated by others, this varies substantially. Some public health oriented work give them little emphasis (cfr. discussion in Rogeberg 2015), other work – such as the recent Lancet/John Hopkins Commission on drug policy (Csete et al., 2016) – gives them strong weight.⁶ Amongst social scientists, some largely ignore the issue (Pacula et al., 2014), some view the harms from arresting pot users as the main harm of criminalization (Caulkins, 2017), and some view illegal market activity as an important harm that helps justify “state-centred legal regulation” for cannabis (Kirst et al., 2015).

None of these approaches use market prices or quantities directly to assess the magnitude of the issue, except indirectly when potential tax revenues following legalization are included as a gain (Caulkins et al., 2015). From an economic perspective, however, taxes are not a social benefit to society – but a transfer that shifts control of resources from consumers to the government. When a previously illegal product is legalized and taxed, however, the tax revenues will reflect savings due to the efficiency advantage of the legal supply side. To see this, consider a case where consumption remains unchanged and the post-tax legal price is equal to the pre-legalization illegal price. In this case, every tax dollar will reflect a dollar reduction in supply costs. In practice, however, the post-tax legal price will differ from the pre-legalization illegal price, making the two magnitudes differ. From a welfare perspective, it is the savings from the supply side – not the tax revenues – we should care about.

Tentative policy conclusions

With the above caveats in mind, we can make a “back of the envelope” assessment of the case for cannabis prohibition by estimating the magnitudes of the different costs and benefits using excess cost estimates and observed market magnitudes and plugging these into the model. To do this, note that the legal tax should be – at most – equal to the excess harms, and compare a counterfactual legal price under this tax level to illegal prices under prohibition. Prohibition would only be optimal if this legal price were to lie substantially above current illegal prices.

Estimates of illegal cannabis have been made around \$70 to \$230 per ounce, with per-gram prices being roughly double this (Caulkins, Hawken, Kilmer, & Kleiman, 2012b). This gives us an illegal price for smaller purchases in the 5–15 USD per gram range. Reasoning by analogy (e.g., from the production costs of cigarettes, gourmet tea, etc), the same source estimates negligible legal production costs for high quality marijuana, at less than five cents per gram. Finally, above-mentioned estimates place excess harms (medical, traffic, crime) in the \$5–10 range per gram.

In total, this gives a counterfactual legal price in the \$5–10 range, which is similar to or below illegal prices. This suggests that an economic cost-benefit analysis would provide support for legalization.

⁶ While the commission suggests cautious experimentation with legal regulation, the illegal market harms it notes are not all relevant to cannabis. Political destabilization and mass murder in South-America, for instance, are more related to hard drugs.

This indicative tax level may be viewed as an “upper bound” of the optimal cannabis tax, in that it fails to include the effect of the tax on the size of the illegal market. Illegal market activity is a major cost of prohibition, and with inelastic cannabis demand the “cost” (in terms of increased use and use harms) of a tax decrease would be moderate. The benefit of a tax increase would be a reduced illegal market, though data is currently lacking on how much the illegal supply shrinks for a given decline in legal prices. Hopefully, this is an area where data gathered from currently legalizing US states will help inform future research.

Further limitations

While our policy model arguably addresses the “high level” costs and benefits involved in a discussion of prohibition, several issues are ignored.

First, the analysis uses a marginal analysis, assessing the change in benefits and costs as we shift taxation levels from 0 to levels representing *de facto* prohibitions. The current formulation, however, does not address all costs. While we include illegal supply costs, we do not include the enforcement costs of prohibition. Nor do we include the costs of establishing and running a legal system regulating production, distribution and consumption.

