

**Pricing Conflict:**

**Legal Regimes, Uncertainty, and Price in Medical Cannabis Markets**

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29 August, 2017

Grants from Amazon Web Services, the Berkeley Institute for Data Science, Github, and the Peder Sather Center at UC Berkeley made this project feasible. We thank Sophia Rabe-Hesketh for discussions about modeling strategy. For provocative and helpful comments, we thank Jens Beckert, Ákos Róna-Tas, participants at Berkeley/Stanford doctoral consortium and the Harvard-MIT economic sociology colloquium, and seminar participants at Northwestern University, Washington State University, the University of Pennsylvania, and the University of Toronto. Kudos to all of the undergraduate computer scientists who worked on this project through the Undergraduate Research Apprentice Program and Oski Lab.

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#### **Abstract**

States govern markets through legal regimes. Although prices are central to markets, we know little about their relationship with legal regimes. We build on sociological and legal scholarship to develop two theories of the impact of legal regimes on prices. Both predict that uncertainty created by legal regimes raises prices by increasing costs and increases price dispersion by hindering the development of market norms, but they differ in how legal regimes create uncertainty. The single-level theory predicts that uncertainty results from the lack of clear property rights; the multi-level theory predicts that uncertainty results from conflict about property rights between legal regimes created by different levels of government (federal, state, local). We apply these theories to state-legal markets for medical cannabis in the United States. Consistent with the multi-level theory, we find that conflict between state-level and federal-level legal regimes resulted in higher and more dispersed prices for medical cannabis and that alignment of local-level and federal-level legal regimes resulted in less dispersed prices. We conclude by considering how the multi-level theory of legal regimes might be applied to other markets.

States govern markets through rules in the form of legislation, administrative regulations, and judicial decisions. The resulting legal regimes make markets legally calculable and market activities predictable by creating property rights that determine who can own and trade which products (Weber, 1927 [1981], 1978). The clearer the property rights created by a legal regime, the easier it is to enforce contracts between buyers and sellers, and the less uncertainty they face. The more certainty there is about property rights, the easier it is to plan, which lowers operating costs and facilitates the development of norms about how to value products and how to operate organizations in the focal market. Thus, depending on the clarity of property rights and the resulting level of certainty or uncertainty, legal regimes can support or suppress the actions of buyers and sellers, and impel or impede the development of market norms (North, 1990; Campbell and Lindberg, 1990; Fligstein, 2001; McAdams, 2015).

Although we have a wealth of research concerning the impact of legal regimes on markets, very little of this work has recognized that many states are federalist systems with nested levels of government (for exceptions, see Dobbin, 1994; Schneiberg and Soule, 2005). Therefore, most work has assumed implicitly that the legal regimes created by different levels of government are aligned. Yet tension inheres in all federalist systems, as a centripetal pull toward a single political center is countered by a centrifugal push away from the center toward political subunits, and different levels of a federation can create distinct, possibly conflicting legal regimes to govern a particular market. Conflict between legal regimes creates uncertainty by clouding property rights. For example, if one level of government authorizes the sale of a product but a second level bans it, then conflict and contradiction is likely to ensue (Campbell and Lindberg, 1990). In the current highly polarized political climate in Europe and the United States, conflict between different levels of federalist systems is becoming more common. In the United States, for example, witness the many different ways Republican-led state governments resisted the roll-out of the Affordable Care Act (42 U.S.C. 18001, 2010), which greatly complicated the structure and functioning of markets for health insurance.

We study the impact of legal regimes and the certainty (or uncertainty) they generate on prices because prices are central to market behavior (Uzzi and Lancaster, 2004; Beckert, 2011). Prices are coordinating mechanisms that align buyers' and sellers' preferences and actions. Prices are determined by both technical factors (supply and demand) and social factors (networks, institutions, and norms). The vast majority of research on prices has involved statistical analysis of how social networks affect prices (e.g., Podolny, 1993; Uzzi and Lancaster, 2004; Askin and Bothner, 2016) or ethnographic and interview-based analysis of how prices are derived from social norms (e.g., Smith, 1989; Velthuis, 2005; Fourcade, 2011); far less has been done to understand how institutions (e.g., legal regimes or religious strictures) determine prices, through either qualitative or quantitative inquiry (Beckert, 2011: 766-768; for an exception, see Calder, 2016). Moreover, we study both the central tendency of price (the mean) and price dispersion (variance).

We lay out two theories of the impact of institutions on prices. The first, a single-level theory, proposes that the prime driver of uncertainty is the *lack of clear property rights*, while the second, a multi-level theory, proposes instead that the prime driver is *conflict between legal regimes* created by different levels of a federalist system *concerning property rights*. Both theories propose that uncertainty makes it difficult for sellers to plan, which impedes operations and increases costs, driving prices higher. In addition, we argue that uncertainty hinders the development of widely shared norms regarding valuation and evaluation, which makes it harder for sellers to classify products in commensurable ways and settle on similar prices for products, thus generating price dispersion. We also argue that uncertainty makes it difficult to develop norms about effective and appropriate forms of organization, increasing the variety of organizations operating in a market; in turn, organizational heterogeneity increases variation in operating costs, increasing price dispersion.

We test these theories in a critical battleground for federalism: markets for medical cannabis in the United States (Mikos, 2009; Schwartz, 2013; Chemerinsky et al., 2015), where

possession and sale of cannabis for medical use is legal at the state level but illegal at the federal level. We study markets in seven states (Arizona, California, Colorado, Michigan, Oregon, Nevada, and Washington) that constituted over 95 percent of state-legal medical cannabis sales in the United States in 2015. The products traded in these markets are morally charged and legally contested, so states' and municipalities' legal regimes are likely to exhibit considerable variation, which facilitates examining the impact of legal institutions on price. But this site has advantages beyond its importance for understanding federalism and markets. State-legal markets for cannabis are growing rapidly and becoming economically important to states' income streams, with sales rising from \$2.7 billion in 2014 to \$6.9 billion in 2016 (ArcView Market Research, 2015, 2017). In 2014, the most recent year for which nationally representative survey data are available, 13 percent of American adults reported using cannabis (Compton et al., 2017). Although we cannot predict the federal government's future actions, a majority of Americans support legalizing cannabis for adult recreational use (60 percent in 2016, up from 34 percent in 2001) (Gallup, 2016), so state-legal cannabis markets are likely to continue to grow, even in the face of federal opposition.

We begin by reviewing research on states and markets from economics, sociology, and legal studies, which yields a single-level theory of how legal regimes affect prices. We then explain the complexities of federalist government systems and develop a multi-level theory of how conflict between legal regimes at different levels of federalist systems affects prices. Next, we review the history of laws concerning cannabis in the United States, and describe how we gathered and analyzed data to test predictions from both theories. After summarizing our empirical results, we consider the implications of our analysis for research on pricing in other markets.

### **Law, Markets, and Prices**

States construct markets by creating rules (legislation, administrative regulations, and judicial decisions) that determine what can be produced and sold, and under what

circumstances; who can own, produce, buy, and sell products; whether anyone can profit from selling them; and under what circumstances and in what ways they can be sold (e.g., Polanyi, 1944; North, 1981, 1990; Campbell and Lindberg, 1990; Fligstein, 2001). By making markets legally calculable and economic action predictable, states make it possible for markets to function (Weber, 1927 [1981], 1978). Legal regimes – the array of state-created rules governing markets – affect markets in three ways. Most fundamentally, legal regimes *constitute* or *generate* markets by defining categories of economic actors and actions, thus determining what kinds of organizations and products are recognized as permitted or prohibited (DiMaggio, 1990; Edelman and Suchman, 1997). This impact of legal regimes is most apparent when markets are in flux – either when new markets emerge or when existing markets are transformed by legal, cultural, economic, or technological change – and almost invisible (taken for granted) in stable markets (Róna-Tas and Guseva, 2014). After they emerge and as they stabilize, markets are shaped by legal regimes in two other ways (Edelman and Suchman, 1997). Legal regimes *facilitate* market exchange by creating tools and forums for buyers and sellers, such as contracts, lawsuits, and mediation. Legal regimes also *regulate* market exchange, through substantive edicts concerning acceptable strategies, products, forms of organization, and practices, in terms of such things as workers’ rights, customer relations, pollution, pricing, and co-operation.<sup>1</sup>

### *A Single-Level Theory of Legal Regimes and Prices*

Legal regimes, especially legislation and administrative regulations, express the beliefs and values of the state authorities who created them; in doing so, these aspects of legal regimes signal public attitudes concerning regulated practices and products, and the risks associated with them (e.g., Cooter, 1998; McAdams, 2015). This is most likely to occur when

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<sup>1</sup> The distinction between legal regimes’ generative function and their facilitative and regulatory functions parallels the distinction North (1981: 203) drew between *constitutional* rules, “the fundamental underlying rules designed to specify the basic structure of property rights and control of the state,” and *operating* rules, which “specify terms of exchange within constitutional rules.”

laws are passed in response to direct democracy (through referenda or ballot initiatives), when laws and regulations are well publicized, and when they affect the public directly. But it may also occur when laws and regulations are initiated by legislators and executives, even in the face of concentrated interests such as lobbyists, to the extent that legislators and executives must appeal to “the median voter” to be re-elected. As signals of public attitudes, these aspects of legal regimes shape people’s perceptions of what is normal and aberrant, right and wrong, and thus create social norms that regulate economic activity. When a legal regime prohibits a product or practice (e.g., abortion, alcohol, cannabis, or gay marriage), it reveals public disapproval of that product or practice, which can lead people to condemn it. But when a legal regime allows a formerly prohibited product or practice (e.g., alcohol or gay marriage) or requires a new product or practice (e.g., child safety seats or privacy notices), it reveals improvements in public attitudes toward that product or practice, which can lead people to consider it more positively. Even when legal regimes do not express the beliefs and values of state authorities, they can still shape public attitudes and behavior, either by legally and symbolically tying them to already legal, and thus socially accepted, practices or products, or by naturalizing behavior; both processes make people more willing to buy products or engage in practices (Lessig, 1995; Geisinger, 2002).

As this discussion reveals, state-created legal regimes have profound effects on markets at both the micro level (buyers’ and sellers’ understandings of acceptable and unacceptable actions, and the consequences of those actions, and thus their ability to calculate costs and benefits) and the macro level (the number and nature of buyers and sellers, their exchange relations, and their prevailing valuation and evaluation schemes). At both levels, legal regimes affect buyers and sellers in two fundamental ways: (1) they produce technical-material incentives and penalties that encourage some activities and forms of organization, and deter others; and (2) they foster the development of cultural understandings of which products,

forms of organization, and practices are normal, celebrated, and rational, and which are deviant, deprecated, and inappropriate.

The most basic aspects of legal regimes are laws governing *property rights*, which define who can use things (usufruct) and exclude others from using them (excludability), as well as who can transfer things from one owner to another (alienability) (Alchian and Demsetz, 1973; Weber, 1978: 44, 130-150; Carruthers and Ariovich, 2004: 24). Property-rights law determines the technical possibilities of and limitations on markets by defining the rules that govern ownership and control over the means of production, the products themselves, and modes of exchange. Thus, property-rights law determines the resources property owners possess and the incentives they face (Campbell and Lindberg, 1990; Fligstein, 2001). Property-rights law also creates cultural opportunities for and constraints on markets: new cognitive schemas concerning the roles buyers, sellers, and other market participants play, novel understandings of their power vis-à-vis exchange partners, and innovative conceptions of the nature of their exchanges (e.g., DiMaggio, 1990; Edelman, Uggen, and Erlanger, 1999; Dobbin and Dowd, 1997; Fligstein, 2001). Because property-rights laws make it clear who is risking what and who gets rewarded for taking risks (Fligstein, 2001: 33), they make it possible to classify economic actors, facilitating rational calculation and planning (Guseva and Róna-Tas, 2001; Carruthers, 2013). Thus clear property rights make it possible to enforce contracts between buyers and sellers, reducing uncertainty.

