

Cannabis Regulations and Crime: A Meta-Analysis

Documento CEDE-CESED

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#12

Abril de 2025

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Impreso en Colombia – Printed in Colombia

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Documento CEDE-CESED

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Cannabis Regulations and Crime: A Meta-Analysis*

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April 29, 2025

Does regulating cannabis markets reduce crime? We conduct a systematic review and meta-analysis of causal inference studies addressing this question. Applying strict inclusion criteria to an initial pool of 31 studies, we synthesize estimates from nine papers. We propose a formal framework linking cannabis regulations to crime through reductions in illicit market size, criminal rents, and violence associated with illegal contract enforcement, as well as through increased police resource reallocation and public health interventions. Our meta-analytic estimates show that cannabis regulations—especially for medical use—reduce overall crime, with effects concentrated in violent offenses. We also document heterogeneity by publication status, suggesting potential publication bias. These findings imply that reforms to cannabis regulations may reduce violence and weaken organized crime.

Keywords: meta-analysis, cannabis, crime, drugs, security

JEL codes: K42, K14, H41, H75, K23

*We are grateful to María Alejandra Vélez and Rosario Queirolo for comments on a previous draft of this manuscript.

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Regulación del Cannabis y Crimen: Un Meta-Análisis*

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April 30, 2025

¿Puede la regulación de los mercados de cannabis reducir el crimen? Este artículo presenta una revisión sistemática y un meta-análisis de la literatura de inferencia causal que busca responder esta pregunta. A partir de una muestra inicial de 31 estudios, sintetizamos los hallazgos de 9 artículos que cumplieran con criterios rigurosos de inclusión. Adicionalmente, proponemos un marco conceptual que vincula la regulación del cannabis con la reducción del crimen a través de distintos mecanismos: la contracción del mercado ilícito, la disminución de las rentas criminales, la reducción del uso de la violencia como mecanismo para hacer cumplir acuerdos ilegales, así como la redistribución de recursos policiales y el fortalecimiento de intervenciones en salud pública. Los resultados del meta-análisis indican que la regulación del cannabis, en particular para uso medicinal, se asocia con una reducción del crimen en general, con efectos más pronunciados para delitos violentos. También encontramos heterogeneidad según el estatus de publicación, lo que sugiere la posible presencia de sesgos de publicación. En conjunto, los resultados sugieren que reformar los marcos regulatorios en torno al cannabis podría contribuir a disminuir la violencia y debilitar las estructuras del crimen organizado.

Palabras clave: meta-análisis, cannabis, crimen, drogas, seguridad

Códigos JEL: K42, K14, H41, H75, K23

*Agradecemos a María Alejandra Vélez y Rosario Queirolo por sus comentarios a una versión anterior de este manuscrito.

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INTRODUCTION

The regulation of cannabis markets has become a relevant public policy debate in the past two decades. As of late 2024, 24 states in the United States have regulated cannabis markets for adult use, removing all criminal penalties regarding the personal possession and consumption of cannabis by adults, corresponding to 54% of the country's population.¹ The cannabis market for adult use is also regulated in Canada, Luxembourg, South Africa, Thailand, and Uruguay, among other countries. Decriminalization—referring to no arrest, prison time, or criminal sanctions for the possession of a small amount of cannabis for personal consumption—has occurred in many other countries, including Belgium, Colombia, and Israel.

Regulation shifts in the cannabis market can take different forms, each with distinct legal and policy implications. Depenalization involves reducing or eliminating criminal penalties for cannabis-related offenses, such as possession or use, but often replaces them with administrative sanctions. Decriminalization generally refers to the removal of criminal charges without altering the legal status of production or sale. Legalization goes further, fully removing legal prohibitions and allowing the production, sale, and/or consumption of cannabis under certain conditions. Regulation typically follows legalization, establishing a legal framework that governs aspects such as licensing, quality control, taxation, and distribution.

A growing literature has studied the effects of these policy shifts on crime, motivated by a relevant empirical puzzle. On the one hand, the regulation and decriminalization of cannabis could potentially reduce overall crime rates by allowing law enforcement to redirect resources from drug enforcement to the deterrence and investigation of other types of criminal activity (Adda, McConnell and Rasul 2014). Moreover, even if the illegal cannabis market does not disappear entirely with regulation, a reduction in its size could diminish revenues for illicit actors, thereby weakening criminal organizations and reducing violence associated with the illegal drug trade. This mechanism is supported by empirical evidence showing that cannabis consumption tends to remain stable

¹This is in addition to the District of Columbia, the Commonwealth of the Northern Mariana Island, and the US Virgin Islands.

following these policy shifts, suggesting that legal markets effectively capture part of the existing demand (Anderson and Rees 2023; Midgette and Reuter 2020; Hasin and Walsh 2021).

On the other hand, arguments raised in public debates suggest that regulation or decriminalization may weaken the capacity of police and military forces to combat illegal markets and criminal organizations. Additionally, if cannabis consumption were to increase, or if usage patterns were to change following policy shifts, this could contribute to higher crime rates due to the drug's potential cognitive and behavioral effects. In particular, the consumption of highly potent strains of cannabis may trigger psychotic episodes or erratic behavior, especially among genetically susceptible individuals (Murray et al. 2017; Vaucher et al. 2018).

Despite the growing number of studies, the findings of this emerging literature have not been systematically analyzed. One reason is the lack of standardization in reporting results, alongside the uneven application of causal inference methods across studies, which together hinder the accumulation of robust and generalizable knowledge.

We perform a meta-analysis of studies focused on causal inference and that examine the connection between cannabis regulations and crime. Systematic meta-analyses are helpful for examining a comprehensive set of studies that address the same research question, enabling the aggregation and synthesis of the overall evidence. We first perform a systematic search of the literature—principally in economics, criminology, and public policy—using inclusion criteria that only admit papers harnessing research designs that address potential threats to causal inference, among them reverse causality and selection bias.² In this paper, we focus specifically on the regulation of cannabis markets, and therefore exclude studies that examine depenalization or decriminalization measures. From a total potential population of thirty-one studies, we ultimately use nine that meet the inclusion criteria. (We discuss these criteria in greater detail in a subsequent section.)

Across these nine studies, a weighted estimate across twenty coefficients shows that regulating the market for recreational or medical cannabis is associated with a 0.076 standard deviation

²Journals that have published these papers include the *Economic Journal*, *Journal of Economic Behavior and Organization*, *Journal of Political Economy*, *Journal of Urban Economics*, *PLoS One*, *International Journal of Drug Policy*, and more.

decrease in crime. We disentangle the effects by type of regulation and find a precisely estimated null effect of adult-use regulations on overall criminal activity, while medical cannabis laws are associated with a 0.12 standard deviation decrease in all crime. When evaluating the effects of cannabis regulation by type of crime, we find that violent crime decreases by 0.125 standard deviations, while we do not find statistically significant effects on property crimes. We also assess heterogeneity across studies, depending upon whether they are working papers or published articles, to understand whether heterogeneity in results stems from potential publication bias (Cools, Finseraas and Rogeberg 2021). We find evidence of publication bias: the weighted average effect size for unpublished estimates is -0.008 standard deviations, whereas the average for published studies is substantially larger, at -0.09 standard deviations.

This paper makes multiple contributions to the economics literature on illicit economies and crime. Our formal framework clarifies the mechanisms through which state regulation of illicit markets can influence crime, integrating insights from models of illegal market structure (Becker, Murphy and Grossman 2006; Miron and Zwiebel 1995) and enforcement externalities (Adda, McConnell and Rasul 2014). Prior economic models have shown how prohibition creates rents for criminal organizations and how enforcement generates unintended consequences, such as increased violence (Castillo, Mejía and Restrepo 2020). However, existing models often treat state intervention in illicit markets primarily through the lens of repression rather than regulatory substitution. By modeling how cannabis regulation may shift demand from illegal to legal markets, reduce criminal rents, reallocate enforcement resources, and affect incentives for violent conflict resolution, the paper expands our theoretical understanding of how different state interventions affect illicit economies (Polinsky and Shavell 2000).

The paper also makes an empirical contribution, providing the first systematic meta-analysis of the causal impact of cannabis market regulation on crime outcomes. Meta-analyses in economics have been used where individual studies produce heterogeneous or context-specific findings, e.g. the study of active labor market programs (Card, Kluve and Weber 2018) or how natural resource endowments affect long-term economic growth (Havranek, Horvath and Zeynalov 2016). While

previous reviews of cannabis reforms have largely centered on public health outcomes (Anderson and Rees 2023), we apply meta-analytic methods to a focused subset of studies with credible identification strategies. Specifically, we include only studies that employ quasi-experimental designs such as difference-in-differences, triple-differences, and synthetic control methods—aligning with empirical standards emphasized in applied microeconomics. This approach allows us to generate more reliable and generalizable conclusions about the effects of cannabis regulatory reforms on crime and contributes to ongoing efforts in economics to synthesize policy-relevant causal evidence across diverse implementation settings (Vivalt 2020).

Finally, we make a policy contribution, demonstrating that cannabis regulation—particularly medical regulation—reduces crime, and especially violent crime, highlighting its potential as a cost-effective alternative to punitive enforcement. Our findings support theoretical predictions that regulatory reforms can reduce criminal rents and violence by shifting market structures and weakening extralegal governance (Becker, Murphy and Grossman 2006; Miron and Zwiebel 1995), and also align with recent empirical evidence on the violent consequences of drug interdiction (e.g. Castillo, Mejía and Restrepo 2020). Our findings therefore contribute to debates on the comparative efficiency of prohibitionist versus regulatory strategies (Mejia and Restrepo 2013; Gaviria 2000). In regions or cities where organized crime exercises de facto governance (Lessing 2020; Blattman 2021), our results suggest that legalization may reduce violence not merely by liberalizing norms about consumption, but by eroding the economic foundations of criminal groups’ coercive power.

The rest of the paper is structured as follows. The next section introduces a formal framework to illustrate the potential channels through which cannabis regulation may influence crime. We then present the data, detailing the studies included in our analysis, the search strategy we use to select studies, and the employed inclusion criteria. Next, we describe our estimation approach and present the results of the meta-analysis. Finally, we discuss our findings and their policy implications.

CANNABIS REGULATIONS AND CRIME

Why might the regulation of cannabis affect crime? We begin by introducing a formal framework, and then use it to propose potential mechanisms that could explain our empirical findings. This framework also allows us to consider what optimal enforcement strategies might look like under different regulatory regimes.

We consider two types of markets for cannabis: a legal market (if cannabis regulation is in place) and an illegal market (where it is not). Crime can be generated by offenses associated with cannabis use where it is illegal, including cultivation, possession, distribution, transport, sale, consumption in public spaces, and more. Yet other crimes can also be driven by related activities, including property crimes (e.g., theft) and violent crimes (e.g., assault, robbery, and homicides), as we detail below.

Regulation aims to shift demand for cannabis from the illegal market to the legal market, and to move from a market regulated by non-state armed actors and criminal organizations to one where disputes are solved by formal, legal, and non-violent processes. This shift reduces the quantity of cannabis sold illegally (Q_I) and increases the quantity sold legally (Q_L). The price differential between the legal and illegal markets plays a crucial role: if the price of cannabis in the legal market (P_L) is significantly higher than in the illegal market (P_I), demand shifts caused by regulation will be smaller, as consumers will continue to purchase from vendors in the illegal market.³ Indeed, this is consistent with evidence from Uruguay, where efforts to legalize the sale of cannabis from authorized dispensaries involve high prices: the illicit (or informal) trade remains, as consumers choose the cheaper product (Olivera and Zelko 2021; Queirolo et al. 2024).⁴ Thus:

$$P_L > P_I \implies \text{less shift from illegal to legal market} \quad (1)$$

³While our theoretical model focuses on price, the shift of users from the illegal to the legal market depends on more than this factor alone. Other relevant elements include ease of access, eligibility requirements for participation in the legal market, the availability of retail locations, the need for official registration as a consumer, and the overall convenience of obtaining the product. For the purposes of our theoretical framework, we assume that most of these variables can be reasonably captured through their effect on price.