Second, the model is too abstract and simplified to discuss how, specifically, a legal regime should be designed to avoid the dangers of profit-driven enterprises promoting heavy use and targeting their product towards the pathological tail of the use distribution. Nor can it help assess details in the complicated issue of how cannabis is best taxed (Caulkins, Hawken, Kilmer, & Kleiman, 2012a). The problem here is that corrective taxes should reflect the harm. A tax on the value of goods (e.g., a tax equal to 20% of the price) would cause the tax to decline with production costs, a tax per gram would decline with inflation while incentivizing suppliers to produce high-potent “bang for the buck” products,⁷ and a tax on THC-content would have to address the differences in THC-absorption following from different consumption methods (e.g., joint, bong, vaporizer, edibles). Nor should THC be considered the only issue, since respiratory damage is absent for edibles and reduced for vapers, while cannabinoids beyond THC (such as CBD) may help reduce the risks of consumption. The model is also too crude to capture the more recent work on economic regulation in the presence of externalities, which would argue for restrictions on advertising, public use, and the role of profit-driven commercial enterprises. These concerns are in line with those noted by several recent contributions (Pacula et al., 2014; Room, 2014). Specifically, RAND researchers have done much to popularize the notion of “intermediate regulatory options” in the space between a commercialized free-enterprise system and a prohibition (Caulkins et al., 2015; Caulkins & Kilmer, 2016).

Third, the model assumes that we are free to choose any level of tax and regulation on a currently prohibited good. In practice, this may not be the case, as higher order constraints can make it difficult to sustain optimal levels of taxation. Policies may themselves trigger the growth and decline of various interest groups, gradually shifting policy in predictable directions (Acemoglu & Robinson, 2013). In the cannabis policy debate, this involves the fear that recreational cannabis markets in practice will come to be under-taxed, under-regulated and over-commercialized as new commercial interests work to influence policy. Even if the initial regulation is adequate, there are worries of a “ratchet mechanism of the influence of commercial market interests, among other forces” (Caulkins & Kilmer, 2016; Room, 2014).

Finally, the model restricts itself to considering cannabis consumption alone – and with a fixed set of tastes and preferences. If legalization of cannabis led to changes in alcohol or tobacco use, this

⁷ Prohibition is essentially a tax on volume, as more concentrated goods are easier to transport and hide. During alcohol prohibition, this caused a marked shift away from beer and towards spirits (Cook, 2007).

would strongly influence the change in harms, though the solution to this from an economic perspective would be to set tax levels and regulation for each good that corrected for the excess costs and “behavioral” issues each good raised. Since laws also influence attitudes (e.g., Kotsadam & Jakobsson, 2011), a legalization may also lead to an upwards shift in demand as cannabis became more acceptable and desirable to law-abiding citizens.

Conclusion

An economic model of regulation in the presence of illegal side markets supports the claim that a legal, regulated market would likely be preferable to a policy of prohibition, evaluated under cost-benefit criteria commonly used in other policy domains. Illegal supply costs are substantial, externalities are moderate, medical harms low. While there are issues of dependence, these are less serious than for alcohol and cigarettes. Note that this *relative* judgment can lead us to be influenced by status quo bias: It may be that the appropriate solution is that all three substances should be prohibited. On the other hand, the relative judgment helps guard against the use of stricter standards for cannabis than for “our” drug. Finally, while the model helps assess common justifications for prohibition, it is too crude to address questions relating to the design and regulatory principles of a legal market.

The model focuses on the trade-offs between consumption benefits, illegal market costs and use-related harms (internalities and externalities). While each of these categories have been addressed by others, I have argued that consumption benefits and the harms of illegal markets are likely higher than typically assumed, while the policy implications of internalities are more subtle than commonly acknowledged – increasing illegal market costs as well as reducing user harms, and speaking to the need for “behavioral” policies over a blanket prohibition. On the other hand, this discussion also suggests that recent economic theory may point towards similar types of “middle ground” legal systems as those suggested by researchers from other fields.

While this is assuredly not the final word on the issue, the analysis is an attempt to assess prohibition as a policy within the kind of framework underlying cost-benefit thinking used in policy analyses generally. Perhaps the main point from this perspective is the importance of externalities and illegal markets for assessing a prohibition: While externalities are surely present for cannabis as for alcohol use, the level of externalities identified for cannabis use appears too low to justify a policy that criminalizes all users and establishes a large, unregulated criminal system that recruits from the same population we aim to protect.