But laws can instead cloud property rights or deny them outright. If legal regimes are unclear about property rights or contain conflicting directives, then buyers' and sellers' property rights are not secure. At the extreme, legal regimes can define particular products as illegal, which denies buyers and sellers property rights in those products; this is most commonly seen in markets for morally contested goods and services, such as human organs, narcotics, ovaries, sex work, and sperm (e.g., Healy, 2004; Almeling, 2011). When property rights are unclear (or at the extreme, non-existent), buyers and sellers cannot enforce contracts through



formal legal channels (Beckert and Wehinger, 2012). While actors with clear property rights can take disputes to mediation or court, those without clear property rights (or, at the extreme, any property rights) must instead avoid conflict by building trust via informal social ties and norms, or adjudicate disputes with violence (Hillmann, 2013). The lack of non-violent formal enforcement mechanisms increases uncertainty, making planning more difficult and investment riskier (Portes and Haller, 2005).

Legal regimes focused on *forms of organization* also influence buyers' and sellers' structures and practices (Edelman and Suchman, 1997; Fligstein, 2001; Schneiberg and Soule, 2005). Such legal regimes may set standards of accountability vis-à-vis the public, employees, and customers (e.g., Edelman, 1990), and mandate, allow, or forbid horizontal expansion or vertical integration (e.g., Dobbin and Dowd, 1997). Such legal regimes can also define specific types of organization, such as limited-liability corporations (e.g., Seavoy, 1982; Kaufman, 2008), and approve or forbid specific forms, such as non-profit versus for-profit organizations (e.g., Schneiberg and Soule, 2005). In toto, such legal regimes determine the nature, number, location, and practices of buying and selling organizations, as well as the formal requirements for operating organizations, in terms of licenses, permits, and fees. Therefore, such legal regimes elaborate the underlying logic of legal rationality (Weber, 1978), legitimating organizations that meet legal requirements and engendering shared understandings of acceptable forms of organization.

Legal regimes focused on forms of organization can either decrease or increase uncertainty by authorizing or prohibiting certain types of organization. Uncertainty is low when legal regimes explicitly authorize particular forms of organization, typically by licensing and regulating them. Organizations that fit within the parameters of licensing regulations have clear property rights and face no legal uncertainty about their operations. In contrast, uncertainty is high when legal regimes explicitly prohibit a particular form of organization. Organizations of that form are denied property rights outright, and can be fined or prosecuted

for operating. In-between are legal regimes that authorize organization to operate, but do not determine through licensing or regulation which forms of organization are acceptable. In such cases, particular forms of organization are neither clearly prohibited nor clearly approved by government authorities and legal uncertainty is intermediate.

The clearer legal regimes are about property rights concerning products and forms of organization, the less uncertainty they generate, and the easier it is for sellers to plan. Planning smooths operations and reduces costs, leading to lower prices. Thus, we predict:

**Hypothesis 1:** In markets where uncertainty is greater due to the lack of clear property rights, prices will be higher than in markets where uncertainty is less due to the existence of clear property rights.

There is an obvious counter-argument. Although legal regimes that clarify property rights reduce uncertainty for state-approved forms of organization, they also increase costs, in terms of money, time, and effort expended. Managers must interact with state authorities, prepare documentation to satisfy formal legal requirements, pay staff to deal with compliance with those requirements, and develop and monitor routines to guarantee workers' and customers' welfare. Increased operating costs will reduce the supply of organizations selling in the affected market and so reduce competition, which will increase prices. This counter-argument reduces our chances of finding support for hypothesis 1. In the statistical analyses shown below, we control for the supply of organizations (and the resulting level of competition) with explicit statistical controls, thus allowing us to assess the effect of legal regimes on prices, net of the supply of organizations and competition.

In addition to affecting prices per se (their central tendency), legal regimes can affect agreement or disagreement about prices (their dispersion). Setting prices requires categorizing products, comparing them within and across categories, and commensurating them in terms of monetary value (Fourcade, 2011). Categorization, comparison, and commensuration is more consistent when it is guided by clear and widely shared norms about which products are valuable and why, because such norms obviate subjective judgment (Hsu, Roberts, and

Swaminathan, 2012). For example, in markets for art, products that are difficult to compare in terms of objective criteria, dealers follow two valuation norms: (1) prices for works from any artist increase with size, and (2) prices remain stable over time, even if sales are slower than anticipated (Velthuis, 2005).

The clearer legal regimes are about property rights concerning products, and thus the less uncertainty they generate in the affected markets, the easier it is for sellers to develop clear and widely shared understandings of what products are valuable and why (i.e., to develop *valuation norms*), and thus to react in a coherent fashion to competitors' pricing strategies (White, 1981). The clearer and more widely shared valuation norms are, the easier it is for sellers to value products in similar ways and settle on similar prices for similar products, which leads to price convergence. In contrast, the more ambiguous and narrowly shared valuation norms are, the more sellers will diverge in their expectations about how to price similar products, which leads to price divergence. For example, in markets for wine, sellers' prices are more likely to converge when the basis for critics' evaluations – and thus the evaluation norms underlying those evaluations – are clearer (Hsu et al., 2012). In addition, the clearer legal regimes are about property rights concerning forms of organization, and thus the less the uncertainty about acceptable organizational strategies, structures, and practices in the affected markets, the easier it is for sellers to develop clear and widely shared understandings about how to operate (i.e., *organizing norms*). The clearer and more widely shared organizing norms are, the more similar organizations are likely to be. Similarity of structure and strategy leads to similarity of operating costs, which also yields convergence in the prices set for similar products. In sum, then, we predict:

**Hypothesis 2:** In markets where uncertainty is greater due to the lack of clear property rights, price dispersion will be greater than in markets where uncertainty is less due to the existence of clear property rights.

*Federalism Complicates Matters: A Multi-Level Theory of Legal Regimes and Prices*

Although much research has analyzed the impact of legal regimes on industries and markets, only a few studies have paid attention to the fact that many nations, such as Brazil, Canada, Germany, India, Mexico, Russia, and the United States, have federalist governmental structures (e.g., Dobbin, 1994; Schneiberg and Soule, 2005). Federalist governments have multiple, nested components, each of which can create distinct legal regimes to govern particular markets. One scholar famously described federalism as follows: “(1) two levels of government rule the same land and people, (2) each level has at least one area of action in which it is autonomous, and (3) there is some guarantee ... of the autonomy of each government in its own sphere” (Riker, 1964: 11). Federations are negotiated compromises between those who seek central control over the full population and all territory, on the one hand, and those who seek local control over subpopulations and territorial subunits. Therefore, tension – a centripetal pull toward a single political center versus a centrifugal push away from the center toward political subunits – inheres in all federalist governments.

Federalist governments offer multiple targets for lobbying to change legal regimes governing markets, which may make them more open to change than unitary governments (Schneiberg and Soule, 2005; Djelic and Quack, 2007). For example, industry lobbyists, union officials, and social-movement activists can push for the expansion or restriction of markets – even the creation of new markets or the closure of existing ones – by promoting local ballot initiatives and referenda, or by appealing to local-level politicians and bureaucrats (state or municipal), and ignoring national publics and national government agents, which are more distant and more expensive to reach than their local counterparts. Such actions can lead to conflict between legal regimes created by different levels of government, which generates uncertainty for organizations operating in the affected markets.

By ignoring federalism, most previous research has implicitly assumed alignment between legal regimes created by different levels of government, and therefore has implicitly

assumed co-operation between legal authorities reporting to different levels of government. But different levels in a federation can create distinct legal regimes to govern a particular market. For example, in the United States, both federal and state governments can pass laws that define property rights, although contract law lies in the hands of the federal government (Riker, 1964; Feeley and Rubin, 2008). If multiple levels of government can create legal regimes concerning property rights – e.g., one level authorizes the sale of a product or sanctions a particular form of organization to sell that product, but a second level bans that product or that form of organization – then there contradiction and conflict can develop between levels of government (Campbell and Lindberg, 1990). Such conflict has become common in the United States: unprecedented levels of political polarization have generated conflict between national and state governments (e.g., concerning the roll-out of the Affordable Care Act under the Obama administration and immigration issues that affect markets for both low- and high-skilled workers under the Trump administration), as well as conflict between state and local governments (e.g., concerning environmental issues that affect many businesses). It is has also erupted in Europe, with the British vote to exit the European Union (a trans-national federation), which promises to roil financial, labor, and production markets for years to come.

To overcome the myopia caused by focusing on a single level of legal regime, we propose a multi-level theory that explicitly considers the extent to which legal regimes at different levels (national, state, and local) are aligned or in conflict. We argue that conflict between legal regimes at different levels of government generates uncertainty in markets because conflicting legal regimes provide political and social platforms for both proponents and opponents of markets, which clouds property rights. For example, if the national government prohibits a product but a state government authorizes it, national officials can seek to stop the sale of that product in that state, while state officials can provide legitimacy – even if state officials cannot, in the face of a conflicting national-level legal regime, provide full legal authorization. In such situations, buyers and sellers face greater uncertainty than in situations

where state-level and national-level legal regimes are aligned. As in the single-level analysis above, we propose that when uncertainty concerning property rights in products and forms of organization is greater, prices will be higher and price dispersion will be greater. Thus:

**Hypothesis 3:** In markets where uncertainty is greater because there are conflicting legal regimes, prices will be higher than in markets where uncertainty is less because there are congruent legal regimes.

**Hypothesis 4:** In markets where uncertainty is greater because there are conflicting legal regimes, price dispersion will be greater than in markets where uncertainty is less because there are congruent legal regimes.

### **The Evolution of Laws Regulating Cannabis in the United States**

In this section, we put historical meat on the bones of our arguments by focusing on an important empirical case: laws regulating cannabis use and sale in the United States, which are significant battlegrounds for federalist principles (Mikos, 2009; Schwartz, 2013; Chemerinsky et al., 2015). Our analysis encompasses three levels of government: national, state, and local.

*Early history.* Before the twentieth century, cannabis (as hashish and in liquid form) was used in the United States as an analgesic. Although there were concerns about accurate labeling and purity, state governments made only scattered attempts to restrict its use. After the Mexican Revolution of 1910, increased immigration of Mexicans to the United States, many of whom smoked cannabis, spurred a racist and xenophobic outcry that relabeled cannabis as “marihuana,” the term used in Mexico, and linked smoking it to an “alien,” “criminal,” and “deviant” subgroup; this outcry, in turn, provoked passage of a series of state laws outlawing cannabis (Bonnie and Whitebread, 1970, 1974 [1999]).<sup>2</sup> In 1937, the federal government joined suit, passing the Marihuana Tax Act (26 U.S.C. §§ 4741-4753), which required transfer tax stamps to grow, import, give away, or sell cannabis – stamps that were far more expensive than

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<sup>2</sup> This is similar to the dynamic described by Gusfield (1986) in his analysis of the movement to outlaw the production and sale of alcohol in the United States in the late nineteenth and early twentieth centuries. In that case, linking alcohol to Catholic immigrants in urban areas bolstered support for the prohibition of alcohol among Protestant, native-born residents of small towns and rural areas.

cannabis itself, thus effectively banning the production, sale, and consumption of cannabis in the United States. This law complemented the 1922 Narcotic Drugs Import and Export Act (21 U.S.C.A. § 176(a)), which made importing cannabis, among other drugs, illegal. For the next 60 years, federal and state government policies were aligned: at both levels, legal regimes prohibited the ownership, consumption, and exchange of cannabis for any purpose.

Although starting in the 1960s, cannabis became associated with the middle class (first youth, then older professionals), rather than poor Mexican immigrants, it remained illegal and authorities' concerns about cannabis did not diminish – instead, they intensified (Bonnie and Whitebread, 1970, 1974 [1999]). In 1969, the Supreme Court ruled that the Marihuana Tax Act and the Narcotic Drugs Act were unconstitutional because complying with them would force self-incrimination (*Leary v. United States*, 1969). In the wake of this decision, the federal government in 1970 passed the Controlled Substances Act (21 U.S.C. § 801 *et seq.*), which classified cannabis, along with heroin, ecstasy, and LSD, as a Schedule 1 narcotic with “a high potential for abuse,” “no currently accepted medical or treatment use in the United States,” and “no accepted safety for use ... under medical supervision” (21 U.S.C. § 812(b)(1)).<sup>3</sup> Passage of this act marked the beginning of the “war on drugs,” in which federal, state, and local governments escalated the arrest, prosecution, and incarceration of cannabis producers, distributors, and consumers. Despite repeated efforts by activists and national legislators to reclassify cannabis as a Schedule 5 drug, the least restrictive category, the federal government has remained obdurate.