⁴Although also see Hollenbeck and Uetake (2021), which shows that even with extremely high taxes in Washington state, “there is not widely available black market cannabis for the marginal consumer.”

The total crime rate (C)—comprising cannabis-related crime (C_m), including offenses committed by users, as well as by groups involved in the production and distribution of cannabis; property crime (C_p); and violent crime (C_v)⁵—is a function of the size of the illegal market (Q_I), the enforcement effort expended by police and other law enforcement agencies (E), and the reallocation of police resources to other pressing issues (E_r).⁶ In this context, enforcement efforts may influence the size of the illegal market (Q_I), thereby affecting the overall crime rate as we examine in more detail below.

In an illegal cannabis market, the only way to buy the substance is via the illicit market. Therefore, the quantity of cannabis in the illicit market is equal to what is demanded, or $Q_I = Q_D$. After introducing regulation that establishes a legal cannabis market, we expect a shift in demand, such that:

$$Q_L + Q_I = Q_D \quad (2)$$

$$Q_I = Q_D - Q_L(P_L, P_I) \quad (3)$$

Effective regulation seeks to minimize Q_I while keeping P_L competitive with P_I .

How does this shift across the legal and illegal markets affect crime? Ideally, regulation should lead to a significant reduction in the illegal market and associated crime rates, such that effective regulation $\implies Q_I \downarrow, P_L \approx P_I$. We discuss below a set of mechanisms through which this may occur.

A challenge for lawmakers is to decide what kind of regulatory environment they will implement. One option is for the state to play a dominant role in the legal cannabis market, as seen in Uruguay, where the government tightly regulates distribution but allows for alternative supply channels, such as cannabis clubs and home cultivation (Queirolo 2020). One advantage of this approach is that—in theory, at least—the state can set an optimal price in the legal market P_L that

⁵Our discussion below also considers violent crimes that may be committed by cannabis consumers.

⁶Formally, we can express cannabis-related crime as $C_m = g(Q_I, E)$, and property crime as $C_p = h(\text{economic conditions, law enforcement, and reallocated efforts } E_r)$.

maximizes the shift from Q_I to Q_L , with the goal of minimizing illicit revenues:

$$\frac{dC}{dP_L} < 0 \quad (4)$$

Why might this be the case? Most obviously, the shift from an illegal to a legal market affects overall crime C by mechanically reducing cannabis-related crime C_m , including arrests for possession, which are no longer considered crimes. Additionally, consumers who obtain cannabis legally may be less likely to commit property crimes C_p in order to afford cannabis—especially among those with cannabis use disorder (e.g. Hasin et al. 2015)—if the optimal price set in a regulated market P_L is lower and more stable than in illicit, unregulated markets. Finally, the illegal cannabis market is sometimes associated with violent crime due to disputes over territory and enforcement of illegal contracts. Reducing Q_I through regulation has the potential to reduce these clashes, thereby lowering the violent crime rate (C_v):

$$\frac{\partial C_v}{\partial Q_I} > 0 \quad (5)$$

Regulation may also free up police resources, permitting law enforcement to reallocate efforts to address violent and property crimes (Miron and Zwiebel 1995; Adda, McConnell and Rasul 2014). If E_r represents reallocated enforcement efforts to non-drug-related crimes, then:

$$\frac{\partial C_v}{\partial E_r} < 0 \quad \text{and} \quad \frac{\partial C_p}{\partial E_r} < 0 \quad (6)$$

By reducing the need to police cannabis offenses, law enforcement can focus on more serious crimes, reducing crime overall. This reallocation likely not only improves the efficiency of policing, but also can enhance community trust in law enforcement, for at least two reasons. When law enforcement prioritizes serious crimes, such as violent offenses or property crimes, it signals to the community that the police is focused on protecting public safety and addressing issues that genuinely threaten the well-being of the population. Second, policing minor cannabis offenses often disproportionately affects marginalized communities. By reducing enforcement of these offenses,

law enforcement may help decrease instances of harassment or “over-policing,” which may help increase community collaboration to solve more serious crimes.

When goods transition from the illicit market to the formal economy, sellers no longer need to rely on violence to enforce contracts. In this sense, a central objective of the regulation process is to integrate into the formal, regulated market those individuals and communities previously engaged in the illegal economy. Doing so not only weakens illicit markets but also creates opportunities for populations that are often vulnerable and marginalized. This reduction in violence is a key benefit of regulation, as legal markets have established mechanisms for dispute resolution, such as courts and arbitration, which reduce the need for extralegal enforcement (Miron and Zwiebel 1995; Djankov et al. 2003).⁷ If this were the case, and as we note above, we would expect that violent crime should decrease following regulation. Essentially, as the size of the illegal market for cannabis Q_I decreases due to regulation, violent crime C_v is expected to decrease, as well.

As noted above, our analysis focuses on price as a key mechanism. Regulation may reduce the price of cannabis in the legal market (P_L) (Pacula 2010), potentially lowering the incentive for individuals to commit property crimes in order to obtain funds to purchase cannabis.⁸ When the legal price is lower and more stable relative to the illegal market, consumers are less likely to engage in theft or burglary to fund their consumption, leading to a decrease in property crimes (C_p). More formally:

$$\frac{\partial C_p}{\partial P_L} > 0 \implies P_L \downarrow \Rightarrow C_p \downarrow.$$

For this reason, when the price of cannabis in the legal market P_L decreases relative to the illegal market, property crime C_p is expected to decrease.

A core motivation for regulating is to shift public policy towards implementing harm reduction

⁷See Hay and Shleifer (1998) for a discussion of how private enforcement creates significant social costs.

⁸We focus on a partial equilibrium perspective, where a lower legal price reduces the need for property crimes associated with cannabis consumption. However, in a general equilibrium framework, while the price of cannabis may decrease, individuals who consume multiple substances may still engage in property crimes to finance the purchase of other drugs, potentially offsetting some of the expected reductions in crime.

and public health strategies (H) to deal with problematic cannabis use.⁹ Increased public funding for these efforts could reduce substance abuse, increase treatments access, and broaden access to healthcare services, not just for those who consume cannabis, but also those who consume more harmful substances. These strategies may help prevent the escalation of occasional drug use into more serious criminal behavior, which would reduce overall crime C . This dynamic can be expressed formally:

$$\frac{\partial C_m}{\partial H} < 0 \quad \text{and} \quad \frac{\partial C_p}{\partial H} < 0 \quad (7)$$

As H increases, both cannabis-related crime C_m and property crime C_p are expected to decrease.

Cannabis use can have pharmacological effects that impair cognitive function and decision-making, potentially affecting crime through at least two pathways. First, for individuals with a clinical history of schizophrenia or a genetic predisposition to mental illness, cannabis consumption may induce psychotic episodes (e.g. Di Forti et al. 2014). In this subpopulation, increased availability of cannabis through a regulated market could raise the likelihood of such episodes and, consequently, the incidence of violent outbursts, thereby increasing violent crime (C_v). Second, even among individuals without a history of mental health disorders, the pharmacological effects of cannabis may elevate the likelihood of erratic or impulsive behaviors. Some evidence suggests that cannabis use—particularly at higher doses—can promote disinhibition and increase risk-taking behavior (Lane et al. 2005; Crean, Crane and Mason 2011). Regulation may unintentionally exacerbate this risk. In legal markets, growers are incentivized to cultivate high-potency strains, and regulations requiring transparency around tetrahydrocannabinol (THC) content allow producers to clearly label and market these products, thereby meeting consumer demand for stronger cannabis (Donnan et al. 2024). Related pharmacological effects may increase both property crime C_p and violent crime C_v . Formally this is equivalent to:

⁹See the Diagnostic and Statistical Manual of Mental Disorders, DSM-5, for a formal definition of the problematic cannabis use.

$$\frac{\partial C_v}{\partial Q_L} > 0 \quad (\text{for vulnerable populations}) \quad (8)$$

Under these theoretical predictions, increased cannabis consumption may lead to higher rates of violent crime (C_v) among individuals with the aforementioned predispositions, and to increases in both property crime (C_p) and violent crime (C_v) among broader segments of the population. However, the provision of accurate information to consumers in a regulated market may help mitigate these secondary and undesirable consequences by promoting informed consumption and risk awareness. Indeed, existing literature reviews indicate that regulatory reforms have *not* led to increased cannabis use overall (Anderson and Rees 2023), suggesting that the predicted adverse behavioral effects may be limited in practice.

Finally, some regimes to regulate cannabis may generate very specific risks of increased crimes: cannabis dispensaries that tend to handle large amounts of cash may become attractive targets for armed robbery. The presence of dispensaries could, therefore, increase property crimes in the areas where they are located, highlighting the need for security measures to protect both businesses themselves and surrounding communities.

$$\frac{\partial C_p}{\partial D} > 0 \quad (9)$$

where D represents the number of cannabis dispensaries. As the number of dispensaries D increases, property crime C_p may increase. (We return to this in the discussion section.)

An additional challenge for policymakers—both when cannabis is legal and regulated, and when it is illegal—is how best to allocate law enforcement effort. One may think that when law enforcement efforts to attack the illegal cannabis market increase ($E \uparrow$), crime should decrease ($C \downarrow$). This could occur, for example, if supply shocks reduce the quantity of cannabis in the illegal market Q_I , producing less revenue for criminal organizations, as reflected here:

$$\frac{\partial Q_I}{\partial E} < 0 \quad \text{and} \quad \frac{\partial C_m}{\partial E} < 0 \quad (10)$$

However, increasing law enforcement, counterintuitively, may generate more violence in illegal markets with relatively inelastic demand for those illicit goods (Britto 2020; Caro 2025; Castillo, Mejía and Restrepo 2020; Durán-Martínez 2017; Lindo and Padilla-Romo 2018; Marín-Llanes 2022; Velasco 2023). In the case of property crimes, as Q_I decreases, those who previously depended on the illegal cannabis trade for income may turn to property crime to compensate for lost revenue. If law enforcement does not concurrently increase efforts to deter property crimes, C_p may rise. Heightened enforcement can also lead to increased violent crime (C_v) if criminal groups attack law enforcement, or if turf wars intensify as decreases in Q_I produce scarcity of cannabis, thereby increasing the value of controlling territory for trafficking, distribution, and sale of illegal cannabis (e.g. Castillo, Mejía and Restrepo 2020; Becker, Murphy and Grossman 2006; Lindo and Padilla-Romo 2018; Velasco 2023). Indeed, the total effect on the overall crime rate (C) depends on the balance between these effects:

$$\frac{\partial C}{\partial E} = \frac{\partial C_m}{\partial E} + \frac{\partial C_p}{\partial E} + \frac{\partial C_v}{\partial E} \quad (11)$$

If $\frac{\partial C_m}{\partial E}$ and $\frac{\partial C_v}{\partial E}$ are negative and outweigh any increase in C_p , then $\frac{\partial C}{\partial E} < 0$. In other words, if decreases in cannabis-related crime and violent crime are large enough to outweigh any increase in property crime, then the total effect of increased law enforcement effort on the overall crime rate will be negative.

Optimal enforcement strategies across different regulatory environments. What does this imply for decisions about how to use law enforcement, both within regulated and unregulated cannabis markets? How might optimal enforcement vary across those options? To begin, we make two assumptions. First, we assume that demand for cannabis is relatively inelastic to changes

in enforcement (e.g. United Nations Office on Drugs and Crime 2024): $\frac{\partial Q_D}{\partial E} \approx 0$.¹⁰ Second, as we argued above, we assume that for most plausible levels of enforcement, violent crime is actually *increasing* in enforcement intensity. This is because enforcement efforts disrupt existing equilibria in illegal markets regulated by armed actors, leading to heightened levels of violence both among drug-trafficking organizations and against civilians, $\frac{\partial C_v}{\partial E} > 0$ (e.g. Castillo, Mejía and Restrepo 2020; Marín-Llanes 2022). Given these assumptions, we seek to derive optimal enforcement strategies that minimize total crime, and then use comparative statics to analyze changes in optimal outcomes as parameters in the model change.