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References

- Acemoglu, D., & Robinson, J. A. (2013). *Economics versus politics: Pitfalls of policy advice* (Working paper No. 18921). National Bureau of Economic Research Retrieved from <http://www.nber.org/papers/w18921>.
- Allcott, H., & Sunstein, C. R. (2015). Regulating externalities. *Journal of Policy Analysis and Management*, 34(3), 698–705. <http://dx.doi.org/10.1002/pam.21843>.
- Babor, T., Caetano, R., Casswell, S., Edwards, G., Giesbrecht, N., Graham, K., et al. (2003). *No ordinary commodity: Alcohol and public policy*. Oxford: Oxford University Press.
- Babor, T. (2010). *Drug policy and the public good*. Oxford University Press.
- Babor, T. (2015). Welcome to hotel california: Comments on Rogeberg (2015). *Nordic Studies on Alcohol and Drugs*, 32(4), 365–366.
- Becker, G., Murphy, K., & Grossman, M. (2006). The market for illegal goods: The case of drugs. *Journal of Political Economy*, 114(1), 38–60.
- Bernheim, D., & Rangel, A. (2005). From neuroscience to public policy: A new economic view of addiction. *Swedish Economic Policy Review*, 12(2), 99.

- Beshears, J., Choi, J., Laibson, D., & Madrian, B. C. (2005). Early decisions: A regulatory framework. *Swedish Economic Policy Review*, 12, 41–60.
- Caulkins, J. P., & Kilmer, B. (2016). Considering marijuana legalization carefully: Insights for other jurisdictions from analysis for Vermont. *Addiction*, 111(12), 2082–2089.
- Caulkins, J. P., Hawken, A., Kilmer, B., & Kleiman, M. A. (2012a). High tax states: Options for gleaming revenue from legal cannabis. *Oregon Law Review*, 91, 1041.
- Caulkins, J. P., Hawken, A., Kilmer, B., & Kleiman, M. A. (2012b). *Marijuana legalization: What everyone needs to know*. Oxford University Press Retrieved from <http://books.google.com/books?hl=en&lr=&id=IMAn8PWf8QC&oi=fnd&pg=PR7&dq=kleiman+cannabis+caulkins&ots=ewOKtaVre&sig=W8debCJnleAg610bsUReprSRKX4>.
- Caulkins, J. P., Kilmer, B., Kleiman, M. A. R., MacCoun, R. J., Midgette, G., Oglesby, P., et al. (2015). *Considering marijuana legalization (Research report)* Santa Monica, CA: RAND Corporation Retrieved from http://www.rand.org/pubs/research_reports/RR864.html.
- Caulkins, J. P. (2016). The real dangers of marijuana. *National Affairs*, 26, 21–24.
- Caulkins, J. P. (2017). Recognizing and regulating cannabis as a temptation good. *International Journal of Drug Policy*, 42, 50–56. <http://dx.doi.org/10.1016/j.drugpo.2017.01.012>.
- Committee on the Health Effects of Marijuana: An Evidence Review and Research Agenda, Board on Population Health and Public Health Practice, Health and Medicine Division, & National Academies of Sciences, Engineering, and Medicine. (2017). The health effects of cannabis and cannabinoids: the current state of evidence and recommendations for research. Washington, D.C: The National Academies Press.
- Compton, W. M., Han, B., Jones, C. M., Blanco, C., & Hughes, A. (2016). Marijuana use and use disorders in adults in the USA, 2002–14: analysis of annual cross-sectional surveys. *The Lancet Psychiatry*, 3(10), 954–964. [http://dx.doi.org/10.1016/S2215-0366\(16\)30208-5](http://dx.doi.org/10.1016/S2215-0366(16)30208-5).
- Cook, P. J. (2007). *Paying the tab: The costs and benefits of alcohol policy*. Princeton: Princeton University Press.
- Csete, J., Kamarulzaman, A., Kazatchkine, M., Altice, F., Balicki, M., Buxton, J., et al. (2016). Public health and international drug policy. *The Lancet*, 387(10026), 1427–1480. [http://dx.doi.org/10.1016/S0140-6736\(16\)00619-X](http://dx.doi.org/10.1016/S0140-6736(16)00619-X).
- Davis, A. J., Geisler, K. R., & Nichols, M. W. (2016). The price elasticity of marijuana demand: Evidence from crowd-sourced transaction data. *Empirical Economics*, 50(4), 1171–1192. <http://dx.doi.org/10.1007/s00181-015-0992-1>.