*States legalize cannabis for medical use.* In the late 1980s, AIDS patients and their caregivers in San Francisco, the epicenter of the AIDS epidemic, discovered that smoking cannabis, which often increased users' appetites, helped alleviate “wasting disease,” a common symptom of HIV/AIDS, and the nausea that accompanied use of anti-retroviral medications (Grinspoon, Bakalar, and Doblin, 1995). This discovery led to the formation of buyers' clubs,

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<sup>3</sup> This act classified cannabis as more dangerous than such Schedule 2 drugs as cocaine and morphine.

where activists distributed cannabis to the seriously ill and dying. In this way, a market for the medical use of cannabis emerged from the well-established black market for the recreational use of cannabis. Spurred by AIDS activists, in November 1996 California voters passed Proposition 215, which was codified as the California Compassionate Use Act (Cal. Health and Safety Code §§ 11362.5 *et seq.*). This law exempted qualified patients and their primary caregivers from state criminal prosecution for cultivation or possession of cannabis for medical use. It defined a primary caregiver as “the individual designated by the person exempted under this section who has consistently assumed responsibility for the housing, health, or safety of that person” (Cal. Health and Safety Code § 11362.5(B)(e)). While this law provided legal protection for patients, caregivers, and physicians in the form of an affirmative defense against criminal charges at the state level,<sup>4</sup> it had two important gaps: it did not explicitly allow patients to exchange cannabis among themselves, and it did not allow patients or their caregivers to establish organizations to cultivate, distribute, or sell cannabis. Thus, it did not authorize the sale of cannabis or provide an affirmative defense for any person (or organization) who did so. Moreover, as we explain below, the federal response to this law was swift and decisively negative.

Over time, medical applications for cannabis expanded from HIV/AIDS to include a wide array of conditions, including (but not limited to) Alzheimer’s disease, amyotrophic lateral sclerosis, cancer, chronic pain, Crohn’s disease, epilepsy, glaucoma, hepatitis C, multiple sclerosis, and post-traumatic stress disorder, and an increasingly diverse array of activists sponsored state ballot initiatives and lobbied state legislators to legalize cannabis use for medical purposes. In hindsight, this was an effective use of direct democracy in an era when the voting public viewed medical cannabis far more positively than did state authorities.

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<sup>4</sup> An affirmative defense is a claim (which must be proven by the defendant) justifying the conduct for which the defendant is on trial, even if that conduct is otherwise unlawful. In practice, this means the defendant admits to the conduct and uses the affirmative defense to limit liability for that conduct. Outside prosecutions for possessing and distributing cannabis, common examples of affirmative defense include pleading insanity, self-defense, or entrapment.



Pushed by activists, more and more states legalized cannabis for medical use. Between 1998 and 2008, 11 states passed laws to similar California's.<sup>5</sup> Most laws required patients to register with the state and submit a signed recommendation from their physician; once their eligibility was confirmed, states added patients to their registers and issued them medical cannabis identification cards. Most laws limited the amount of cannabis patients and caregivers might possess, in terms of the number of plants, ounces of flowers, or both.

These laws provided exemption from state-level criminal prosecution for qualified medical cannabis patients, caregivers, and physicians, as well as exemption from state-level civil sanctions. Thus, while these laws provided an affirmative defense for patients, caregivers, and physicians, they did not create clear property rights in the ownership of cannabis (Mikos, 2009). Finally, most laws did not authorize or legally protect the sale of medical cannabis; indeed, one state (Alaska) explicitly banned the sale of medical cannabis. Most states neglected completely the issue of how patients and caregivers were to gain possession of cannabis, much less detail whether or how cannabis could be distributed or sold.

In the wake of these laws, many organizations were launched to distribute cannabis to medical patients. Prominent examples include the Oakland (California) Cannabis Buyers' Co-operative (1995-1998), the Colorado Compassion Club (Denver, 2004-2008), and the Emerald Cross (Seattle, Washington, 1998-2015). These organizations operated in legal gray areas, as state laws explicitly allowed individuals, not organizations, to provide cannabis to qualified medical patients, but they did not explicitly ban organizations from doing so. Because cannabis-providing organizations were neither clearly legal nor clearly illegal under these state-level legal regimes, observers labeled these regimes "quasi-legal" for organizations providing cannabis to medical patients (e.g., Samuels, 2008; Ohlson, 2013).

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<sup>5</sup> These states were Alaska (Ballot Measure 8, 1999), Oregon (Ballot Measure 67, 1998), Washington (Initiative 692, 1998), Maine (Ballot Question 2, 1999), Colorado (Ballot Amendment 20, 2000), Hawaii (S.B. 862, 2000), Nevada (Ballot Question 9, 2000), Vermont (S.B. 76, 2003), Montana (Initiative 148, 2004), Rhode Island (S.B. 0710, 2006), and Michigan (Proposition 1, 2008).

In 2003, with the passage of Senate Bill 420, California became the first state to explicitly permit the sale of medical cannabis and to formally recognize that organizations, rather than individual caregivers, could provide cannabis to patients. This law authorized medical cannabis co-operatives and collectives to buy and sell cannabis, and allowed them to ask for “reasonable compensation” (S.B. 420 § 11362.765(c)). Rather than actively regulate providers selling cannabis to patients, by spelling out who could form such organizations, how such organizations should be structured, and how such organizations should operate, this law merely gave these organizations restrictive property rights. Moreover, this law said nothing about how growers (concentrated in far northern California counties such as Humboldt and Mendocino) should get their products to providers and patients (concentrated in more southern urban areas such as Los Angeles, San Diego, and San Francisco).

In 2007, New Mexico passed a law that not only authorized organizations to sell medical cannabis, but also regulated them by detailing the requirements to become “licensed producer[s] ... qualified to produce, possess, distribute and dispense cannabis” (S.B. 523 § 3(D)). Between 2009 and October 2015, 10 states plus the District of Columbia followed suit.<sup>6</sup> These laws created state-regulated systems for the cultivation, distribution, and sale of medical cannabis. During this period, nine states that had previously passed affirmative-defense laws amended their legal regimes to create state-regulated systems for the cultivation and distribution of medical cannabis.<sup>7</sup> To facilitate comparisons between state-level legal regimes,

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<sup>6</sup> The states were Arizona (Proposition 203, 2010), New Jersey (S.B. 119, 2010), Delaware (S.B. 17, 2011), Connecticut (H.B. 5389, 2012), Illinois (H.B. 1, 2013), Massachusetts (Ballot Question 3, 2013), New Hampshire (H.B. 573, 2013), Maryland (H.B. 1101, 2014), Minnesota (S.F. 2470, 2014), and New York (A. 6357/S. 9723, 2014). The D.C. statute was B18-622 (2010). By the end of our study period (October 2015), only eight of these 10 state-legal markets were open. Maryland and New Hampshire were still in the process of implementing market regulations and so did not have markets operating then.

<sup>7</sup> The states were Maine (Question 5, 2009), Rhode Island (Edward O. Hawkins and Thomas C. Slater Medical Marijuana Act, 2009), Colorado (H.B. 1284/S.B. 109, 2010), Vermont (S.B. 17, 2011), Nevada (S.B. 394, 2013), Oregon (H.B. 3460, 2013), California (Medical Marijuana Safety Act, 2015), Hawaii (Act 241 H.B. 321, 2015), and Washington (S.B. 5052, 2015). By the end of our study period, laws for California, Hawaii, and Washington had not yet come into effect, and the law for Nevada was only partly in effect.

and to trace how individual states' legal regimes varied over time, Figure 1 charts all states with active state-legal markets for medical cannabis through 2015 and details how key features of their legal regimes evolved over time.<sup>8</sup>

[Figure 1 about here]

Each state law legalizing cannabis altered social norms about cannabis within the focal state, by legitimating the use of cannabis for medical purposes in that state (Lessig, 1995; Geisinger, 2002). State laws had stronger effects on social norms about cannabis than federal law because state laws reflected geographically concentrated local norms while federal law reflected more diffuse national-level norms, and because state laws were passed more recently than federal law, so they reflected more current norms (McAdams, 2015). In combination, the many state laws had even stronger effects on norms about cannabis, as they repeatedly suggested that many state authorities – not just those in the state in which medical cannabis patients, growers, distributors, and sellers lived – perceived cannabis as medically safe and beneficial, not dangerous and wicked.<sup>9</sup>

*The federal response to state action.* Although by 2015, 23 states and the District of Columbia, home to 47 percent of the American population, had legalized cannabis for medical use, this drug remained illegal at the federal level.<sup>10</sup> Cannabis continued to be classified as a Schedule 1 narcotic under the Controlled Substances Act and federal authorities continued to

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<sup>8</sup> Because we analyze data from 2014 to 2015, we do not consider states that legalized cannabis for medical use in 2016 – Arkansas, Florida, and North Dakota.

<sup>9</sup> The situation recently became more complicated, as eight states – Colorado (2012), Washington (2012), Alaska (2014), Oregon (2014), California (2016), Maine (2016), Massachusetts (2016), and Nevada (2016) – and the District of Columbia (2014) passed laws legalizing cannabis for recreational use by adults. These legal regimes for markets for the recreational use of cannabis have many similarities: they repealed criminal penalties for possession of small amounts of cannabis, tasked state officials with developing regulations for these markets, and taxed the sale of cannabis. Because our empirical focus is on medical markets for cannabis, we do not discuss these in detail.

<sup>10</sup> In 2017, it still is illegal, and with the election of Donald Trump as President and the installation of fervent cannabis opponent Jeff Sessions as Attorney General in charge of drug law, there is little likelihood that federal law concerning cannabis will soften (Angell, 2017; Chilkoti, 2017; Schaneman, 2017).

prosecute patients, providers, wholesale distributors, and growers in state-legal medical cannabis markets.

In the United States, there are three routes through which conflict between federal-level and state-level legal regimes might be resolved, relating to pre-emption, interstate commerce, and co-operation. First, the pre-emption doctrine is based on the Supremacy Clause of the Constitution (Article VI, Clause 2), which grants federal law priority over state law when the two conflict. In some cases, pre-emption can be limited by claims of privilege based on other foundational legal documents, such as the First Amendment's guarantee of freedom of speech. A key test of the pre-emption doctrine came soon after California legalized medical cannabis: in a policy brief, federal authorities stated that they would continue to enforce the Controlled Substances Act holding that cannabis is an illegal substance with no medical use (McCaffrey, 1997). A group of physicians, patients, and retailers contested this policy, which ultimately led to a District Court ruling that the federal policy violated the First Amendment rights of physicians and patients who communicated with each other about the use of cannabis to treat disease (*Conant v. McCaffrey*, 1997).

Pre-emption in other markets has been limited by the anti-commandeering doctrine of the Tenth Amendment to the Constitution, which forbids the federal government from forcing states to enact laws or assist federal officials in enforcing federal law within any state (e.g., *Printz v. United States*, 1995). The distinction between pre-emption and anti-commandeering is roughly the same as the distinction between federal authorities *preventing* states from acting (pre-empting) and *demanding* that states act (commandeering). Legal scholars have argued that under the commandeering doctrine, while states could legalize cannabis, they could not prevent federal authorities from prosecuting those who grew, bought, sold, or possessed cannabis – but state authorities did not have to assist federal authorities (Mikos, 2009; Chemerinsky et al., 2015; for a contrary view, see Schwartz, 2013). But no decisive judicial

ruling about this issue has been made, indicating that state officials and medical cannabis buyers and sellers continue to face legal uncertainty about pre-emption.

Second, the Commerce Clause of the Constitution (Article I, Section 8, Clause 3) gives federal officials authority over interstate trade. It has long been interpreted by the courts as giving federal officials authority over *intrastate* trade, if they can demonstrate that trade occurring entirely within the boundaries of one state “substantially affects” related trade in other states (Tribe, 2000: 811-824). In 2005, the Supreme Court applied the commerce clause to cannabis markets, ruling that the federal government could prosecute those who cultivated and possessed cannabis in California, even when allowed under state law, because even if cannabis was not sold or transported across state lines, there could be an “indirect” effect on interstate commerce (*Gonzales v. Raich*, 2005). But as the phrase “substantially affects” in the legal treatise quoted above implies, demonstrations of such indirect effects are not guaranteed in future cases.