To capture the rising resource cost of policing, let $c(E)$ be a strictly increasing, convex cost function, and let B be the fixed enforcement budget. Consider a policymaker who solves the following optimization problem:

$$E_u^* = \underset{E}{\operatorname{argmin}} [C_m(E) + C_p(E) + C_v(E)] \quad \text{s.t.} \quad c(E) \leq B. \quad (12)$$

By the Kuhn–Tucker conditions, the interior solution E_u^* satisfies

$$c'(E_u^*) = \lambda^* \quad \text{and} \quad \left. \frac{d}{dE} [C_m + C_p + C_v] \right|_{E_u^*} = \lambda^*, \quad (13)$$

such that the marginal enforcement cost equals the marginal crime reduction. This is intuitive: policymakers face a genuine trade-off in that more enforcement costs more, and are unable to push E to infinity given budget constraints. The “sweet spot” is where the marginal cost of an extra unit of enforcement equals its marginal benefit in crime reduction.

Specifying a functional form. To get closed-form intuition, we assume that enforcement costs are quadratic:

$$c(E) = \kappa E^2, \quad \kappa > 0. \quad (14)$$

¹⁰This assumption is likely to hold in various contexts. Despite systematic and repressive enforcement methods being implemented for over five decades, cannabis consumption has continued to rise steadily. It remains the most widely consumed fiscalized substance globally. Furthermore, previous studies, including a systematic literature review, have found that decriminalization processes do not affect the prices of substances, which is the primary mechanism for altering demand (Vicknasingam et al. 2018).

Then the stationarity condition in the unregulated market becomes

$$2\kappa E_u^* = -\frac{d}{dE} [C_m(E) + C_p(E) + C_v(E)] \Big|_{E=E_u^*}, \quad (15)$$

so that E_u^* is exactly the marginal crime-reduction divided by 2κ . Likewise, under the same cost function and budget B_r in a regulated market, the first-order condition is

$$2\kappa E_r^* = -\frac{d}{dE} [C_m(E) + C_p(E) + C_v(E)] \Big|_{E=E_r^*}. \quad (16)$$

In an unregulated cannabis market, the enforcement strategy E_u should be:

$$E_u^* = \operatorname{argmin}_E (C_m(E) + C_p(E) + C_v(E)) \quad (17)$$

subject to:

$$\frac{\partial Q_D}{\partial E} \approx 0 \quad \text{and} \quad \frac{\partial C_v}{\partial E} > 0 \quad (18)$$

The goal is to find E_u^* such that the total crime rate is minimized without disproportionately increasing violent crime. We are especially focused on avoiding increases in violent crime given the disproportionately high costs that these crimes impose on society (Jaitman et al. 2017). One plausible option is to target enforcement efforts E_v at high-value violent targets while keeping overall enforcement E moderate, in order to avoid escalating violence:

$$E_v = \max \left(\frac{\partial C_v}{\partial E_v} \times \frac{\partial Q_I}{\partial E_v} \right) \quad (19)$$

In a *regulated* cannabis market, enforcement resources may expand thanks to tax revenues derived from excise and licensing taxes on legal cannabis that can boost enforcement resources. For this reason, we now incorporate an endogenous post-regulation budget. Formally, this can be expressed as:

$$B_r = B + \tau P_L Q_L, \quad (20)$$

where τ is the average tax rate on cannabis sales. A higher Q_L thus raises B_r , expanding the feasible set for E .

$$E_r^* = \operatorname{argmin}_E (C_m(E) + C_p(E) + C_v(E)) \quad \text{subject to} \quad c(E) \leq B_r. \quad (21)$$

Enforcement strategies may also be qualitatively different in regulated markets, given that regulation can facilitate the transition of users from the illicit to the legal market, reducing the overall size of the illegal market. Enforcement strategies should then focus on maintaining the integrity of the legal market while minimizing residual illegal activity that coexists alongside legal cannabis. This enforcement effort E_r in a regulated market can be expressed as:

$$E_r^* = \operatorname{argmin}_E (C_m(E) + C_p(E) + C_v(E)) \quad (22)$$

Subject to:

$$\frac{\partial Q_I}{\partial E} \approx 0 \quad \text{and} \quad \frac{\partial C_v}{\partial E} < 0 \quad (23)$$

Here, the goal is to reduce Q_I to near zero while avoiding any increases in violent crime stemming from this shock to the illicit supply of cannabis. The first constraint is particularly important: it is crucial to use enforcement efforts in a way that does not increase the size of the illicit market. Precisely because widespread consumption of cannabis and its possession is not the focus of enforcement in a regulated market, enforcement can focus on dismantling illegal networks with targeted enforcement E_v :¹¹

$$E_v = \max \left(\frac{\partial C_v}{\partial E_v} \times \frac{\partial Q_I}{\partial E_v} \right) \quad (24)$$

Optimal enforcement levels E^* differ markedly between unregulated and regulated markets. Comparative statics help make this clearer: assume E_u^* is the optimal enforcement level in an un-

¹¹We acknowledge that the resources used for enforcement efforts may not be perfectly transferable: redeploying police officers on the beat from performing stop and frisk requires different skills than conducting high-value operations against drug king-pins and improving criminal investigation.

regulated market and E_r^* the optimal enforcement level in a regulated market. $C_m(E)$ decreases with higher enforcement in an unregulated market, but the reduction is limited due to inelastic demand for cannabis. Higher enforcement could lead to increased violent crime (C_v) due to turf wars and competition over the illicit drug trade. In a regulated market, however, $C_m(E)$ may decrease more effectively with enforcement as the presence of a legal alternative reduces the demand for illicit cannabis. The shift from illegal to legal consumption reduces the need for enforcement of cannabis markets, lowering E_r^* compared to E_u^* , and allowing for the police to focus on other priorities. When considering effects on property crime, $C_p(E)$ could rise in an unregulated market if enforcement drives individuals involved in that market to commit property crimes to diversify their revenue streams. In contrast, in a regulated market, $C_p(E)$ might decrease or remain stable because the legal market provides an alternative source of income, reducing the incentive of consumers to commit property crimes in order to obtain cannabis. E_r^* therefore might be lower because the legal market absorbs some of the criminal labor force.

Because the legal market provides an alternative to illicit sales, the marginal crime-reduction payoff to enforcement is lower under regulation. Holding all else equal (including the budget), one therefore expects

$$E_r^* < E_u^* \quad \text{and} \quad C(E_r^*) < C(E_u^*),$$

meaning that regulated markets both require less policing and should achieve lower total crime.¹²

The mechanisms discussed in this section are summarized in Table 1 for ease of reference and analysis. Having provided a set of plausible theoretical mechanisms through which cannabis regulations could affect crime, we now turn to the data we use to derive meta-analytic estimates for this relationship and then discuss our empirical strategy. Given data limitations that we discuss below, our ability to test specific mechanisms is limited, so we leave this for further research.

¹²We show in Appendix A that, under a Stackelberg enforcement game, that stronger enforcement deters violence whenever criminal profits face diminishing returns.

Table 1: Mechanisms linking cannabis regulation to crime outcomes

Mechanism	Effect	Type of crime	Description
Legality of cannabis possession & distribution	↓	Cannabis-related crimes	Reduced arrests for possession and distribution offenses.
Lower and more stable legal market prices	↓	Property crimes	Lower and more stable cannabis prices reduce the need for theft or burglary to fund consumption.
Reduction of the size of the illegal market	↓	Violent crimes	Cannabis regulation decreases the size of the illegal market and reduces violent crime due to disputes over territory.
Reallocation of law enforcement resources	↓	Property crimes, violent crimes	With fewer cannabis-related offenses to police, law enforcement can redirect efforts toward more serious crimes, improving deterrence.
Legal dispute resolution & contract enforcement	↓	Violent crimes	The legal market establishes formal dispute resolution mechanisms, decreasing violence associated with illegal contract enforcement.
Harm reduction and public health strategies	↓	Cannabis-related crimes, property crimes	Increased funding for public health & harm reduction initiatives reduces substance abuse and mitigates the risk of escalating criminal behavior.
Pharmacological effects of cannabis	↑	Violent crimes	Greater cannabis availability may lead to erratic or violent behavior, particularly among vulnerable populations and with high-potency strains.
Dispensaries as crime targets	↑	Property crimes	Cannabis dispensaries, often handling large amounts of cash, may attract robberies, increasing local property crime.
Changes to law enforcement in illegal markets	↑	Property crimes, violent crimes	Stricter enforcement can shrink illegal cannabis markets, but may drive property crime or escalate violence against law enforcement and rival groups.

DATA

In Table 2 we report studies that met the inclusion criteria for the meta-analysis—described in detail below. As noted in the introduction, this includes 9 studies and their 20 main estimates.

Searching for relevant articles. We began with the following Google Scholar search: “(cannabis OR marijuana OR pot) AND (legalization OR legalize OR decriminalization OR decriminalize OR depenalization OR depenalize OR law OR dispensaries) AND (effect OR impact) AND (crime OR criminality OR offence OR violence OR violent).” Using this search, we reviewed the first 30 pages of the search results and selected all relevant papers. We then performed a less rigid search that included the following words: “marijuana,” “law,” “effect,” and “crime”. We reviewed the first 50 pages of search results to select any relevant papers that were not previously selected. Next we reviewed references for each of the identified papers and finally examined all studies citing any of the papers that met the criteria listed above. We include both published articles and

working papers to prevent biasing our findings towards published results (e.g. Cools, Finseraas and Rogeberg 2021).

Selecting relevant articles. We establish five criteria for selecting studies to include in our meta-review. The first requires that the study employs a research design explicitly developed to estimate causal effects—whether experimental or quasi-experimental—such as randomized controlled trials, difference-in-differences, regression discontinuity, or synthetic control designs, and includes a clearly defined counterfactual. By limiting our review to studies with reasonably strong internal validity, we exclude those that do not employ methodologies to estimate causal effects and that, ultimately, only estimate a correlation between cannabis regulations and various types of crime.

The second criterion requires the use of administrative data for crime measures, which facilitates cross-study comparability. Accordingly, we include studies that rely on crime data reported by police departments, the Federal Bureau of Investigation (FBI), and other law enforcement agencies, as well as administrative data drawn from hospital records. We exclude studies based on self-reported victimization data gathered through surveys, as these are subject to reporting biases, differences in survey design, and inconsistencies in respondents' perceptions of crime, making comparisons across studies less reliable.

The third criterion restricts our analysis to published articles and working papers, excluding master's and doctoral theses due to concerns about the consistency of quality standards. While we include unpublished working papers—given that they are often subject to informal peer review and public scrutiny—we exclude theses because they generally lack a formal review process and may vary in methodological rigor. The fourth criterion limits our analysis to studies estimating local effects, defined as the impact of cannabis regulation on crime within the same jurisdiction where the law was enacted. We exclude studies that focus exclusively on spillover effects.

The final criterion aims to ensure consistency in the measurement of crime outcomes across studies, which included rates, counts, and log transformations. To standardize effect sizes, we used Cohen's d , which required restricting our review to studies that reported the standard deviation of the outcome variables or whose authors were willing to share replication data *ex post*.

Unfortunately, many studies did not provide this information, and several authors did not respond to our data requests. We also excluded studies that presented results only in graphical form, as they lacked point estimates and corresponding standard errors necessary for inclusion. These limitations highlight the importance of improved scientific reporting standards during the revision and publication process. Enhancing transparency and consistency in the reporting of key statistical details would not only facilitate cross-study comparability but also enable the development of generalizable conclusions through methodologies such as meta-analysis.

General characteristics of the articles. The general characteristics of the selected studies are summarized in Table 2. The sample includes 9 papers published between 2016 and 2024. Specifically, two were published in 2016, one in 2017, two in 2019, two in 2021, one in 2022, and another in 2024. Two are working papers, while seven are published studies. All of these studies are focused on the United States and examine the effects of various aspects of cannabis regulation on different types of crime, including all crime (pooled), violent crime, and property or non-violent crime. It is important to note that some studies report estimates for multiple outcomes; therefore, the unit of analysis in the meta-analysis is the individual point estimate, rather than the article.