- Gallet, C. A. (2014). Can price get the monkey off our back? A meta-analysis of illicit drug demand. *Health Economics*, 23(1), 55–68. <http://dx.doi.org/10.1002/hec.2902>.
- Hall, W. D., Renström, M., & Poznyak, V. (2016). *The health and social effects of nonmedical cannabis use*. (Retrieved 26. March from) World Health Organization, Geneva http://www.who.int/substance_abuse/publications/msb_cannabis_report.pdf.
- Huestis, M. A. (2015). Detering driving under the influence of cannabis. *Addiction*, 110(11), 1697–1698. <http://dx.doi.org/10.1111/add.13041>.
- Intiaz, S., Shield, K. D., Roerecke, M., Cheng, J., Popova, S., Kurdyak, P., et al. (2016). The burden of disease attributable to cannabis use in Canada in 2012. *Addiction*, 111(4), 653–662. <http://dx.doi.org/10.1111/add.13237>.
- Kahneman, D. (2011). *Thinking, fast and slow*. New York: Farrar Straus & Giroux.
- Kerr, W. C., & Greenfield, T. K. (2007). Distribution of alcohol consumption and expenditures and the impact of improved measurement on coverage of alcohol sales in the 2000 National Alcohol Survey. *Alcoholism: Clinical and Experimental Research*, 31(10), 1714–1722. <http://dx.doi.org/10.1111/j.1530-0277.2007.00467.x>.
- Kirst, M., Kolar, K., Chaiton, M., Schwartz, R., Emerson, B., Hyshka, E., et al. (2015). A common public health-oriented policy framework for cannabis, alcohol and tobacco in Canada? *Canadian Journal of Public Health; Ottawa*, 106(8), E474–E476. <http://dx.doi.org/10.17269/CJPH.106.5206>.
- Kotsadam, A., & Jakobsson, N. (2011). Do laws affect attitudes? An assessment of the Norwegian prostitution law using longitudinal data. *International Review of Law and Economics*, 31(2), 103–115. <http://dx.doi.org/10.1016/j.irle.2011.03.001>.
- Krugman, P. (1998). Two cheers for formalism. *The Economic Journal*, 108(451), 1829–1836.
- Krugman, P. (2009). *How did economists get it so wrong*. *New York times* (September 2) Retrieved from <http://www.nytimes.com/2009/09/06/magazine/06Economic-t.html>.
- Krugman, P. (2014). *Ending prohibition 2.0*. (July 30) Retrieved October 31, 2017, from <https://krugman.blogs.nytimes.com/2014/07/30/ending-prohibition-2-0/>.
- Laibson, D. (2001). A cue-theory of consumption. *The Quarterly Journal of Economics*, 116(1), 81–119. <http://dx.doi.org/10.1162/003355301556356>.
- Light, M. K., Orens, A., Lewandowski, B., & Pickton, T. (2014). *Market size and demand for marijuana in Colorado*. Colorado, USA: Colorado Department of Revenue p. 32.
- Marie, O., & Zöltz, U. (2017). High achievers? Cannabis access and academic performance. *The Review of Economic Studies*, 84(3), 1210–1237. <http://dx.doi.org/10.1093/restud/rdx020>.
- Mathers, C., Vos, T., & Stevenson, C. (1999). *The burden of disease and injury in Australia*. Australian Institute of Health and Welfare.
- Moore, T. (2007). *Working estimates of the social costs per gram and per user for cannabis, cocaine, opiates and amphetamines* (Monograph No. 14). Sydney, Australia: National Drug and Alcohol Research Centre Retrieved from [http://www.dpmp.unsw.edu.au/DPMPweb.nsf/resources/DPMP+Monographs3/\\$file/DPMP+MONO+14.pdf](http://www.dpmp.unsw.edu.au/DPMPweb.nsf/resources/DPMP+Monographs3/$file/DPMP+MONO+14.pdf).
- Nutt, D. J., King, L. A., & Phillips, L. D. (2010). Drug harms in the UK: A multicriteria decision analysis. *The Lancet*, 376(9752), 1558–1565.
- O'Donoghue, T., & Rabin, M. (2003). Studying optimal paternalism, illustrated by a model of sin taxes. *The American Economic Review*, 93(2), 186–191.
- O'Donoghue, T., & Rabin, M. (2005). Optimal taxes for sin goods. *Swedish Economic Policy Review*, 12(2), 7.
- Pacula, R. L., Kilmer, B., Wagenaar, A. C., Chaloupka, F. J., & Caulkins, J. P. (2014). Developing public health regulations for marijuana: Lessons from alcohol and