Third, federal officials can co-operate with state officials. Although federal officials have the authority to enforce federal law themselves, effective enforcement may require assistance from state and local officials, who may be reluctant to provide it and who can use the anti-commandeering doctrine to justify inaction. This is true for medical cannabis markets: while in theory federal authorities could enforce federal drug laws themselves, in practice federal enforcement has depended heavily on state and local officials, who have superior local knowledge and larger pools of resources (Mikos, 2009). In response to these constraints, pragmatic authorities in the Obama Administration developed a co-operative policy: when deciding whether to prosecute cannabis possession, they began to take into consideration the quality of state-level legal regimes (Kamin, 2014; Chemerinsky et al., 2015). This policy waxed and waned over time. In 2009, federal authorities announced that they would conserve their scarce resources and not prosecute medical cannabis users “whose actions are in clear and unambiguous compliance with existing state laws” (Ogden, 2009). But a 2011 memo by the

new Deputy Attorney General reversed that accommodation and recommenced active prosecution of cannabis providers, singling out “commercial operations cultivating, selling, or distributing cannabis” (Cole, 2011). Two years later, after Colorado and Washington voted to legalize cannabis for recreational use by adults, the federal stance softened anew. The same Deputy Attorney General declared in a memo that federal authorities would not prioritize enforcement of federal law in states that had robust regulation of cannabis; prosecution was advised for a limited set of circumstances derived from lax regulation (Cole, 2013).<sup>11</sup> In an interview, he said: “If you don’t want us prosecuting [cannabis users] in your state, then get your regulatory act together” (Phelps, 2014: A1). The federal government’s co-operative stance vis-à-vis state-level legal regimes was reinforced by legislative efforts at the national level, which sought to limit federal enforcement powers in states where medical cannabis was legal (Chemerinsky et al., 2015).

In sum, it remains unclear whether the pre-emption or anti-commandeering doctrine dominates the resolution of federal-state conflict in medical cannabis markets. But by 2013, the application of pragmatic co-operation to medical cannabis markets became clear: federal law-enforcement efforts would be concentrated on states without comprehensive regulations. Under this co-operative federalism policy, states that authorized organizations to sell cannabis but did not regulate their forms and activities through comprehensive licensing systems were sites of the greatest conflict between federal and state law. States that authorized organizations to sell cannabis *and* regulated their forms and activities were sites of limited (but not zero) conflict between federal and state law because those state-level legal regimes were deemed reasonable by federal officials. Finally, states that did not authorize organizations to

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<sup>11</sup> According to this memo, states could reduce the likelihood of federal prosecution if they prevented the distribution of cannabis to minors, the flow of revenue from the sale of cannabis to criminal enterprises or gangs, the distribution of cannabis across state lines, the use of cannabis markets as cover for other forms of drug trafficking or any other illegal activity, the use of firearms by cannabis buyers and sellers, drugged driving or other public-health problems, growing cannabis on public land, and the possession or use of cannabis on federal property.

distribute cannabis may also have been sites of limited conflict between federal and state law, because their markets were very small and the few organizations that did provide medical cannabis in those markets were likely to evade federal scrutiny by, for example, not filing federal taxes.

*Local responses to state action.* Municipalities in many states opposed state legalization of cannabis for medical use and banned cannabis providers. Some state laws explicitly addressed whether municipalities could prohibit cannabis providers: Arizona law mandated acceptance of medical cannabis providers throughout the state, while Colorado, Oregon and Nevada laws allowed municipalities to ban them. Other state laws were silent on this issue, giving municipalities legal leeway. Where they had leeway, many municipalities prohibited medical cannabis providers through ordinances; others used permissive zoning rules, which allowed municipalities to reject business permit applications from medical cannabis providers.<sup>12</sup> Despite such bans, many cannabis providers continued to operate in those markets, which reflects cannabis's black-market legacy, confusion concerning local laws, and the difficulty of enforcement.

## **Research Design**

### *Data sources*

*State-level legal regimes.* As outlined above, different states followed different paths to legalizing cannabis. To assess whether states authorized formal organizations to sell cannabis to medical patients and whether states licensed cannabis sellers, we analyzed each state's history, including ballot propositions, statutes, and court decisions about cannabis markets. We also visited the websites of the government agencies charged with overseeing medical cannabis markets to assess what on-the-ground guidelines had been implemented.

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<sup>12</sup> Permissive zoning rules are ones that list all land uses that are permitted; everything not specifically listed is prohibited.

*Local-level legal regimes.* All states in our dataset except Arizona allowed municipalities to ban medical cannabis markets within their jurisdiction. To assess whether cities and towns banned formal organizations or certain organizational forms (bricks-and-mortar store or delivery-only service) from selling cannabis to consumers, the first author reviewed city ordinances, minutes from city council meetings, and local news coverage of municipal politics and law-making.

*Medical cannabis providers.* We gathered data on providers, including location, product menu, and prices from Weedmaps, the oldest and largest online directory of cannabis providers in the United States. Figure 2 shows a screenshot from Weedmaps, demonstrating the wealth of data available on that site. We gathered data on provider name, organizational form (bricks-and-mortar store or delivery-only service), location (city, state, zip code, and street address, if any), date on which the provider first joined the Weedmaps platform, the date on which the provider last updated its menu,<sup>13</sup> number of page views, attributes of and price for each product in the menu.

[Figure 2 about here]

Using data from an online directory obviates one possible alternative explanation for hypotheses 1 and 2, namely that requiring providers to be licensed might increase transparency in the market. If so, price competition would be more intense, average prices would fall, and price dispersion would decrease. But this data source makes prices transparent in all three types of legal regime.

Our analysis covers the seven largest state-legal medical cannabis markets at that time: Arizona, California, Colorado, Michigan, Nevada, Oregon and Washington. These constituted 99.9 percent of product observations and 99.2 percent of provider observations on Weedmaps.

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<sup>13</sup> This allows us to check that providers were still operating. Marijuana prices change frequently, so a provider not updating its menu frequently indicates it is not active. We removed providers that had not updated their menus during the 30 days preceding the date of data collection.



Figure 3 shows the estimated size of these markets in terms of sales revenue in 2015, and compares them to the 15 jurisdictions (14 states plus DC) we do not study.

[Figure 3 about here]

We analyzed data covering an 11-month period, with observations on November 24, 2014 (the first date we had good detailed data from Weedmaps); May 3, 2015; and October 10, 2015 (the day after regulations for medical cannabis in California were signed into law, which soon unleashed chaos in this large market). Some delivery-only cannabis providers posted multiple, identical menus for multiple, nearby geographic areas. When we assessed local competition in these state markets, we included each menu because these organizations were participating in multiple local markets. But when we created a dataset to analyze prices (with one observation per provider per product per time period), we excluded multiple menus because they would have over-represented delivery-only providers, each of which was only a single organization.

### *Measures*

*Dependent variables: price.* There is a wide variety of cannabis product types: flowers (smokeable and vaporizable plant), edibles (cookies, candies, crackers, etc.), concentrates (primarily hash and oil), pre-rolled joints, gear (pipes, paper, clothing, etc.), topicals (ointments and salves), seeds, and clones (saplings for home growing). We focused on prices for flowers, the product category that accounts for the largest volume of sales. We measured prices for each flower product sold by each provider in each market.<sup>14</sup> Providers typically sell cannabis flowers in 1-gram, 3.5-gram, 7-gram, 14-gram, and 28-gram increments. We limited our analysis to 3.5 grams of cannabis flowers because that is the most common amount sold by weight, enough to create four to seven joints. We log-transformed this variable to normalize it.

*Explanatory variables: uncertainty.* We developed this measure in several steps. To begin, we assessed state-level legal regimes on two key dimensions: whether or not they

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<sup>14</sup> Prices exclude sales taxes charged by state or local authorities.

explicitly authorized organizations to sell cannabis for medical purposes, and whether or not they established comprehensive regulations through licensing. We then created two dummy variables, *legal unlicensed regime* and *legal licensed regime*. The first was coded one if a state legal regime clearly and without contradiction articulated that formal organizations could sell cannabis but did not license cannabis providers, and zero if it (a) did not explicitly declare that formal organizations could sell cannabis or (b) explicitly licensed cannabis providers. The second was coded one if the state required cannabis providers to acquire specific licenses under comprehensive statewide regulations and zero otherwise. The reference category, labeled *quasi legal regime*, refers to state legal regimes that did not explicitly authorize formal organizations to sell cannabis or contained contradictory dictates regarding the sale of cannabis; for such markets, both *legal unlicensed regime* and *legal licensed regime* were coded zero. These measures were coded at the level of the provider because states with new licensing systems (Nevada and Oregon) were home to both licensed providers (which were granted property rights under state law) and unlicensed providers (which lacked property rights under state law).<sup>15</sup>

Next, we assessed the *uncertainty* in each type of state-level legal regime in two different ways, based on the two theories laid out above. Under the *single-level theory*, providers' property rights were clouded in quasi-legal regimes because it was unclear whether state law allowed formal organizations, rather than individual caregivers, to provide cannabis to medical patients, much less sell it to them. In contrast, property rights were clear in legal licensed regimes: state law explicitly allowed formal organizations to sell cannabis to medical patients and their caregivers, and detailed the conditions under which those organizations might operate, so it was crystal clear what kinds of organizations would be accepted by state authorities. For example, in Colorado medical cannabis providers had to be owned by Colorado

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<sup>15</sup> Just under 2 percent of observations came from unlicensed providers in newly licensed regimes. We coded these providers as operating in quasi-legal regimes because they lacked clear property rights but could still claim an affirmative defense for possessing cannabis during this transitional period.

residents, have a physical location, pass inspection, and operate at specific hours (Code of Colorado Regulations 212, 2013). Finally, property rights were somewhat unclear in legal unlicensed markets: while state law explicitly allowed formal organizations to sell cannabis to medical patients and their caregivers, it did not detail conditions of operation, so it was unclear what kinds of organizations would be acceptable to state authorities. In sum, under the single-level theory, uncertainty caused by unclear property rights, which makes it difficult to plan, raises operating costs, and impedes the development of market norms, was greatest in quasi-legal regimes, intermediate in legal unlicensed regimes, and least in legal licensed regimes.

Under the *multi-level theory*, the co-operative policy set by the 2013 Cole Memorandum, which was in effect throughout our study period, the level of uncertainty varied according to the level of conflict between state-level and federal-level legal regimes. State-federal conflict (and uncertainty) was less in legal licensed regimes than in legal unlicensed regimes because in the former, providers were more likely to meet the explicitly stated requirements of the Cole Memorandum. Thus in legal licensed regimes, state and federal property rights regimes were in conflict according to the letter of the law (*de jure*) but aligned in practice (*de facto*). Providers were well aware of this: in California's legal unlicensed regime, they pushed for greater regulation, seeking to use state law as a shield against federal prohibition. They believed that licensing "would make California's cannabis industry less vulnerable to interference by the federal government, which has said it will leave approved dispensaries alone in states that properly regulate them" (Garrick, 2015). In sum, this theory predicts that uncertainty due to state-federal conflict was greater in legal unlicensed regimes than in legal licensed or quasi-legal regimes. Moreover, uncertainty due to state-federal conflict was less in quasi-legal regimes than in legal unlicensed regimes because in the former, providers tended to be small and few in number, so they could more easily "fly under the radar" of federal scrutiny.

Table 1 summarizes the measures derived from the single-level and multi-level theories. It categorizes states by type of state-level legal regime, describes those regimes' most salient features, and shows the predicted level of uncertainty from each theory.

[Table 1 about here]

We created an additional measure of uncertainty based on local legal regimes: a dummy variable, *local ban*, coded one if the focal municipality specifically prohibited the operation of organizations selling medical cannabis or had permissive zoning codes that did not list cannabis sale as permitted, and zero otherwise. We coded local laws covering 88.4 percent of observations on products and 86.9 percent of observations on providers. These data cover 185 municipalities; of these, 127 banned at least one form of cannabis provider, delivery-only service or bricks-and-mortar store. When we added local laws to the models, we dropped 11.6 percent of observations on products. When we did so, we judged whether the results changed materially (they did not). Because local bans were often specific to organizational form, *local ban* was coded for each provider.