83% of these papers' authors are economists (19 out of 23 authors). Other contributing disciplines include criminal justice (8%) and sociology (8%). Methodologically, the most commonly employed approach in these papers is difference-in-differences, used in 77% of studies, followed by the use of fixed effects (22%). Of the 20 analyzed point estimates, 60% (12 estimates) are statistically significant at the 5% level.

Table 2: Descriptives of Assembled Studies

Paper	Year	Location	Period	Type of marijuana laws	Outcomes	Unit of measurement	Method	Published
Huber III, et al.	2016	USA	1970-2012	Medical marijuana legalization	Violent crime Non-violent crime	Log of the rate per 100.000	DD	Yes
Shepard, et al.	2016	Western Census region USA	1997-2009	Other type of medical marijuana laws	Violent crime Non-violent crime	Rate per 1.000	FE	Yes
Gavrilova, et al.	2017	Mexican-border states USA	1994-2012	Other type of medical marijuana laws	Violent crime	Rate per 100.000	DDD	Yes
Chu, et al.	2019	USA	1988-2013	Medical marijuana legalization	Violent crime Non-violent crime	Log of the rate per 100.000	DD, SC	Yes
Dragone, et al.	2019	Washington & Oregon states, USA	2010-2014	Recreational marijuana legalization	Violent crime Non-violent crime	Rate per 100.000	DSD	Yes
Callahan, et al.	2021	USA	1994-2017	Other type of medical marijuana laws	Violent crime Non-violent crime	Rate	FE	No
Wu, Wen, et al.	2021	Oregon state, USA	2007-2017	Recreational marijuana legalization	Violent crime Non-violent crime	Rate per 100.000	DD	Yes
Wu, Li, et al.	2022	Oregon state, USA	2007-2017	Recreational marijuana legalization	Violent crime	Rate	DD	Yes
Lee	2024	USA	2006-2019	Recreational marijuana legalization	Violent crime Non-violent crime	Rate per 100.000	DD	No

ESTIMATION AND RESULTS

There are multiple estimation alternatives to capture the effect of cannabis regulations on crime across studies. A fixed effects model to pool evidence across studies would only be appropriate if the papers estimate the same underlying effect. Given the diverse set of time periods and populations under study across papers, the fixed effects model could result in biased results. For this reason—and following Cools, Finseraas and Rogeberg (2021)—we use a random effects approach. In a random-effects meta-analysis, each effect estimate is weighted by the inverse of the sum of its variance and the estimated variance of the true effect distribution:

$$\hat{\theta}_{\text{RE}} = \frac{\sum_{i=1}^k w_i \hat{\theta}_i}{\sum_{i=1}^k w_i} \quad (25)$$

where $\hat{\theta}_{\text{RE}}$ is the overall pooled estimate from the random-effects model; $\hat{\theta}_i$ is the effect estimate from study i ; and k is the total number of studies. The weights w_i are calculated as:

$$w_i = \frac{1}{\hat{\sigma}_i^2 + \tau^2} \quad (26)$$

where $\hat{\sigma}_i^2$ is the variance within study i and τ^2 is the estimated variance of the distribution of true effects (between-study variance). To estimate τ^2 we use the restricted maximum likelihood (REML) approach.¹³ The key distinction with respect to a fixed effects approach, the random-effects model accounts for both within-study variance ($\hat{\sigma}_i^2$) and between-study variance (τ^2), allowing for greater generalizability beyond the included studies.

In this section, we present the REML meta-estimates of the effects of cannabis regulations on crime. We aggregate the data in multiple ways to obtain both theoretically and policy-relevant conclusions. First, we estimate the pooled effect of adult-use and medical cannabis regulations on all crime.¹⁴ Given the gradual evolution of medical cannabis regulation worldwide and ongoing

¹³Alternatives such as the DerSimonian-Laird estimator also exist.

¹⁴This includes all types of medical cannabis laws: for medical purposes, medical purposes through comprehensive programs, comprehensive medical-only programs, and medical programs that only allow for the use of CBD/low-THC products for qualifying medical condition(s), as defined by the Centers for Disease Control and Prevention (2023).

policy debates surrounding the regulation of both adult-use and medical markets, a pooled model may be relevant from both theoretical and policy perspectives. For studies that did not report aggregated crime results, we include results for property and violent crime individually. Next, we disaggregate the analysis by type of cannabis regulation, estimating the effects of adult-use and medical cannabis measures separately on all crime. Finally, we estimate the effect of pooled regulatory measures on violent and property crime, separately.

The trade-offs between these approaches involve balancing statistical power and the ability to identify how specific regulatory measures affect particular types of crime. Pooling regulations and crime categories increases the number of observations, thereby enhancing statistical power. However, this approach may obscure important heterogeneity across regulation types and crime dimensions. In contrast, disaggregating the data allows for a more nuanced understanding of the distinct effects of each regulatory measure on specific forms of crime, albeit at the cost of reduced statistical power. We balance these trade-offs by focusing on the most pressing policy and scholarly relevant results.¹⁵

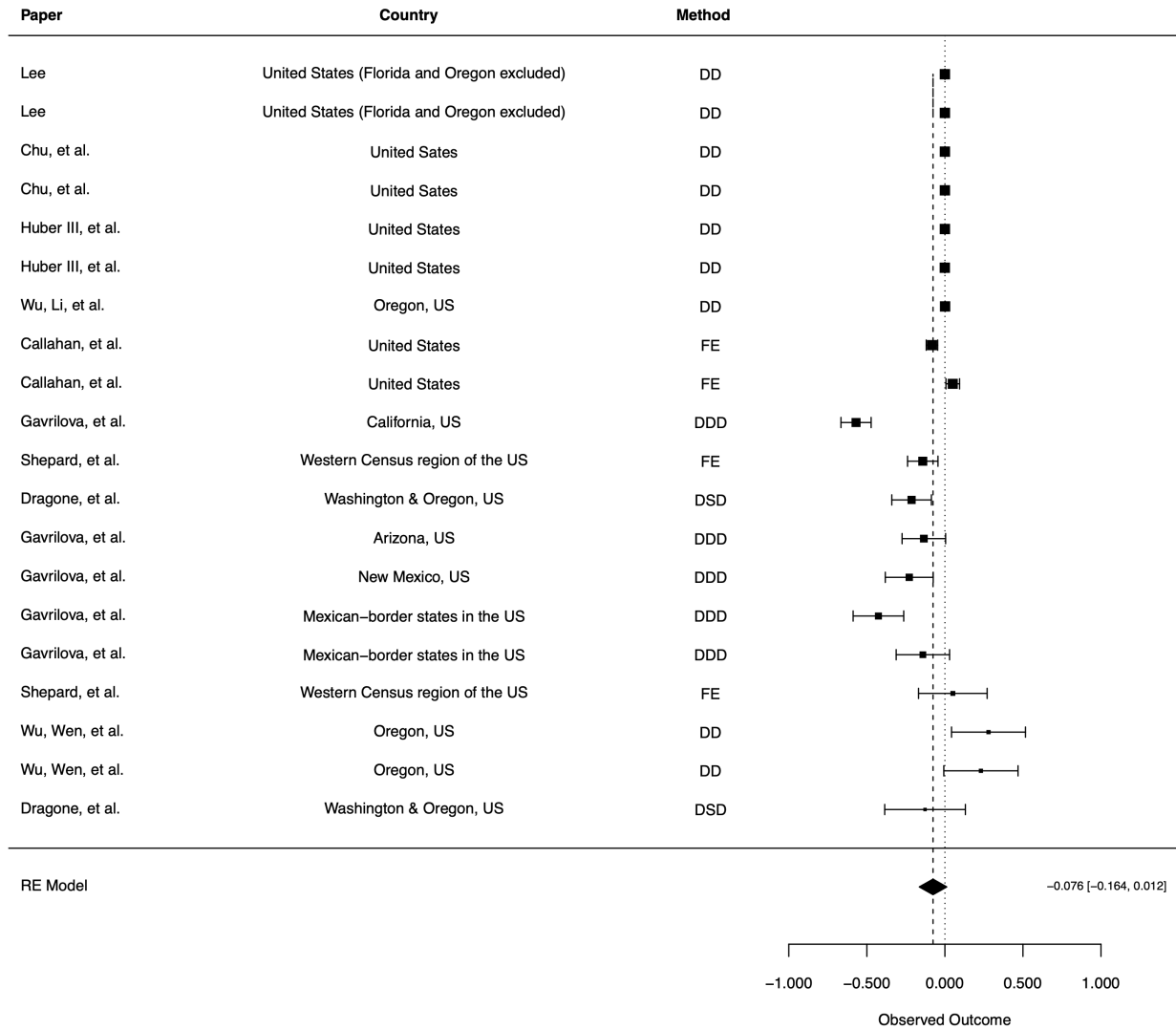
We present our core results are presented in forest plots. For each point estimate, the figures display the authors, the geographical location of the study, the identification strategy employed, as well as the individual coefficient and its corresponding confidence interval. At the bottom of each figure, we report the random-effects (RE) meta-estimate along with its associated 95% confidence interval.

Effect of pooled regulations on all crime. Figure 1 shows that pooled recreational and medical regulations are associated with a crime reduction of 0.076 standard deviations; while this effect is not significant at the 95% confidence level, it is significant at $p < .10$. We aggregate nine studies (20 estimates)—all conducted in the United States, most using difference-in-differences designs—to estimate the combined impact on any criminal outcome. When a study did not report an all-crime

¹⁵As we are also interested in potential publication bias, in Appendix B.1 we discuss at length a Bayesian approach to estimating bias models that introduce two bias parameters for relative publication probabilities, which may have distorted the observed publication record (Cools, Finseraas and Rogeberg 2021). Each parameter is assigned a prior that encapsulates prior knowledge; with small sample sizes, in particular, these priors may well affect the inferences we draw.

aggregate, we include its separate violent and property crime estimates. On average, we find a negative effect of changes in cannabis regulation on aggregated crime. We then proceed to disentangle the effects of medical and adult-use regulations, as well as their impacts on violent and property crimes.

Figure 1: Forest Plot, REML model for all regulations on all crime



Notes: Squares refer to point estimates, lines to 95% confidence intervals. The diamond and vertical dotted line show the meta-estimate from the REML model. Studies are sorted by precision. Method abbreviations are as follows: “DD” denotes difference-in-differences; “FE” fixed effects; “SC” synthetic control; “ITS” interrupted time-series; “DSD” difference-in-spatial-discontinuity; “DDD” difference-in-difference-in-differences.

Effects of recreational cannabis regulation on all crime. Figure 2 presents the results of adult-use cannabis regulation on all crime, using the same structure as Figure 1. Again, these results encompass all criminal outcomes reported in studies included in the analysis. Our results show that recreational cannabis laws have no statistically significant effect on aggregate crime. This core result pools seven estimates from four studies—five located in Oregon—using difference-in-differences or spatial-discontinuity methods.¹⁶ The absence of a measurable effect in these contexts highlights the need for studies with broader geographic coverage before generalizing about recreational legalization.