- tobacco. *American Journal of Public Health*, 104(6), 1021–1028. <http://dx.doi.org/10.2105/AJPH.2013.301766>.
- Palali, A., & Van Ours, J. C. (2014). *Cannabis use and support for cannabis legalization* (Center discussion paper no. No. 2014-027). Tilburg University.
- Ritter, A. (2009). Methods for comparing drug policies—The utility of composite drug harm indexes. *International Journal of Drug Policy*, 20(6), 475–479.
- Rogeberg, O., & Elvik, R. (2016a). Cannabis intoxication, recent use and road traffic crash risk. *Addiction*, 111(8), 1495–1498.
- Rogeberg, O., & Elvik, R. (2016b). The effects of cannabis intoxication on motor vehicle collision revisited and revised. *Addiction*, 111(8), 1348–1359. <http://dx.doi.org/10.1111/add.13347>.
- Rogeberg, O., & Melberg, H. O. (2011). Acceptance of unsupported claims about reality: A blind spot in economics. *Journal of Economic Methodology*, 18(01), 29–52.
- Rogeberg, O. (2004). Taking absurd theories seriously: Economics and the case of rational addiction theories. *Philosophy of Science*, 71(3), 263–285.
- Rogeberg, O. (2015). Drug policy, values and the public health approach – Four lessons from drug policy reform movements. *Nordic Studies on Alcohol and Drugs*, 32(4), 347–364. <http://dx.doi.org/10.1515/nsad-2015-0034>.
- Room, R. (2014). Legalizing a market for cannabis for pleasure: Colorado, Washington, Uruguay and beyond. *Addiction*, 109(3), 345–351. <http://dx.doi.org/10.1111/add.12355>.
- Room, R. (2015). Public health, the public good, and drug policy. *Nordic Studies on Alcohol and Drugs*, 32(4), 367–370.
- Storti, C. C., & De Grauwe, P. (2008). Modelling disorganized crime: The cannabis market. *Bulletin on Narcotics*, 60, 79–100.
- Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press Retrieved from <http://books.google.com/books?hl=en&lr=&id=dSJQn8egXvUC&oi=fnd&pg=PA17&ots=0cNRPEDhWt&sig=dXx1I66zCLhgSgFUWVTV8zs4TiY>.
- van Amsterdam, J., & van den Brink, W. (2010). Ranking of drugs: A more balanced risk-assessment. *The Lancet*, 376(9752), 1524–1525. [http://dx.doi.org/10.1016/S0140-6736\(10\)62000-4](http://dx.doi.org/10.1016/S0140-6736(10)62000-4).
- Williams, J., van Ours, J. C., & Grossman, M. (2011). *Why do some people want to legalize cannabis use?* (Working paper No. 16795). National Bureau of Economic Research Retrieved from <http://www.nber.org/papers/w16795>.