As with uncertainty derived from state-level legal regimes, uncertainty derived from local-level legal regimes depends on the theory used. The *single-level theory* suggests that because the vast majority of drug-enforcement activity is conducted by state and local officials,<sup>16</sup> municipalities that banned cannabis increased the likelihood that local police would raid or shutter providers, relative to municipalities that did not ban cannabis. In this way, local bans decreased property-rights protection and so increased uncertainty for cannabis providers. In contrast, the *multi-level theory* suggests that municipalities that banned cannabis aligned their policies with federal laws prohibiting cannabis, relative to municipalities that did not ban cannabis.<sup>17</sup> Thus, local bans decreased local-federal legal conflict and therefore decreased

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<sup>16</sup> Federal officials make a tiny fraction of arrests for drug offenses. For example, in 2012, there were 30,476 arrests by federal officials and over 1.3 million by state and local officials (Sacco, 2014).

<sup>17</sup> All municipalities, whether or not they banned cannabis, would be aligned with state law because state law allowed bans in all states except Arizona.

uncertainty for cannabis providers. In sum, in municipalities with local bans, uncertainty due to unclear property rights was greater than in municipalities without bans (single-level theory), while uncertainty due to legal conflict was less (multi-level theory).

*Control variables: product characteristics.* We included four indicator variables to capture product quality. First, we created an indicator for providers that followed a low-price strategy, meaning that they stated on their Weedmaps entry that they never sold products above a certain price cap (*price cap*). Second, we created an indicator for products that were sold under “buy-one-get-one-free” terms (*buy one get one free*). Third, we created two indicators for general product quality. *High end* was set to one for products that contained any term indicating top quality (exotic, connoisseurs, reserve, organic, exclusive, frosty, top, syrup, pr/p r/p.r., indoor, greenhouse/green house, cannabis cup, head stash/headstash, clean green, vegan, reserva, all star, cannoisseur\*, dank, premium, by (a signifier of a branded cannabis product), plat, hydro, or vip). *Low end* was set to one for products that contained any term indicating bottom quality (popcorn, od, deal, low shelf, small bud, baby nugs, sungrown/sun grown, outdoor, salad, smalls, minis, budlets, low, or sale).

Finally, we controlled for general product type. *Indica* was set to one for products derived from pure strains of the *C. indica* species and zero otherwise, while *sativa* was set to one for products derived from pure strains of the *C. sativa* species and zero otherwise. The reference group is *hybrid*, for products derived from combinations of the two species. Although their physiological and psychological effects are debated, indica products tend to contain higher ratios of cannabidiol to tetrahydrocannabinol than sativa products, and most cannabis users perceive indica products as relaxing and sedative, while they perceive sativa products as energizing and creativity-inducing.

*Control variables: provider characteristics.* We controlled for the number of different flower products (*flower count*) sold by the focal provider to distinguish price variance due to product differentiation from price variance due to uncertainty. We log-transformed this

variable to normalize it. We also controlled for *provider age*, measuring days since the provider joined Weedmaps. This variable was left-censored for providers that operated before Weedmaps came online in July 2008. For such providers, we set the date of joining as August 1<sup>st</sup>, 2008. We log-transformed this variable to normalize it. And we controlled for provider *popularity* in terms of page views per day, by dividing the cumulative number of page views by the number of days on Weedmaps. We logged this variable to normalize it. We controlled for provider organizational form. Medical cannabis providers can take two forms: bricks-and-mortar stores or delivery-only services. The former offer walk-in service; some also offer delivery service. The latter do not have a physical location accessible to the public, but rather have drivers bring products to customers. We created a dummy variable (*delivery only*) coded one if the provider was a delivery-only service and zero if it had a bricks-and-mortar storefront.

We also controlled for the heterogeneity of products sold by the focal provider (*menu heterogeneity*) by comparing the strain names included in each provider menu using a cosine similarity measure, which is based on a text-mining technique that uses a “bag of words” model to turn each provider menu of cannabis strain names into a vector of word (strain name) counts for that observation (Manning, Raghavan, and Schütze, 2008). We aggregated all strain names in each provider’s menu to create a vector of word counts and weighted each word count using the term-frequency inverse-document-frequency score, which captures how important a word is to a corpus.<sup>18</sup> We measured the distance between each pair of providers’ menus using the cosine of the angle between their weighted vectors in the m-dimensional space created by the m words in the pair of vectors. This measure is scaled by the product of the Euclidean lengths of the vectors (i.e., the sum of the squared weights of the words in each vector) to account for vectors of different lengths. It thus constrains the measure to range from 0 one 1. A score of 0 means that providers’ menus are orthogonal: they do not share any strain names. A score of 1

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<sup>18</sup> This score increases in proportion to the number of times the word appears in the focal document (menu), but decreases as the word appears more frequently in the corpus as a whole (all menus of providers in the focal provider’s state in the focal time period).

means that providers' menus are identical: they use exactly the same strain names with exactly the same frequency. To calculate menu heterogeneity for a provider vis-à-vis multiple providers (rather than vis-à-vis a single other provider), we used the average cosine similarity for the focal provider across all other providers in that state and time period. We subtracted this measure from 1 to turn it into a dissimilarity measure.

*Control variables: local human demographics.* For this, we gathered data from the American Community Surveys for 2013 to 2015 at the county level (US Census Bureau, 2013-2015). We measured the attractiveness of the local market with *median household income*. We divided this number by \$100,000 to make it more interpretable. We captured the demography of the local population with *human population* (number of people per square mile) and the *percentage non-white*. We logged *human population* to normalize it.

Our models also included *municipality fixed effects*, which capture otherwise unobserved time-stationary differences between municipalities. To have enough degrees of freedom when including municipal fixed-effects, we dropped observations in municipalities with fewer than 25 product observations, leaving a dataset that covered 95 percent (4,691 of 4,940) of cannabis providers operating in these state in this time period.

*Control variables: local market structure.* To measure *local competition*, we used Google's geo-location application program interface to determine the longitude and latitude of every medical cannabis provider based on its street address. If a provider did not list a street address, we used the centroid of the most specific geographic unit (zip code, city, or county) listed. Following previous research (e.g., Sorenson and Audia, 2000), we calculated *local competition* (LC) as the distance-weighted count of providers in the state:

$$LC_{is} = \sum_{js} \frac{1}{(1 + d_{ijs})},$$

where  $i$  indexes the focal cannabis provider,  $j$  indexes all other providers,  $s$  indexes the state, and  $d_{ijs}$  is the distance between providers  $i$  and  $j$  in state  $s$ . We limited comparisons by state

because it is illegal under all state-level legal regimes to sell medical cannabis across state lines. This count included recreational cannabis sellers in states that had both medical and recreational providers during our study period (Colorado, Washington, and Oregon) because medical patients could purchase cannabis at recreational providers instead of medical providers. We log-transformed this variable to normalize it.

*Control variables: time.* Finally, we controlled for longitudinal changes in cannabis prices with a *time trend* variable, counting days since November 24, 2014, the date of the first observations.

### *Modeling strategy*

To model both the mean and the dispersion of price, we used the multiplicative heteroskedasticity model, which is sometimes called the variance function regression model (Harvey, 1976; Davidian and Carroll, 1987). We broke the price of product  $i$  sold by provider  $j$  at time  $t$  ( $p_{ijt}$ ) into two components, mean price ( $\mu_{ijt}$ ) and price dispersion ( $\sigma_{ijt}$ ):

$$p_{ijt} = \mu_{ijt} + \sigma_{ijt} + \varepsilon_{ijt}$$

where  $\varepsilon_{ijt}$  is the error term. We modeled each component as a function of explanatory variables,  $X_{ijt}$  and  $Z_{ijt}$ :

$$\mu_{ijt} = E(p_{ijt}) = \beta'X_{ijt} ,$$

$$\text{and } \sigma^2_{ijt} = \text{Var}(p_{ijt}) = \exp(\gamma'Z_{ijt}).$$

Because the first and second moments of a normal distribution (mean and variance, respectively) are independent, we maximized the likelihood function to obtain the estimates of the  $\beta$  and  $\gamma$  parameters separately, using the `reghv` command in Stata (Weesie, 1998).

The data are cross-classified, not hierarchically nested: while products are nested in providers, many providers sell the same products. To properly estimate standard errors for such a data structure, where the general linear model's independence assumption is violated, requires models with crossed random effects for provider and product (Goldstein, 1987; Rabe-Hesketh and Skrondal, 2008: 472-508). But we could not do that because, in the Weedmaps



platform, strain names were not standardized. Instead, providers could label identical strains differently by including modifiers and using spelling variations. There were 70,119 unique product-name strings in the data, out of 169,960 product observations. This made it impossible to identify identical products and specify cross-classified errors. Instead, we approximated identical products by creating a unique identifier from a combination of product type (indica, sativa, and hybrid) and product quality (high end, low end, middle). We also clustered standard errors by provider-product.

*Robustness checks.* We assessed the robustness of our results to model specification by estimating models of price variance that included mean price. Such models take into consideration the possibility that higher-priced products might have greater dispersion. We also assessed the robustness of our results to measurement choices. Some municipalities banned medical cannabis providers through permissive zoning laws that did not allow cannabis providers to secure business permits. Others banned what they called cannabis “dispensaries” without clearly defining that term. These laws created ambiguity concerning whether delivery-only services located outside the focal municipality could legally deliver cannabis within the municipality. For the main analysis, we coded municipalities with these laws as having local bans for both bricks-and-mortar storefronts and delivery-only services. For the robustness check, we coded municipalities with these laws as having ban only on bricks-and-mortar storefronts, not delivery-only services.

## Results

Table 2 presents descriptive statistics. Because *local ban* is missing for 11.6 percent of product observations, we used the pairwise deletion option in Stata to calculate correlations. Most are low or moderate, indicating that multicollinearity is not an issue. Among the moderate and strong correlations, *legal unlicensed regime* was positively correlated with competition ( $r = 0.76$ ) and *local ban* (0.51), while *legal licensed regime* was negatively correlated with competition ( $r = -0.45$ ) and *local ban* (-0.43). Interestingly, 63 percent of

product observations were for locations where the focal provider was banned locally, indicating that many providers operated in spite of local bans.

[Table 2 about here]

*Mean price.* Table 3 presents the multivariate analysis of the relationship between state legal regimes and price. The first four models present results on mean price; the second four, on price dispersion. Model 1 is a baseline containing product and provider characteristics, as well as local human demographics and market structure. Model 2 adds *legal unlicensed* and *legal licensed* to distinguish among three types of state-level legal regime. It shows that prices for cannabis sold by providers in legal unlicensed regimes (*legal unlicensed regime* = 1, *legal licensed regime* = 0) were substantially higher than prices for cannabis sold by providers both in legal licensed regimes (*legal licensed regime* = 1, *legal unlicensed regime* = 0) and quasi-legal regimes (both variables = 0). These results are net of product type, provider characteristics (including product diversity), local competition, and local market characteristics. These results support hypothesis 3 (derived from the multi-level theory) and fail to support hypothesis 1 (derived from the single-level theory). These effects are not just statistically significant; they are substantively significant. Based on the parameters in model 2, prices in legal unlicensed regimes were 16.1 percent higher ( $\exp[0.149] = 1.161$ ) than those in quasi-legal regimes, and prices in legal licensed regimes were 5.9 percent higher ( $\exp[0.057] = 1.059$ ) than those in quasi-legal regimes. Thus, prices in legal licensed regimes were 8.2 percent lower ( $\exp[0.057 - 0.143] = 0.918$ ) than those in legal unlicensed regimes.