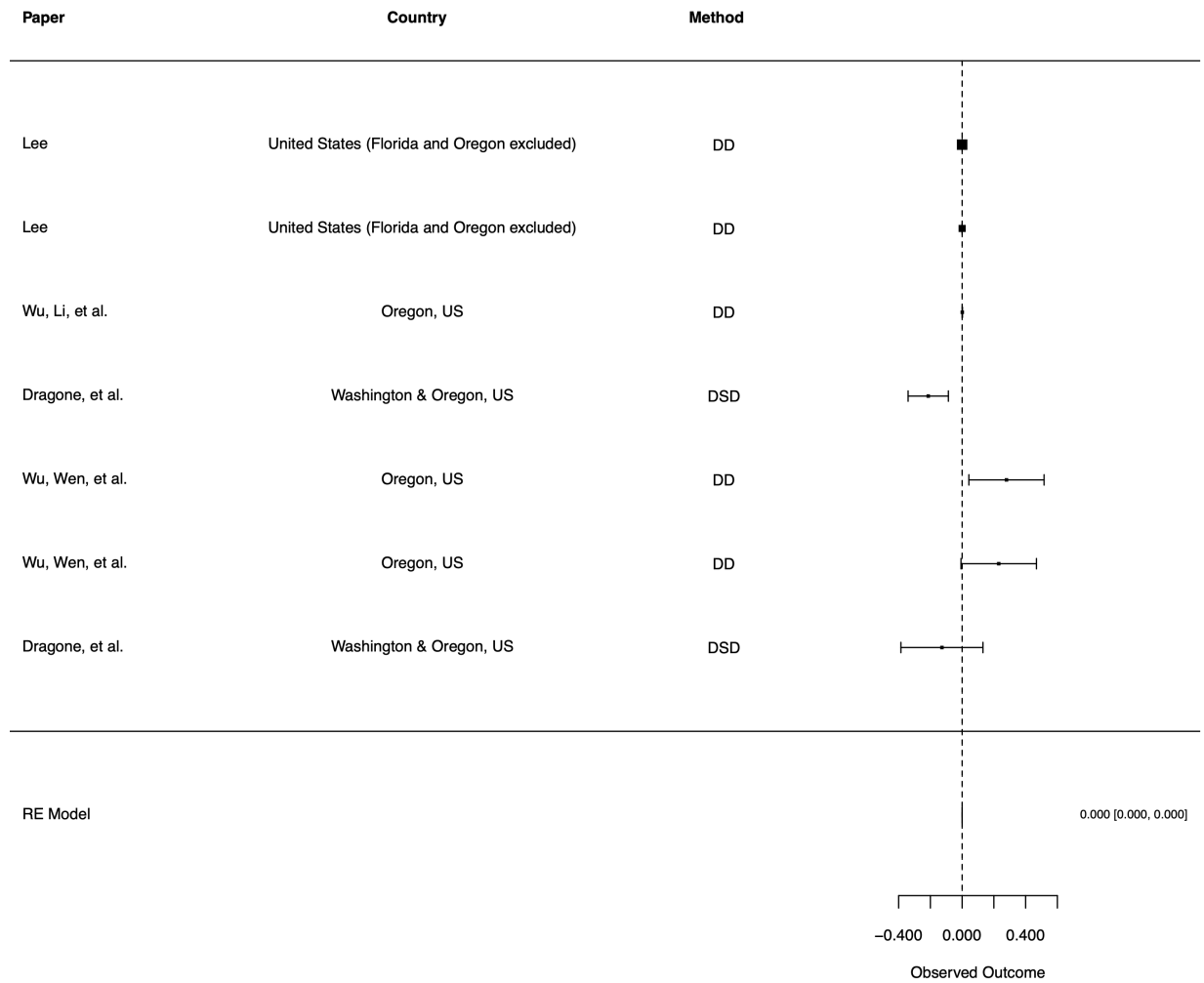
Effects of medical cannabis regulation on all crime. Figure 3 shows that medical cannabis regulations yield a statistically significant 0.12 standard deviation reduction in overall crime (significant at $p < .05$). This finding is based on 13 estimates from five U.S. studies, employing difference-in-differences, triple-differences, and fixed-effects designs (Figure 3).¹⁷ The robust crime-reducing effect of medical programs points to the potential of controlled, condition-based regulations to weaken illicit markets.

Taken together, our results suggest that legal regulation of cannabis markets does not appear to increase crime; if anything, regulation reduces crime. Disentangling the effects of cannabis regulation on violent and non-violent crimes provides suggestive evidence about the underlying mechanisms. Reductions in violent crimes due to regulations are likely associated with the weakening of drug-trafficking organizations, more efficient allocation of public resources to combat crime, decreases in the use of substances related to violent behavior, and shifts in competition among criminal groups toward other illegal markets. In contrast, reductions in non-violent crimes are more plausibly linked to changes in individual behavior related to psychoactive substance use increases and the substitution of illegal activities by criminal groups in response to reductions in the cannabis illegal market. Collectively, these mechanisms likely account for the aggregate decline in

¹⁶Of the three studies excluded for missing standard deviations, only one reported positive, statistically significant effects (see Table B.1).

¹⁷Two of the five excluded estimates suggest negative effects on crime and one suggests a positive impact on property crime (see Table B.1).

Figure 2: Forest Plot, REML model for recreational cannabis regulation on all crime

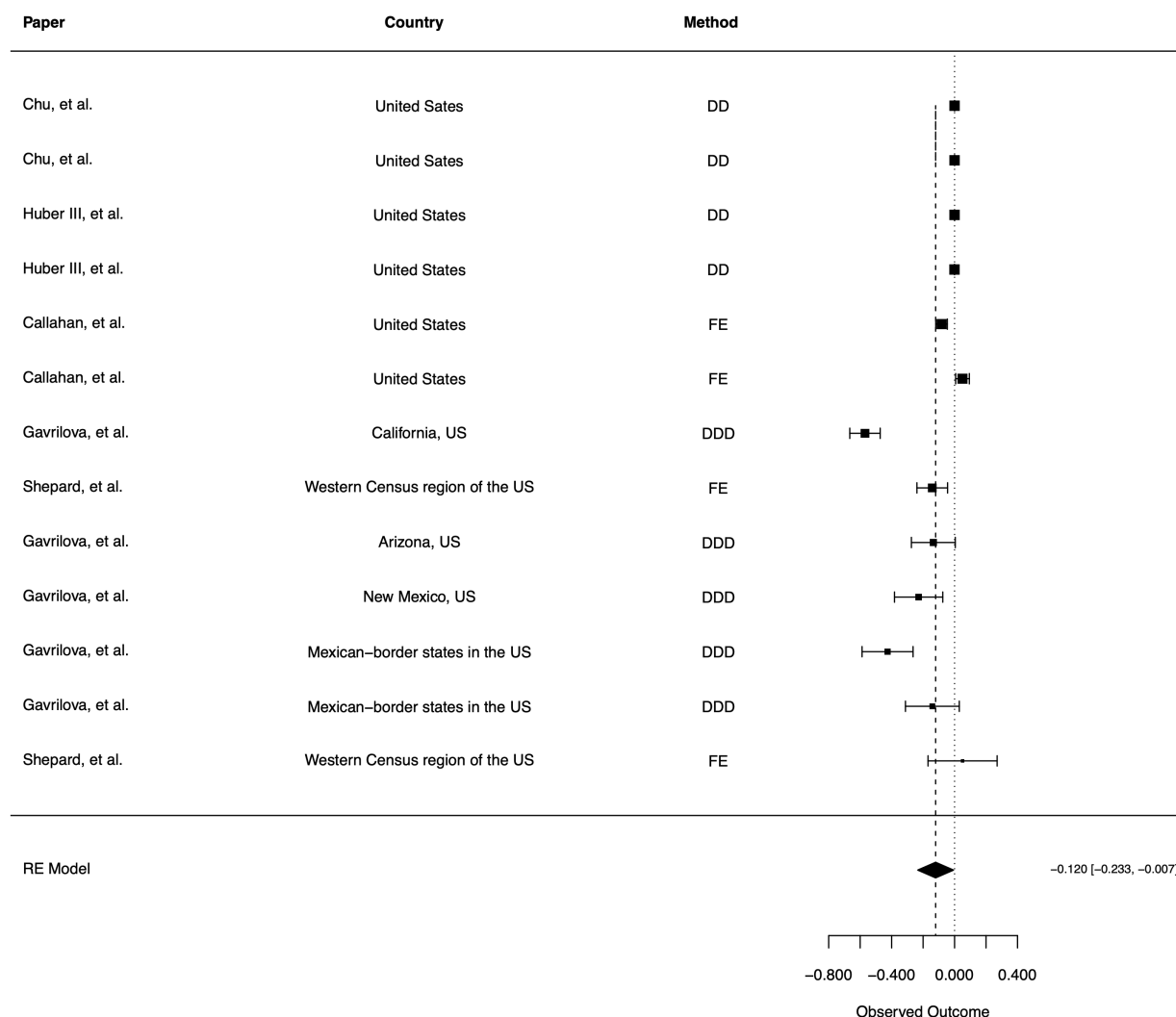


Notes: Squares refer to point estimates, lines to 95% confidence intervals. The diamond and vertical dotted line show the meta-estimate from the REML model. Studies are sorted by precision. Method abbreviations are as follows: “DD” denotes difference-in-differences; “FE” fixed effects; “SC” synthetic control; “TTS” interrupted time-series; “DSD” difference-in-spatial-discontinuity; “DDD” difference-in-difference-in-differences.

both violent and non-violent offenses observed in our empirical analysis of cannabis regulations, although testing specific mechanisms is impossible given data restrictions.

Effects of pooled regulations on violent crime. As Figure 4 indicates, when we pool recreational and medical regulations we find a reduction of violent offenses by 0.125 standard deviations (significant at $p < .05$). Thirteen estimates from nine U.S. studies—using DiD, triple-DiD, and other quasi-experimental approaches—compose this meta-estimate (Figure 4). Consistent de-

Figure 3: Forest Plot, REML model for medical cannabis regulation on all crime

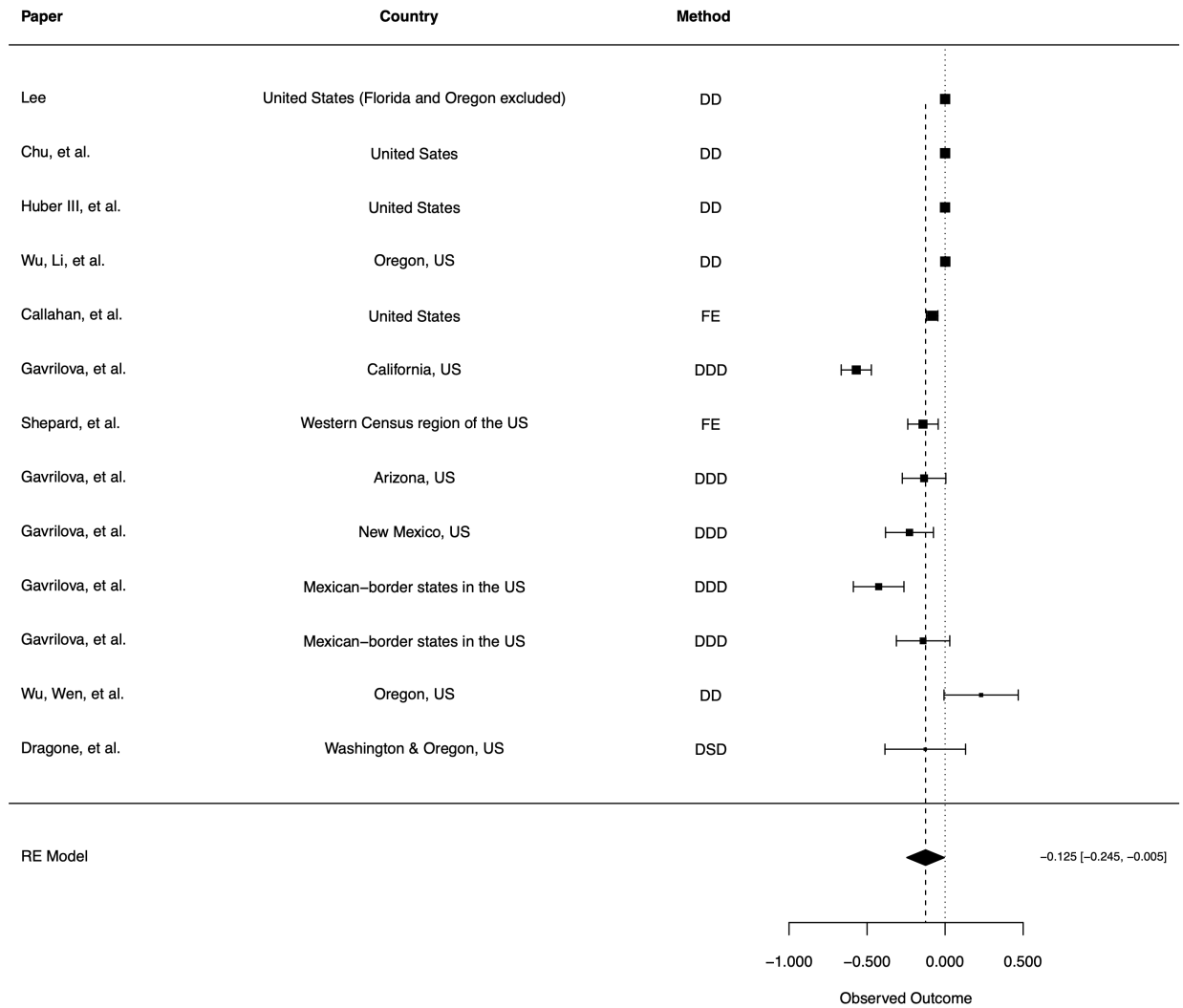


Notes: Squares refer to point estimates, lines to 95% confidence intervals. The diamond and vertical dotted line show the meta-estimate from the REML model. Studies are sorted by precision. Method abbreviations are as follows: “DD” denotes difference-in-differences; “FE” fixed effects; “SC” synthetic control; “ITS” interrupted time-series; “DSD” difference-in-spatial-discontinuity; “DDD” difference-in-difference-in-differences.

clines in violent crime align with theoretical predictions that legalization likely undermines criminal organizations and may reallocate enforcement resources.