[Table 3 about here]

This pattern suggests that price is driven by uncertainty derived from conflict between state and federal legal regimes created by different levels of government, rather than uncertainty derived from lack of clear property rights under the legal regime created by the state-level government. This pattern also suggests that if licensing increased operating costs (relative to costs of operating in legal unlicensed regimes), that effect was trumped by the

reduction in uncertainty created by aligning state-level and federal-level legal regimes. That prices for cannabis in legal licensed regimes were closer to the prices in quasi-legal regimes than legal unlicensed regimes suggests that there was a U-shaped relationship between legal regime and price. Prices were lower in quasi-legal and legal-licensed regimes, where federal and state policies were more aligned, and higher in legal-unlicensed regimes where federal and state policies were more in conflict.

Model 3 replicates model 2, but limits the analysis to the subset of data for which we have coded local laws (88.4 percent of observations). It shows a pattern of results similar to that shown in model 2: the effects of state legal regime were in the same direction and of the same significance level, although the magnitude of *legal unlicensed regime* decreased slightly and the magnitude of the *legal licensed regime* increased slightly. Model 4 adds *local ban* and shows a non-significant relationship between local bans and price, which fails to support either hypothesis 2 or 4.

*Price dispersion.* Model 5 is a baseline that contains control variables only. Model 6 adds *legal unlicensed regime* and *legal licensed regime* to distinguish among three types of state-level legal regime. It shows that price dispersion in legal unlicensed regimes was 51.7 percent greater than in quasi-legal regimes ( $\exp[0.417] = 1.517$ ), while price dispersion in legal licensed regimes was 27.6 percent greater than in quasi-legal regimes ( $\exp[0.244] = 1.276$ ). Thus, price dispersion in legal licensed regimes was 15.9 percent lower ( $\exp[0.244-0.417] = 0.841$ ) than in legal unlicensed regimes. Again, these results are net of product type, provider characteristics, local competition, and local market characteristics. They support hypothesis 4 (derived from the multi-level theory) and fail to support hypothesis 2 (derived from the single-level theory). They indicate that uncertainty, which makes it difficult to develop norms about how to operate and set prices was greatest in legal unlicensed regimes, where conflict between state and federal laws was greatest.

Model 7 replicates model 6, but limits the analysis to the subset of data for which we have coded local laws (88.4 percent of observations). It shows a pattern of results similar to that shown in model 6: the effects of state legal regime were in the same direction, although they decreased somewhat in magnitude and state-licensed is now only marginally significant ( $p < 0.10$ ). Model 8 adds *local ban* and shows that price dispersion was lower in municipalities that banned the focal form of cannabis provider. Prices were 8.8% lower ( $\exp[-0.092] = 0.912$ ) in municipalities that ban cannabis providers. This result supports hypothesis 4, not hypothesis 2.

*Summary.* The results in Table 3 provide strong support for the multi-level model of state legal regimes, with five out of six effect estimates in the direction predicted by this theory. One effect estimate, for local ban in models of (average) price, had a non-significant effect, supporting neither the single-level theory nor the multi-level theory.

*Robustness checks.* Table 4 presents a robustness check for model specification by adding *mean price* to models of price variance. Higher-priced products were associated with less dispersion, not more dispersion. The rest of the results were similar to those in Table 4, with one exception. The relationship between *legal licensed regime* and price dispersion was not statistically significant, suggesting that when the price of cannabis is accounted for, price variance in legal licensed and quasi-legal licensed regimes were similar. This finding supports hypothesis 4, that prices dispersion was greatest when legal regimes created by different levels of government conflicted.

[Table 4 about here]

Table 5 shows robustness checks for the alternate measures of *local ban*, coding it as zero for delivery-only providers if a municipality's ban did not explicitly prohibit such providers. This table shows nearly identical results to those shown in Table 3, suggesting that measurement of this variable does not affect our results.

[Table 5 about here]

## Conclusion

Price is central to markets, so it is not surprising that price is the focus of a growing number of studies of markets. Most of this work has examined relationships (social networks) or cognitive-cultural understandings (social norms); far less has been done to study how institutions such as legal regimes affect prices (Beckert, 2011). Moreover, most research on markets and state institutions (which generally did not study prices) has examined a single level of government, typically the national level, and has ignored the fact that many states are federalist, with nested levels of government (for exceptions, see Dobbin, 1994; Schneiberg and Soule, 2005; Djelic and Quack, 2007). The neglect of federalism means that previous research on states and markets has assumed, implicitly, that legal regimes are aligned across all levels of government.

In this paper, we used sociological and legal research to lay out a single-level theory of legal regimes and pricing patterns, and then built a multi-level theory of conflict (or alignment) among nested legal regimes and its effect on pricing patterns. We went beyond most previous research on price by developing predictions from both theories, not just about the central tendency of price, but also about price dispersion. We tested these predictions on a battleground for federalism in the United States: state-legal medical cannabis markets. We found support for the multi-level theory rather than the single-level theory, in terms of both mean price and price dispersion. Overall, our results provide strong evidence for the argument that price distributions are driven by uncertainty derived from conflict among legal regimes created by different levels of government, rather than by uncertainty derived from legality or illegality at any single level of government.

Although markets for medical cannabis are large and growing rapidly, as more states legalize cannabis for medical use and an increasing fraction of the population approves of cannabis legalization, and although these markets have been deemed critical battlegrounds for federalism in the United States (Mikos, 2009; Schwartz, 2013; Chemerinsky et al., 2015), many

other markets are affected by conflict among local-level, state-level, and national-level legal regimes. Most of these markets are for goods and services that are contentious on moral, religious, or scientific grounds, because contention provides a solid basis for legal conflict. Current examples of contentious markets include those in “the sharing economy” (or, pejoratively, “the gig economy”), such as those for accommodations (e.g., Airbnb) and local transportation (e.g., Uber), as well as markets for “fracking” natural gas and for trading carbon dioxide permits and credits (Dokshin, 2016). Historical examples include markets for life insurance, fire insurance, alcohol, and electricity in the late nineteenth century and early twentieth century (Zelizer, 1979; Gusfield, 1986; Schneiberg and Bartley, 2001; Yakubovich, Granovetter, and McGuire, 2005).

In all these markets, many different kinds of actors (industry lobbyists, union officials, and social-movement activists) motivated by economics, ethics, religion, or science can push for market expansion or restriction, even new market creation or existing market closure, by promoting local (state or municipal) ballot initiatives and referenda or by appealing to local-level politicians and bureaucrats. Such actions can lead to conflict between legal regimes created by different levels of government, which generates uncertainty for organizations operating in the focal markets. Therefore, contentious markets are excellent sites for applying our multi-level theory of legal regime conflict to investigate price-setting and other market practices.

In the current political situation in the United States and Europe, conflict among federal, state, and local governments over immigration, wages, environmental standards, health-care benefits, and contentious products like cannabis and sharing services (e.g., Uber, Airbnb) is becoming more prevalent. This situation makes it critical that our models of states and markets explicitly recognize the federalist nature of many nations’ governments.

## References: Academic Research and News Reports

- Alchian, Arman A., and Harold Demsetz. 1973. The property rights paradigm. *Journal of Economic History*, 33, 16-27.
- Almeling, Rene. 2011. *Sex Cells: The Medical Market for Eggs and Sperm*. Berkeley: University of California Press.
- Angell, Tom. 2017. Exclusive: Sessions asks Congress to undo medical marijuana protections. *Massroots*, 12 June. (<https://www.massroots.com/news/exclusive-sessions-asks-congress-to-undo-medical-marijuana-protections>; viewed 26 July, 2017)
- ArcView Market Research. 2015. *The State of Legal Marijuana Markets*, 3<sup>rd</sup> ed. Oakland, CA: The ArcView Group.
- ArcView Market Research. 2017. *The State of Legal Marijuana Market*, 5<sup>th</sup> ed. Oakland, CA: The ArcView Group.
- Askin, Noah, and Matthew S. Bothner. 2016. Status-aspirational pricing: The “Chivas Regal” strategy in U.S. higher education, 2006-2012. *Administrative Science Quarterly*, 61 (2): 217-253.
- Beckert, Jens. 2011. Where do prices come from? Sociological approaches to price formation. *Socio-Economic Review*, 9: 757-786.
- Beckert, Jens, and Frank Wehinger. 2012. In the shadow: Illegal markets and economic sociology. *Socio-Economic Review*, 11 (1): 5-30.
- Bonnie, Richard J., and Charles H. Whitebread II. 1970. The forbidden fruit and the tree of knowledge: An inquiry into the legal history of American cannabis prohibition. *Virginia Law Review*, 56 (6): 971-1203.
- Bonnie, Richard J., and Charles H. Whitebread II. 1974 [1999]. *The Marijuana Conviction: A History of Marijuana Prohibition in the United States*. New York: The Lindesmith Center.
- Calder, Ryan. 2016. God’s technicians: Religious jurists and the usury ban in Judaism, Christianity, and Islam. *European Journal of Sociology*, 57 (2): 207-257.
- Campbell, John L., and Leon N. Lindberg. 1990. Property rights and the organization of economic activity by the state. *American Sociological Review*, 55: 634-647.
- Carruthers, Bruce G. 2013. From uncertainty toward risk: The case of credit ratings. *Socio-Economic Review*, 11: 525-551.
- Carruthers, Bruce G., and Laura Ariovich. 2004. The sociology of property rights. *Annual Review of Sociology*, 30: 23-46.
- Chemerinsky, Erwin, Jolene Forman, Allen Hopper, and Sam Kamin. 2015. Co-operative federalism and cannabis regulation. *UCLA Law Review*, 62: 74-122.
- Chilkoti, Avantika. 2017. States keep saying yes to marijuana use. Now comes the federal no. *New York Times*, 16 July: A18. (<https://nyti.ms/2umdm8>; viewed 16 July, 2017)
- Compton, Wilson M., Beth Han, Arthur Hughes, Christopher Jones, and Carlos Blanco. 2017. Use of cannabis for medical purposes among adults in the United States. *Journal of the American Medical Association*, 317 (2): 209-211.
- Cooter, Robert. 1998. Expressive law and economics. *Journal of Legal Studies*, 27 (S2): 585-607.

- Davidian, M., and R.J. Carroll. 1987. Variance function estimation. *Journal of the American Statistical Association*, 82: 1079-1091.
- DiMaggio, Paul J. 1990. Cultural aspects of economic action and organization. In R. Friedland and A. Robertson, eds., *Beyond the Marketplace: Rethinking Economy and Society*, 113-136. Aldine de Gruyter Publishers.
- Djelic, Marie-Laure, and Sigrid Quack. 2007. Overcoming path dependency: Path generation in open systems. *Theory and Society*, 36 (2): 161-186.
- Dobbin, Frank. 1994. *Forging Industrial Policy: The United States, Britain, and France in the Railway Age*. Cambridge: Cambridge University Press.
- Dobbin, Frank R., and Timothy Dowd. 1997. How policy shapes competition: Early railroad foundings in Massachusetts. *Administrative Science Quarterly*, 42: 501-529.
- Dokshin, Fedor. 2016. Whose backyard and what's at issue? Spatial and ideological dynamics of local opposition to fracking in New York State, 2010 to 2013. *American Sociological Review*, 81 (5): 921-948.
- Edelman, Lauren B. 1990. Legal environments and organizational governance: The expansion of due process in the American workplace. *American Journal of Sociology*, 95: 1401-1440.
- Edelman, Lauren B., and Mark C. Suchman. 1997. The legal environments of organizations. *Annual Review of Sociology*, 23: 479-515.
- Edelman, Lauren B., Christopher Uggen, and Howard S. Erlanger. 1999. The endogeneity of legal regulation: Grievance procedures as rational myth. *American Journal of Sociology*, 105: 406-454.
- Feeley, Malcolm M., and Edward L. Rubin. 2008. *Federalism: Political Identity and Tragic Compromise*. Ann Arbor, MI: University of Michigan Press.
- Fligstein, Neil. 2001. *The Architecture of Markets: An Economic Sociology of Twenty-First-Century Capitalist Societies*. Princeton, NJ: Princeton University Press.
- Fourcade, Marion. 2011. Cents and sensibility: Economic valuation and the nature of "nature." *American Journal of Sociology*, 116 (6): 1721-1777.
- Gallup. 2016. *Support for Legal Marijuana Use Up to 60% in U.S.* (<http://www.gallup.com/poll/196550/support-legal-cannabis.aspx>, viewed 3 February, 2017)
- Garrick, D. 2015. New state laws bolster local med pot shops. *San Diego Union Tribune*, 17 October. (<http://www.sandiegouniontribune.com/news/politics/sdut-cannabis-state-legislation-dispensary-strengthen-2015oct17-story.html>; viewed 5 November, 2015)
- Geisinger, Alex. 2002. A belief-change theory of expressive law. *Iowa Law Review*, 88: 35-73.
- Goldstein, H. 1987. Multilevel covariance components analysis. *Biometrika*, 74: 430-431.
- Grinspoon, Lester, James B. Bakalar, and Rick Doblin. 1995. Marijuana, the AIDS wasting syndrome, and the US government. *New England Journal of Medicine*, 333 (10): 670-71.
- Gusfield, Joseph R. 1986. *Symbolic Crusade: Status Politics and the American Temperance Movement*, 2<sup>nd</sup> ed. Urbana and Chicago, IL: University of Illinois Press.
- Harvey, A.C. 1976. Estimating regression models with multiplicative heteroskedasticity. *Econometrica*, 44 (3): 461-465.



- Healy, Kieran. 2004. Altruism as an organizational problem: The case of organ procurement. *American Sociological Review*, 69: 387-404.
- Hillmann, Henning. 2013. Economic institutions and the state: Insights from economic history. *Annual Review of Sociology*, 39: 251-273.
- Hsu, Greta, Peter W. Roberts, and Anand Swaminathan. 2012. Evaluative schemas and the mediating role of critics. *Organization Science*, 23 (1): 83-97.
- Kamin, Sam. 2015. Co-operative federalism and state cannabis regulation. *University of Colorado Law Review*, 85: 1105-1122.
- Kaufman, Jason. 2008. Corporate law and the sovereignty of states. *American Sociological Review*, 73: 402-425.
- Lessig, Lawrence. 1995. The regulation of social meaning. *University of Chicago Law Review*, 62 (3): 943-1045.
- Manning, Christopher D., Prabhakar Raghavan, and Hinrich Schütze. 2008. *Introduction to Information Retrieval*. Cambridge: Cambridge University Press.
- McAdams, Richard H. 2015. *The Expressive Powers of Law: Theories and Limits*. Cambridge, MA: Harvard University Press.
- Mikos, Robert A. 2009. On the limits of supremacy: Medical cannabis and the states' overlooked power to legalize federal crime. *Vanderbilt Law Review*, 62: 1421-1482.
- North, Douglass C. 1981. *Structure and Change in Economic History*. New York: W.W. Norton.
- North, Douglass C. 1990. *Institutions, Institutional Change, and Economic Performance*. Cambridge: Cambridge University Press.
- Ohlson, Al. 2013. Medical cannabis becoming blockbuster drug. *MSNBC* ([http://www.nbcnews.com/id/42237531/ns/business-small\\_business/t/medical-cannabis-becoming-blockbuster-drug/](http://www.nbcnews.com/id/42237531/ns/business-small_business/t/medical-cannabis-becoming-blockbuster-drug/), viewed 15 December, 2016)
- Phelps, Timothy. 2014. California needs strong cannabis regulation, federal official says. *Los Angeles Times*, October 26. (<http://www.latimes.com/local/la-me-attorney-general-cannabis-20141017-story.html>; viewed December 6, 2016)
- Podolny, Joel M. 1993. A status-based model of market competition. *American Journal of Sociology*, 98: 829-872.
- Polanyi, Karl. 1944. *The Great Transformation: The Political and Economic Origins of Our Time*. Boston: Beacon Press.
- Portes, Alejandro, and William Haller. 2005. The informal economy. In Neil J. Smelser and Richard Swedberg, eds., *The Handbook of Economic Sociology*, 2<sup>nd</sup> ed: 403-425. Princeton: Princeton University Press.
- Rabe-Hesketh, Sophia, and Anders Skrondal. 2008. *Multilevel and Longitudinal Modeling Using Stata*, 2<sup>nd</sup> Ed. College Station: Stata Press.
- Riker, William H. 1964. *Federalism: Origin, Operation, Significance*. Boston: Little, Brown.
- Róna-Tas Ákos, and Alya Guseva. 2014. *Plastic Money: Constructing Markets for Credit Cards in Eight Post-Communist Countries*. Stanford, CA: Stanford University Press.

- Sacco, L. N. 2014. Drug enforcement in the United States: History, policy, and trends. *Journal of Drug Addiction, Education, and Eradication*, 10(4): 415-441.
- Samuels, David. 2008. Dr. Kush: How medical cannabis is transforming the pot industry. *The New Yorker*, 28 July.
- Schaneman, Bart. 2017. New Washington State cannabis regulations reflect concern about federal threat. *Marijuana Business Daily*, 29 June. (<https://mjbizdaily.com/?p=70089>; viewed 30 June, 2017)
- Schwartz, David S. 2013. High federalism: Marijuana legalization and the limits of federal power to regulate states. *Cardozo Law Review*, 35: 567-641.
- Schneiberg, Marc, and Tim Bartley. 2001. Regulating American industries: Markets, politics, and the institutional determinants of fire insurance regulation. *American Journal of Sociology*, 107: 101-146.
- Schneiberg, Marc, and Sarah A. Soule. 2005. Institutionalization as a contested, multi-level process: The case of rate regulation in American fire insurance. In Gerald F. Davis, Doug McAdam, W. Richard Scott, and Mayer N. Zald, eds., *Social Movements and Organization Theory*: 122-160. Cambridge: Cambridge University Press.
- Seavoy, Ronald E. 1982. *The Origins of the American Business Corporation, 1784-1855*. Westport, CT: Greenwood.
- Simon, Herbert A. 1946 [1976]. *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization, 3rd Edition*. New York: Free Press.
- Smith, Charles W. 1989. *Auctions: The Social Construction of Value*. Berkeley: University of California Press.
- Sobel, Michael E. 1982. Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological Methodology*, 13: 290-312.
- Sorenson, Olav, and Pino G. Audia. 2000. The social structure of entrepreneurial activity: Geographic concentration of footwear production in the United States, 1940-1989. *American Journal of Sociology*, 106: 424-462.
- Tribe, Laurence H. 2000. *American Constitutional Law, 3rd ed., Vol. 1*. New York: Foundation Press.
- United States Census Bureau. 2013-2015. *American Community Survey (1-Year Estimates)*. (<http://www.socialexplorer.com/tables/ACS2013>; retrieved January 29, 2017)
- Uzzi, Brian, and Ryon Lancaster. 2004. Embeddedness and price formation in the corporate law market. *American Sociological Review*, 69: 319-344.
- Velthuis, Olav. 2005. *Talking Prices: Symbolic Meanings of Prices on the Market for Contemporary Art*. Princeton, NJ: Princeton University Press.
- Weber, Max. 1927 [1981]. *General Economic History*. (Translated by Frank H. Knight.) New Brunswick, NJ: Transaction Publishers.
- Weber, Max. 1978. *Economy and Society: An Outline of Interpretive Sociology*. (Translated and edited by Guenther Roth and Claus Wittich.) Berkeley: University of California Press.
- Weesie, Jeroen. 1998. Regression analysis with multiplicative heteroskedasticity. *Stata Technical Bulletin*, 42: 28-32.

- White, Harrison C. 1981. Where do markets come from? *American Journal of Sociology*, 87: 517-547.
- Yakubovich, Valery, Mark Granovetter, and Patrick McGuire. 2005. Electric charges: The social construction of rate systems. *Theory and Society*, 34: 579-612.
- Zelizer, Viviana A. Rotman. 1979. *Morals and Markets: The Development of Life Insurance in the United States*. New York: Columbia University Press.

### References: Statutes, Cases, and Regulations

- 26 U.S.C. §§ 4741 et seq. *Marihuana Tax Act of 1937*. Repealed by the Comprehensive Drug Abuse Prevention and Control Act of 1970, 21 U.S.C. § 801 et seq.
- 21 U.S.C.A. § 176(a). *Narcotic Drugs Import and Export Act of 1922*. Repealed by the Comprehensive Drug Abuse Prevention and Control Act of 1970, 21 U.S.C. § 801 et seq.
- 21 U.S.C. § 801 et seq. *Comprehensive Drug Abuse Prevention and Control Act of 1970*. (<http://www.law.cornell.edu/uscode/text/21/chapter-13> , retrieved December 2, 2016)
- 42 U.S.C. 18001. *Patient Protection and Affordable Care Act of 2010*. (<https://www.gpo.gov/fdsys/pkg/PLAW-111publ148/html/PLAW-111publ148.htm>, viewed May 17, 2017)
- Cal. Health and Safety Code § 11362.5. *Compassionate Use Act of 1996*. (<https://www.cdph.ca.gov/programs/MMP/Pages/CompassionateUseact.aspx>, retrieved December 2, 2016)
- Cal. Senate Bill 420. *Medical Marijuana Act of 2003*. ([ftp://www.leginfo.ca.gov/pub/03-04/bill/sen/sb\\_0401-0450/sb\\_420\\_bill\\_20031012\\_chaptered.html](ftp://www.leginfo.ca.gov/pub/03-04/bill/sen/sb_0401-0450/sb_420_bill_20031012_chaptered.html), retrieved December 2, 2016)
- Cal. Assembly Bill 266. *Medical Marijuana Act of 2015*. ([https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201520160AB266](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB266); retrieved December 15, 2016)
- Cal. Assembly Bill 243. *Medical Marijuana Act of 2015*. ([https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201520160AB243](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB243); retrieved December 15, 2016)
- Cal. Senate Bill 643. *Medical Marijuana Act of 2015*. ([https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201520160SB643](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB643); viewed December 2, 2016)
- Code of Colorado Regulations 212. 2013. *Permanent Rules Related to the Colorado Medical Marijuana Code*. Denver: Colorado Department of Revenue. ([https://www.colorado.gov/pacific/sites/default/files/Medical%20Marijuana%20Rules%20-%20ADOPTED%20090913%2C%20Effective%2010152013\\_0.pdf](https://www.colorado.gov/pacific/sites/default/files/Medical%20Marijuana%20Rules%20-%20ADOPTED%20090913%2C%20Effective%2010152013_0.pdf); retrieved July 31, 2017).
- Cole, James. 2011. *Memorandum for United States Attorneys: Guidance Regarding the Ogden Memo in Jurisdictions Seeking to Authorize Medical Marijuana Use*. Washington, DC: Department of Justice. (<http://www.justice.gov/sites/default/files/oip/legacy/2014/07/23/dag-guidance-2011-for-medical-cannabis-use.pdf>; retrieved October 7, 2015)
- Cole, James. 2013. *Memorandum for All United States Attorneys: Guidance Regarding Marijuana Enforcement*. Washington, DC: Department of Justice.

(<http://www.justice.gov/iso/opa/resources/3052013829132756857467.pdf>; retrieved October 7, 2015)

Conant v. McCaffrey. 1972 FRD 681, 685 (N.D. Cal. 1997)

Gonzales v. Raich. 545 US 1, 6-7 (2005).

Leary v. United States. 395 U.S. 6, 16 (1969).

McCaffrey, Barry R. 1997. *Administration Response to Arizona Proposition 200 and California Proposition 215*, 62 Fed. Reg. 6164.

New Mexico State Bill 523. *The Lynn and Erin Compassionate Use Act of 2007*.

(<http://medicalcannabis.procon.org/view.resource.php?resourceID=000881#NewMexico>, retrieved December 4, 2016)

Ogden, David. 2009. *Memorandum for Select United States Attorneys: Investigations and Prosecutions in States Authorizing the Medical Use of Marijuana*. Washington, DC: Department of Justice.

(<http://www.justice.gov/opa/blog/memorandum-selected-united-state-attorneys-investigations-and-prosecutions-states>; viewed October 7, 2015)

Printz v. United States. 521 U.S. 898, 933 (1997).