Effects of pooled regulations on property crime. Figure 5 presents estimates for the effect of pooled cannabis regulations on property crimes, demonstrating no effect. This precisely estimated null effect draws on seven estimates (one per study), all U.S.-based and primarily using

Figure 4: Forest Plot, REML model for pooled regulations on violent crime

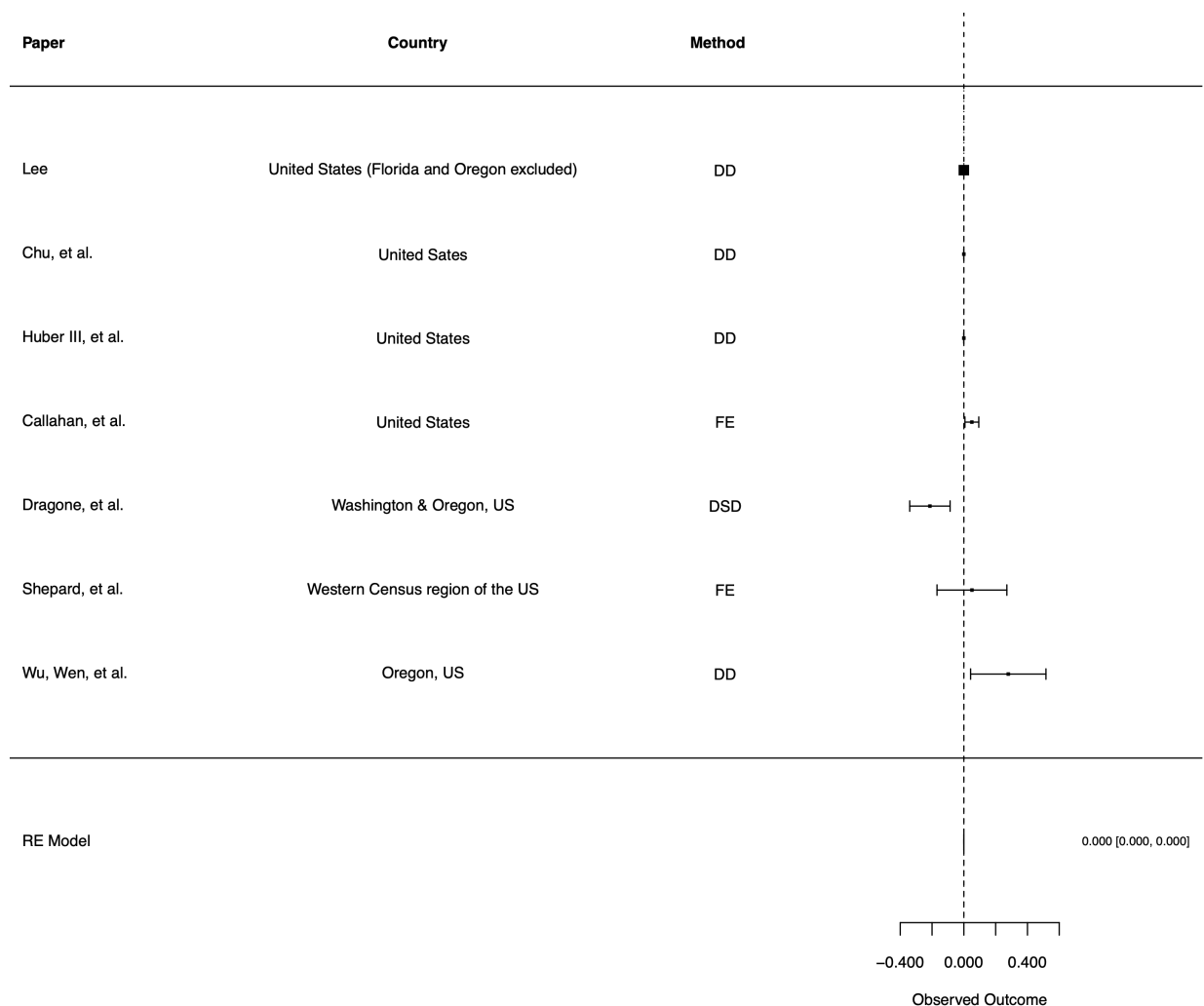


Notes: Squares refer to point estimates, lines to 95% confidence intervals. The diamond and vertical dotted line show the meta-estimate from the REML model. Studies are sorted by precision. Method abbreviations are as follows: “DD” denotes difference-in-differences; “FE” fixed effects; “SC” synthetic control; “ITS” interrupted time-series; “DSD” difference-in-spatial-discontinuity; “DDD” difference-in-difference-in-differences.

difference-in-differences or fixed-effects methods (Figure 5). The null finding for property crimes suggests non-violent offenses may respond differently to market legalization, possibly reflecting substitution effects or changes in individual behavior.

Meta-summary of results. We find that, based on the available research to date, cannabis regulations have, on average, contributed to a significant reduction in criminal activity. When disaggre-

Figure 5: Forest Plot, REML Model for pooled regulations on property crime



Notes: Squares refer to point estimates, lines to 95% confidence intervals. The diamond and vertical dotted line show the meta-estimate from the REML model. Studies are sorted by precision. Method abbreviations are as follows: “DD” denotes difference-in-differences; “FE” fixed effects; “SC” synthetic control; “TTS” interrupted time-series; “DSD” difference-in-spatial-discontinuity; “DDD” difference-in-difference-in-differences.

gating the results, we observe that these impacts are primarily driven by medical cannabis laws and by reductions in violent crime rather than property crime. At the very least, the evidence allows us to likely rule out any crime-increasing effects of cannabis regulations. The strongest available evidence is limited to the United States; to guide effective policymaking, future studies should examine a more diverse set of jurisdictions where cannabis regulations have been implemented. Taken together, these findings suggest that cannabis regulations and broader drug policy reforms

may serve as effective alternatives to reduce criminal activity, contrasting with previous repressive approaches that have neither diminished the availability of psychoactive substances nor weakened criminal organizations.

DISCUSSION AND CONCLUSION

This paper contributes to the academic literature and public policy debates by synthesizing existing research on the impact of cannabis regulation on crime and violence. Our meta-analytic estimates consistently reveal a crime-reducing effect of cannabis-related regulatory reforms, particularly in the case of medical cannabis regulation and violent crime. Importantly, we find no evidence that adult-use regulation leads to increases in criminal behavior.

We disaggregate these effects by the type of regulation implemented—medical versus adult-use—and find that the primary driver of the observed reductions in crime is medical-use regulation. One possible explanation for this difference is the limited availability of results concerning adult-use cannabis regulations, as most of the existing evidence is concentrated in a small number of U.S. states. Further research should continue the effort to systematize findings across a broader set of jurisdictions, especially as research and policy processes advance in the regulation of adult-use markets. Additionally, it is worth considering the relative size of the markets. If the medical cannabis market is significantly larger, this would be consistent with one of our theoretical mechanisms: a larger shift from illegal to legal sales could lead to more substantial reductions in crime.

Moreover, when disaggregating by type of criminal activity—property crimes versus violent crimes—our findings suggest that cannabis regulations reduce violent crimes yet do not increase property crimes. These findings align with several theoretical mechanisms outlined in our framework. The observed reductions in violent crime may be explained by a decrease in the size of the illegal market, which weakens drug-trafficking organizations by cutting off a key revenue source. With fewer financial resources, these groups may struggle to maintain their labor force and become less capable of enforcing contracts through violence. This highlights an important economic insight: cannabis regulation can alter incentives for violence within illegal markets. Additionally,

our results may also reflect the reallocation of law enforcement resources, allowing authorities to focus on more serious crimes, such as violent offenses.

Moreover, in line with Anderson and Rees (2023), another possible explanation is that regulated cannabis markets may reduce the consumption of substances like alcohol and opioids, which are strongly associated with violent behavior. If cannabis acts as a substitute rather than a complement to alcohol, this could help explain the observed decrease in violent crime.

At the same time, our findings suggest that the regulation of cannabis markets does not affect property crime. One possible explanation is that regulated markets do not lead to increased consumption levels and, consequently, do not generate additional economic crimes. For instance, the null effect on property crime is consistent with existing evidence showing no significant increase in cannabis use following regulation (Anderson and Rees 2023). Moreover, these findings may also indicate that cannabis regulation does not prompt criminal organizations to substitute cannabis-related illegal activities with other illicit enterprises.

An additional avenue for future research lies in the role of cannabis dispensaries. The opening of dispensaries is an intensive margin change, typically occurring in contexts where regulation has already been enacted, with the counterfactual being areas where the cannabis market is already regulated. Consequently, dispensaries' impacts may reflect intrastate or even highly local displacements of crime, if they generate any effects on crime at all. In Appendix B.3, we conduct a preliminary analysis of the impact of dispensaries on all crime, pooling together recreational and medical cannabis dispensaries. From our initial search of relevant articles, we collected 17 results for aggregated crime, violent crime, or property crime. However, we include five point estimates from three articles, as these were the only ones for which we could obtain the standard deviation necessary to calculate the respective Cohen's d , as explained in the Data section.¹⁸ The studies included in this analysis were conducted in the United States (in California, Washington, and Colorado) and all employed difference-in-differences to estimate causal effects. We find a precisely-estimated null effect of dispensaries on all crime, suggesting that concerns about dispen-

¹⁸For one study, we excluded the violent and property crime estimates, as it is already included the aggregated crime result.

saries attracting property crime are likely overblown.

Despite its relatively rapid expansion in the United States in recent decades, cannabis regulations remain surprisingly limited. In the United States, 26 states have yet to regulate the adult-use cannabis market. In Latin America, for example, 45% of the region's countries lack a regulatory framework for medical cannabis, and adult-use markets remain criminally prohibited in 95% of the region (Vélez and Marín Llanes 2024).

In efforts to curtail rents that support organized crime, cannabis regulation represents a promising policy tool. Although interventions targeting criminal activity can be context-sensitive (e.g. Braga et al. 2019; Blattman 2021), cannabis regulation may offer immediate, measurable reductions in crime, particularly in regions suffering from sophisticated criminal syndicates associated with drug trafficking. These results suggest that cannabis market regulation could reduce violence and allow public resources to be directed toward other more pressing priorities.

While crime reduction is not the sole reason to pursue cannabis regulation—human rights, individual autonomy and public health also provide powerful arguments—the evidence presented here contributes to ongoing debates about the security consequences of changes to the prevailing wisdom on drug policy. Our findings add to a growing body of literature challenging the conventional wisdom in economics on the regulation of psychoactive substances, demonstrating some potential benefits of reform. This may be especially true for Latin America, given its pressing security and organized crime challenges (Lessing 2020; De Bruin et al. forthcoming). Cannabis regulation offers a promising alternative for reducing crime and reallocating scarce justice sector resources to more productive ends.

Nevertheless, the ability of cannabis regulation to address deep-seated social and economic inequalities and criminal dynamics is likely limited when implemented in isolation. Broader reforms to the legal and criminal justice systems may be necessary to meaningfully advance social equity and protect citizens comprehensively. This limitation is particularly relevant in contexts where all other drug markets remain illegal. In such settings, the potential for crime reduction through cannabis regulation may be constrained, as criminal organizations can redirect their operations to-

ward other illegal substances. Any meaningful reductions in crime may therefore be concentrated among groups primarily involved in cannabis trafficking, which likely represent a small fraction of the overall illegal drug market. However, it is important to note that in all the contexts studied, other psychoactive substances remained criminalized, and yet the regulation of cannabis markets was still associated with reductions in criminal activity. This suggests that even within the broader framework of drug prohibition, cannabis regulation can yield differential and measurable public safety benefits.

Future research should investigate how different regulatory models affect crime. For example, California's market-oriented approach contrasts with the social equity-focused models of New York and Massachusetts, where licenses were granted to individuals previously convicted of drug offenses. These differences may produce divergent outcomes in terms of social justice, public health, and crime reduction. As more impact evaluations of these programs emerge, future work should explore the differential effects of these regulatory models as they aim to balance objectives such as maximizing social equity, reducing crime, and enhancing public health (Marín Llanes et al. 2024; Queirolo 2020).

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APPENDIX

A GAME-THEORETIC ENFORCEMENT MODEL

We formalize the enforcement–violence interaction as a two-stage Stackelberg game. All functions of E use the same notation as what is used in the main text.

1. Criminals' best–response

The state sets enforcement $E \geq 0$. Criminal organizations then choose violence intensity $V \geq 0$ to maximize their net illicit payoff:

$$\max_{V \geq 0} \left[\underbrace{\Pi(V)}_{\substack{\text{illicit revenue} \\ \Pi' > 0, \Pi'' < 0}} - \underbrace{\frac{\gamma}{2} V^2}_{\substack{\text{private cost} \\ \gamma > 0}} - \underbrace{\theta E V}_{\substack{\text{enforcement penalty} \\ \theta > 0}} \right].$$

The first-order condition (FOC) is

$$\Pi'(V^*(E)) - \gamma V^*(E) - \theta E = 0,$$

which defines the best-response $V^*(E)$, decreasing in E .

2. State's problem

Anticipating $V^*(E)$, the state chooses E to minimize total social cost:

$$\min_{E \geq 0} C_m(E) + C_p(E) + \underbrace{\phi V^*(E)}_{= C_v(E)} + c(E),$$

where $\phi > 0$ converts violence intensity into the violent-crime cost $C_v(E)$. Assuming an interior optimum, the first-order condition is

$$\frac{d}{dE} \left[C_m(E) + C_p(E) + \phi V^*(E) + c(E) \right] = 0.$$

By the envelope theorem and using the criminals' FOC, this yields

$$\frac{\partial C_v}{\partial E} = \phi \frac{dV^*}{dE} = -\phi \frac{\theta}{\Pi''(V^*) - \gamma}.$$

Interpretation

- Since $\Pi''(V^*) - \gamma < 0$ and $\phi, \theta > 0$, we have $\partial C_v / \partial E < 0$: stronger enforcement deters violence.
- Larger θ or larger γ each increase $|\partial C_v / \partial E|$, amplifying deterrence.
- If, instead, $\Pi''(V^*) - \gamma > 0$, then $\partial C_v / \partial E > 0$, which reproduces the scarcity-driven turf-war dynamics that we discuss in the main body of the paper.

This appendix provides the micro-foundations for the enforcement–violence elasticity $\partial C_v / \partial E$ used in the theoretical section of the paper, directly tying its sign and magnitude to the structural parameters Π'' , γ , and θ .

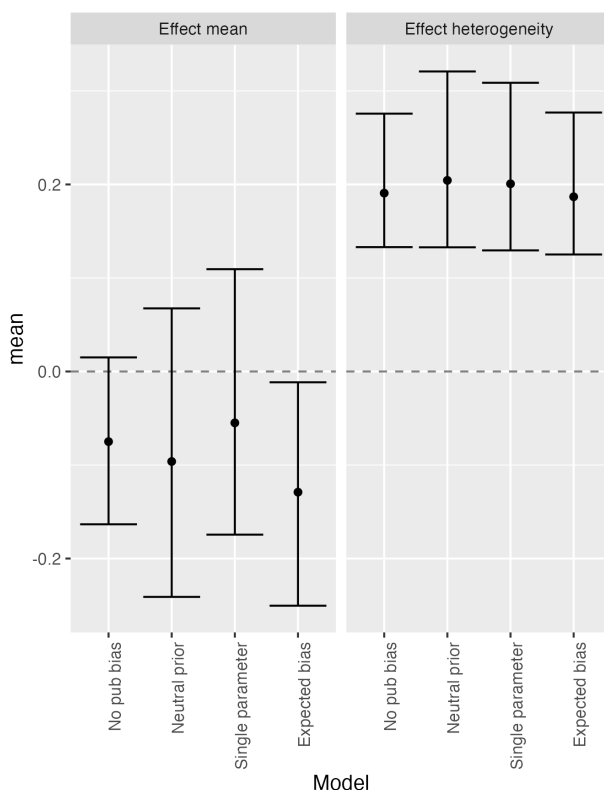
B ADDITIONAL ANALYSES

B.1 Bias Models

Pooled regulations on all crime

Figure B.1 shows the effect mean in the baseline model is almost identical to the REML estimation. All three additional models are also similar, in magnitude and significance, except for the fourth, which shows a statistically significant effect slightly larger than what is estimated via the REML model. These results indicate a reasonable approximation of our model to the real parameter. Regarding effect heterogeneity across studies, the point estimates and confidence intervals are also quite similar across models. In summary, these results indicate low variability and limited imprecision in the estimated effects.

Figure B.1: **Bias Models for pooled regulations on all crime**



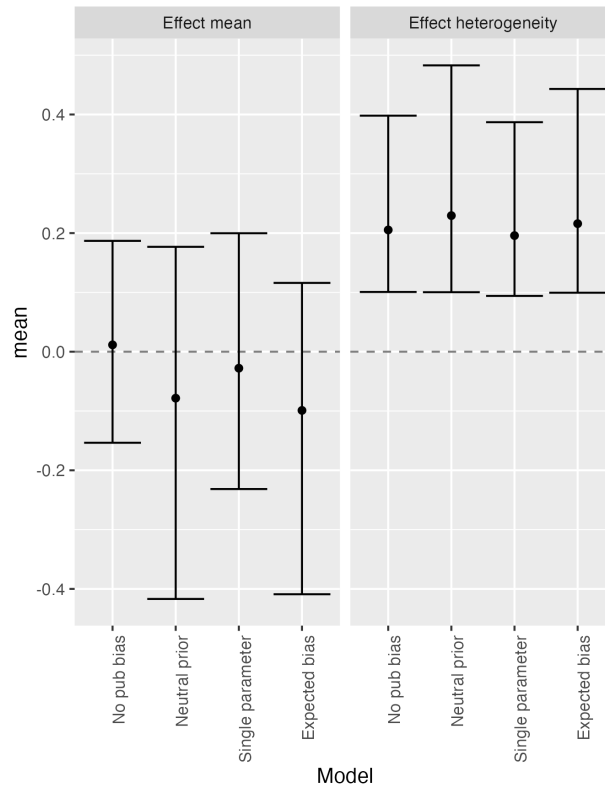
Notes: The figure displays the posterior mean and 95% credibility intervals for four Bayesian models: (1) a baseline model without publication bias, (2) an extended model with two bias parameters (s^- and ns vs. s^+) with neutral priors, (3) a model with one combined bias parameter (s^- and ns vs. s^+) with a neutral prior, and (4) an extended model with two bias parameters and a prior expecting bias toward s^+ results.

Recreational cannabis regulation on all crime

Figure B.2 shows that in the baseline model the effect mean is similar to the RE estimate, although more imprecisely estimated. The three models that allow for publication bias have negative but also imprecisely-estimated effects. Similarly, this *could* suggest the existence of unpublished

studies with negative estimates. In the right panel of Figure B.2, we observe similar point estimates across models with reduced precision indicating, as mentioned above, substantial variability in the results.

Figure B.2: Bias Models - Recreational Cannabis Regulation, All Crime

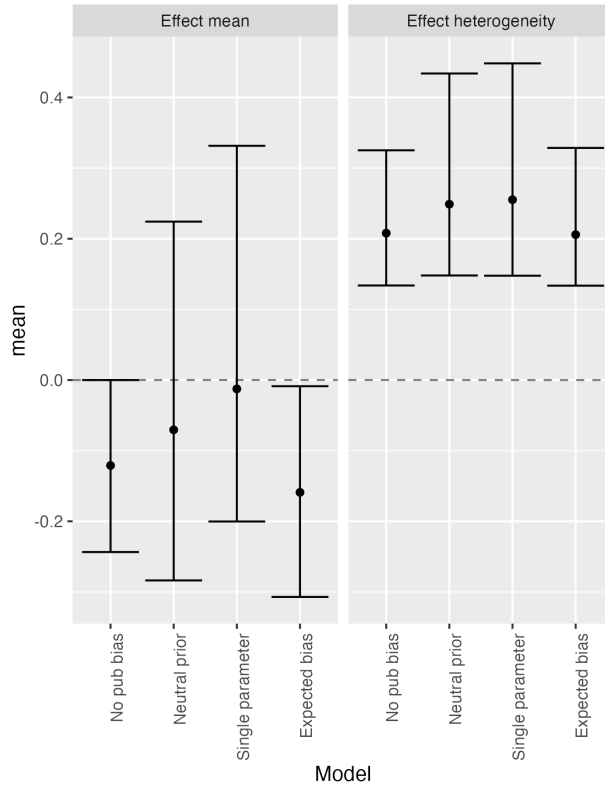


Notes: The figure displays the posterior mean and 95% credibility intervals for four Bayesian models: (1) a baseline model without publication bias, (2) an extended model with two bias parameters (s^- and ns vs. s^+) with neutral priors, (3) a model with one combined bias parameter (s^- and ns vs. s^+) with a neutral prior, and (4) an extended model with two bias parameters and a prior expecting bias toward s^+ results.

Medical cannabis regulation on all crime

Figure B.3 shows that the effect means estimated with the baseline model and the three variants of the bias model indicate possible publication bias. Although the baseline model is very similar to the RE estimate and is statistically significant, the other three models have varying magnitudes and confidence intervals. The point estimates and confidence intervals in the effect heterogeneity panel suggest a similar conclusion.

Figure B.3: Bias Models - Medical Cannabis Regulation on All Crime

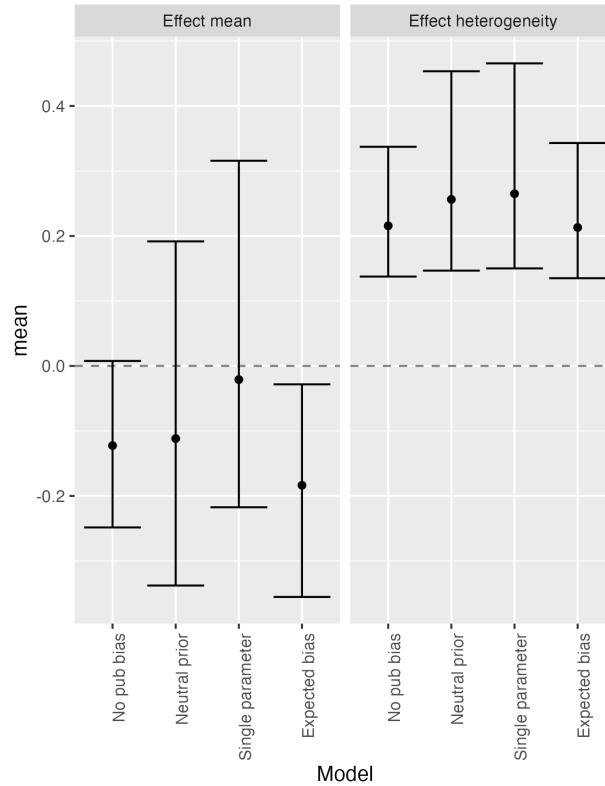


Notes: The figure displays the posterior mean and 95% credibility intervals for four Bayesian models: (1) a baseline model without publication bias, (2) an extended model with two bias parameters (s^- and ns vs. s^+) with neutral priors, (3) a model with one combined bias parameter (s^- and ns vs. s^+) with a neutral prior, and (4) an extended model with two bias parameters and a prior expecting bias toward s^+ results.

Pooled regulations on violent crime

Figure B.4 indicates that the precision of the estimate is reduced when analyzing the bias models: the varying point estimates and the imprecise confidence intervals suggest the presence of publication bias. This conclusion is supported by the effect heterogeneity estimates. In sum, these results show a negative effect of cannabis regulation on violent crime, although the precision and exact magnitude depend on the extent of publication bias.

Figure B.4: Bias Models - effect of pooled regulations on violent crime

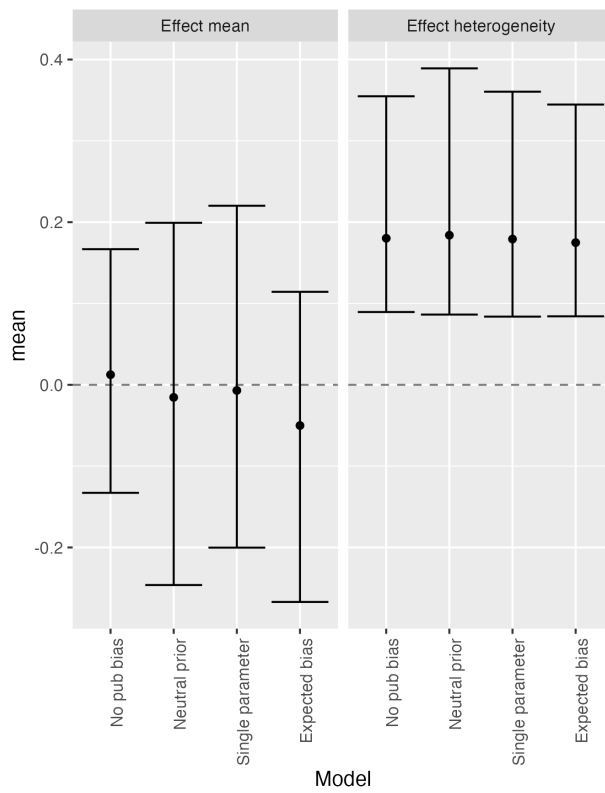


Notes: The figure displays the posterior mean and 95% credibility intervals for four Bayesian models: (1) a baseline model without publication bias, (2) an extended model with two bias parameters (s^- and ns vs. s^+) with neutral priors, (3) a model with one combined bias parameter (s^- and ns vs. s^+) with a neutral prior, and (4) an extended model with two bias parameters and a prior expecting bias toward s^+ results.

Pooled regulations on property crime

In Figure B.5, we can observe that the RE's point estimate is very similar to the ones estimated by the baseline model and by the models allowing for publication bias. This, along with the confidence intervals of all four models, indicates the possible existence of publication bias. This conclusion is supported by the large effect heterogeneities and their respective confidence intervals found in the left panel of Figure B.5.

Figure B.5: Bias Models - Pooled Regulations on Property Crime



Notes: The figure displays the posterior mean and 95% credibility intervals for four Bayesian models: (1) a baseline model without publication bias, (2) an extended model with two bias parameters (s - and ns vs. s +) with neutral priors, (3) a model with one combined bias parameter (s - and ns vs. s +) with a neutral prior, and (4) an extended model with two bias parameters and a prior expecting bias toward s + results.

B.2 Excluded studies due to data availability

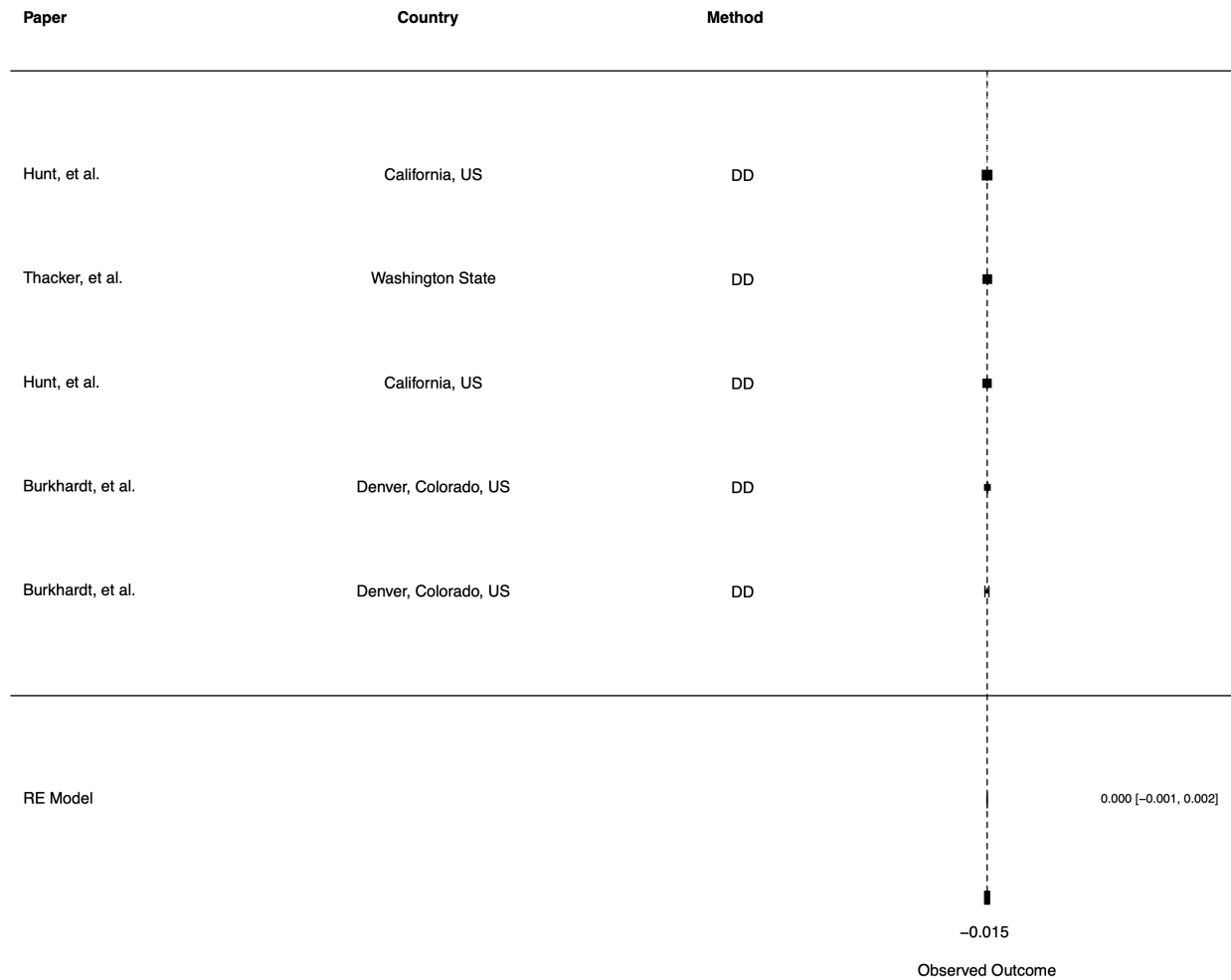
Table B.1: Studies excluded from the meta-analysis due to data availability

Regulation	Authors	Journal / WP Series	Year	Location	Study Dates	Outcome	Method	Point Est.	SE	Signif. (95%)
Medical cannabis regulation	Chu, Y.L., Townsend, W.	Journal of Economic Behavior and Organization	2019	United States	1988–2013	Property crime	DD	-0.032	0.055	No
	Callahan, S., Bruner, D.M., Giguere C.	Appalachian State Univ. WP	2021	United States	1994–2017	Property crime	FE	180.240	79.612	Yes
	Chu, Y.L., Townsend, W.	Journal of Economic Behavior and Organization	2019	United States	1988–2013	Violent crime	DD	-0.014	0.029	No
	Callahan, S., Bruner, D.M., Giguere C.	Appalachian State Univ. WP	2021	United States	1994–2017	Violent crime	FE	-29.102	6.600	Yes
	Gavrilova, E., Kamada, T., Zoutman, F.	Oxford University Press	2017	California, US	1994–2012	Violent crime	DDD	-144.358	12.504	Yes
Recreational cannabis regulation	Wu, G., Wen, M., Wilson, F.A.	Journal of Criminal Justice	2021	Oregon, US	2007–2017	Property crime	DD	365.404	158.141	Yes
	Wu, G., Li, Y., Lang, X.	Int. Journal of Drug Policy	2022	Oregon, US	2007–2017	Violent crime	DD	48.029	26.079	No
	Lin, R., Lin, T.	SSRN	2021	Denver, Colorado, US	2011–2016	Aggregated crime	DD	-0.001	0.048	No

B.3 Dispensaries Estimates

Figure B.6 shows the point estimated included in the analyses and presents the meta-estimate for the effect of dispensaries on all crime, which is a highly precise null.

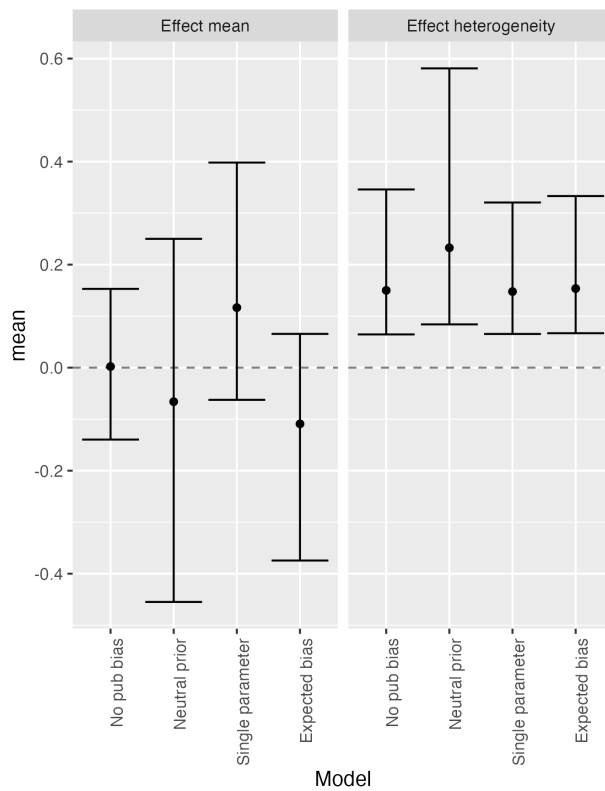
Figure B.6: Forest Plot, REML model for dispensaries on all crime



Notes: Squares refer to point estimates, lines to 95% confidence intervals. The diamond and vertical dotted line show the meta-estimate from the REML model. Studies are sorted by precision. Method abbreviation is “DD” for difference-in-differences.

In Figure B.7, we can observe that the RE’s point estimate is very similar to the ones estimated by the baseline model and by the models allowing for publication bias. However, the confidence intervals are somewhat different. This indicates the possible existence of publication bias, but it is difficult to say to what extent or in which direction. This conclusion is supported by the effect heterogeneities and their respective confidence intervals found in the left panel of Figure B.7.

Figure B.7: Bias Models - Dispensaries on All Crime



Notes: The figure displays the posterior mean and 95% credibility intervals for four Bayesian models: (1) a baseline model without publication bias, (2) an extended model with two bias parameters (s^- and ns vs. s^+) with neutral priors, (3) a model with one combined bias parameter (s^- and ns vs. s^+) with a neutral prior, and (4) an extended model with two bias parameters and a prior expecting bias toward s^+ results.