**Figure 1: The Evolution of State (& DC) Legal Regimes Concerning Medical Cannabis**

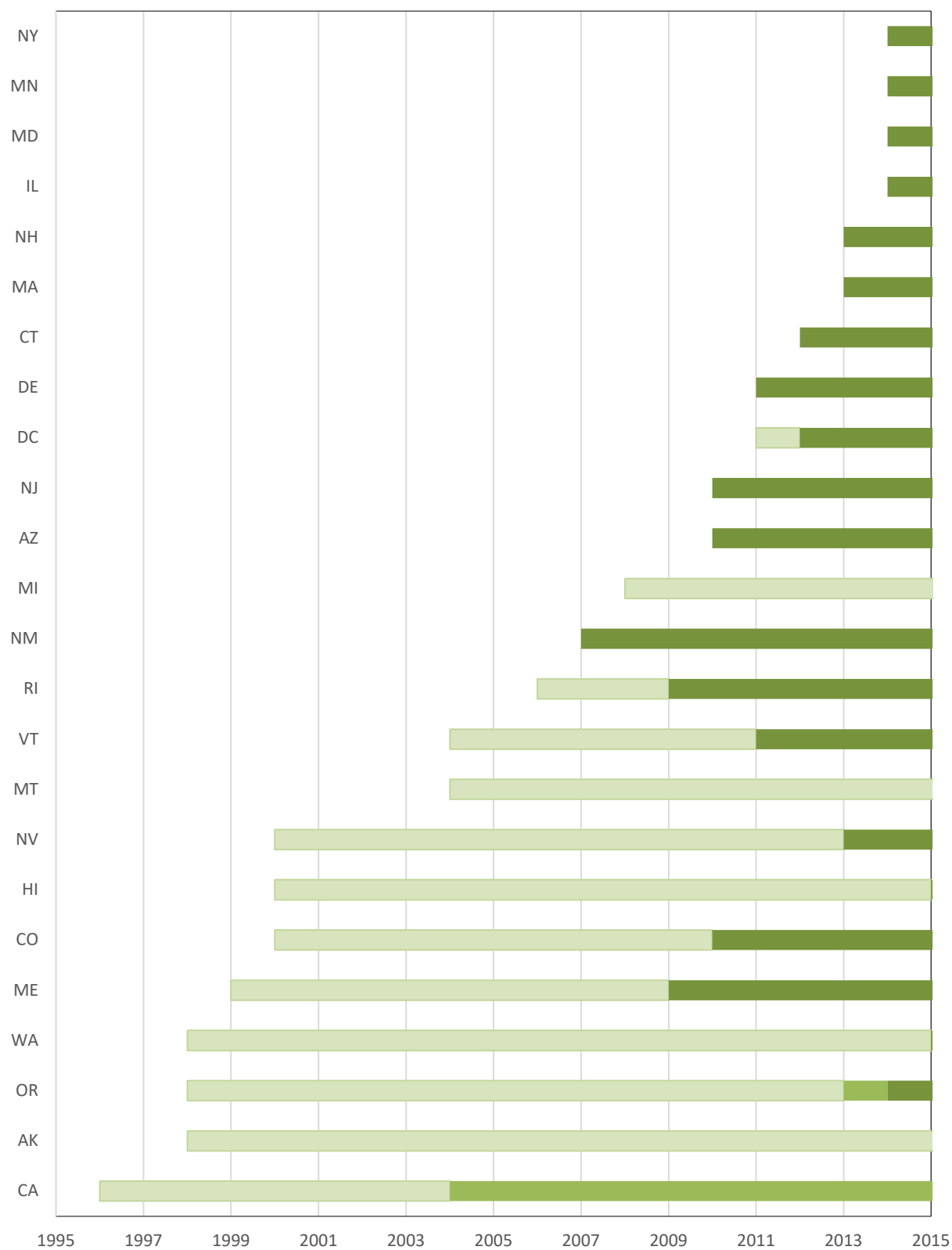


Figure 2: Screen Snapshot of Weedmaps Website for One Provider

**weedmaps™** Dispensaries Search by Dispensary Name, City, Zip or State Select Region

**Berkeley Patients Group**  
Medical Dispensaries / Berkeley (148,114 hits)

**Photos Videos**

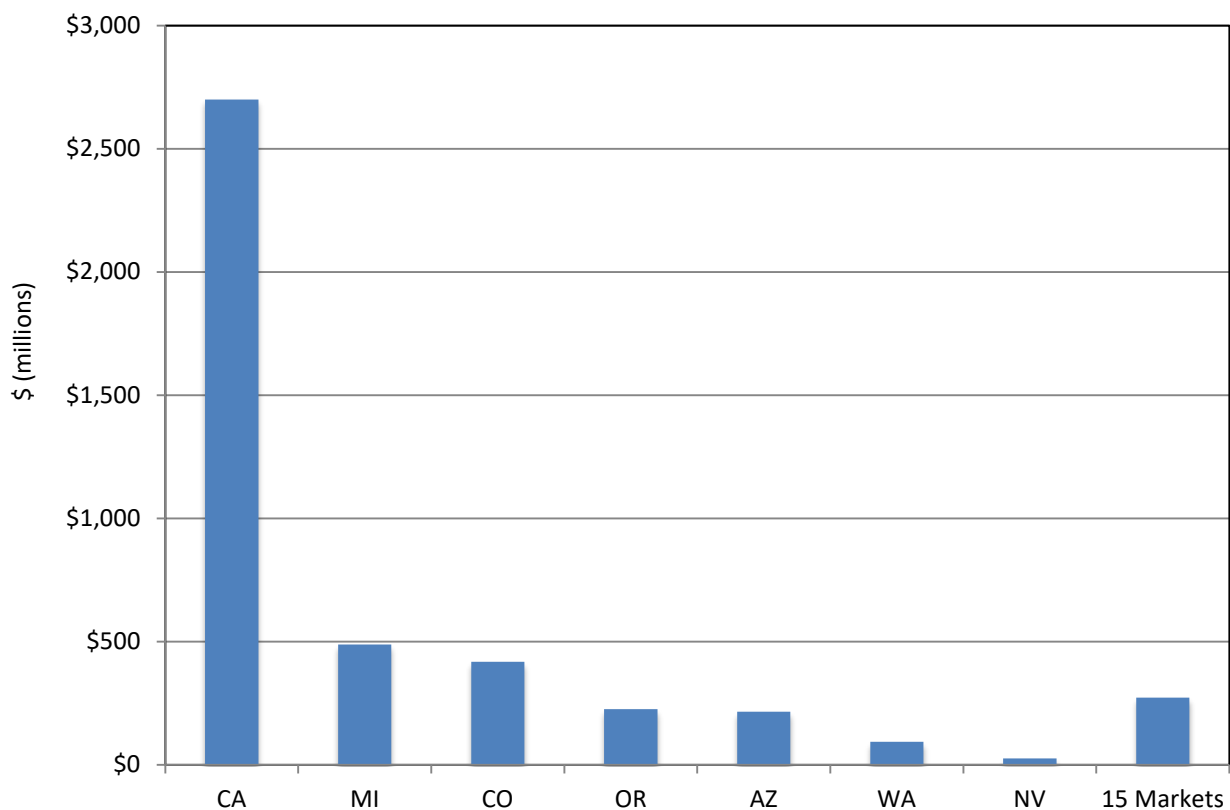
**WeedMenu Description**

WeedMenu updated 42 minutes ago

Indica	g	1/8	1/4	1/2	oz
All Star White x Pure Afghani	18 g	60 1/8		200 1/2	375 oz
All Star White Alien	18 g	60 1/8		200 1/2	375 oz
3X Crazy	15 g	50 1/8		170 1/2	325 oz
Chocolate Hashberry	15 g	50 1/8		170 1/2	325 oz

Source: <https://weedmaps.com/dispensaries/bpg-express>, retrieved October 10, 2015)

**Figure 3: Market Size (by Revenue) of the Sampled State-Legal Cannabis Markets in 2015**



**Note:** The category “15 Markets” consists of medical cannabis markets in Alaska, Connecticut, District of Columbia, Delaware, Hawaii, Illinois, Maine, Massachusetts, Minnesota, Montana, New Jersey, New Mexico, New York, Rhode Island, and Vermont. Medical cannabis markets in Maryland and New Hampshire had not opened by the end of 2015.

**Table 1:**  
**Measuring Uncertainty in Medical Cannabis Markets, 2014-2015**

<b>Legal Regime</b>	<b>Authorized Providers</b>	<b>Licensing of Providers</b>	<b>Uncertainty (Single-Level Theory)</b>	<b>Uncertainty (Multi-Level Theory)</b>	<b>Jurisdictions</b>
Quasi-legal	Individuals	No	High	Low	AK, HI, MI, WA, NV*, OR*
Legal unlicensed	Organizations	No	Medium	High	CA
Legal licensed	Organizations	Yes	Low	Low	AZ, CO, CT, DC, IL, MA, MD, ME, OR*, RI, NV*, NH, NJ, NM, NY, VT

**Note:** \* indicates that Nevada and Oregon were home to both licensed providers (which were granted property rights under state law) and unlicensed providers (which lacked property rights under state law). In those states, legal regimes were assessed at the provider level.



**Table 2: Univariate Statistics and Correlations**

	1	2	3	4	5	6	7	8	9	10	11	12	13
Mean	3.706	0.438	5.924	3.856	0.407	3.470	0.714	0.014	0.039	0.170	0.036	0.238	0.461
SD	0.276	0.352	1.223	0.826	0.491	0.764	0.104	0.116	0.193	0.376	0.186	0.426	0.498
Min	0.010	0.000	0.693	0.035	0.000	0.000	0.512	0.000	0.000	0.000	0.000	0.000	0.000
Max	4.564	0.879	7.865	6.997	1.000	5.549	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1 Price (logged)	1.000												
2 Time Trend (365 days)	0.055	1.000											
3 Provider Age (logged)	-0.016	0.010	1.000										
4 Popularity (logged)	-0.011	-0.033	0.301	1.000									
5 Delivery Only	0.332	0.034	-0.096	-0.344	1.000								
6 Flower Count (logged)	-0.141	0.078	0.215	0.414	-0.515	1.000							
7 Menu Heterogeneity	-0.012	0.128	0.034	-0.046	0.092	-0.206	1.000						
8 Price Cap	-0.066	0.054	-0.038	0.044	-0.059	0.060	-0.039	1.000					
9 Buy One Get One Free	0.132	-0.029	0.005	0.090	-0.042	0.115	0.072	0.016	1.000				
10 High End	0.116	0.037	-0.032	0.004	0.105	-0.045	0.147	0.009	-0.030	1.000			
11 Low End	-0.056	0.000	-0.004	0.002	0.016	0.004	0.039	0.008	0.003	-0.005	1.000		
12 Sativa	-0.014	p-0.012	0.026	0.008	-0.007	0.001	0.024	-0.007	0.008	0.015	-0.028	1.000	
13 Indica	0.042	-0.007	-0.037	0.044	-0.008	0.029	-0.057	0.025	0.018	0.025	0.047	-0.517	1.000
14 Human Population (logged)	-0.016	-0.018	-0.006	0.100	-0.150	0.182	-0.068	0.063	0.094	0.025	-0.004	0.012	0.054
15 Median HH Income (\$100k)	0.114	-0.003	0.077	0.011	0.150	-0.029	0.042	-0.042	-0.012	0.050	-0.006	0.031	-0.041
16 Percent Non White	0.104	0.030	-0.076	0.143	0.005	0.115	-0.149	0.084	0.103	0.036	0.017	-0.019	0.113
17 Local Competition (logged)	0.105	0.111	-0.072	0.143	0.061	0.116	-0.168	0.079	0.130	0.067	0.012	0.005	0.157
18 Legal Unlicensed Regime	0.245	0.008	-0.096	0.139	0.268	-0.022	-0.162	0.052	0.098	0.094	0.036	-0.006	0.123
19 Legal Licensed Regime	-0.255	-0.002	0.146	-0.106	-0.256	0.032	0.170	-0.032	-0.061	-0.063	-0.024	0.025	-0.084
20 Local Ban	0.180	0.000	-0.210	0.000	0.250	-0.095	-0.107	-0.026	0.083	0.065	0.012	-0.013	0.124

**Note:** This table presents statistics on all 169,960 observations on flower products sold by all 4,940 medical-cannabis providers operating in seven state markets in 2014 and 2015.

**Table 2: Univariate Statistics and Correlations (continued)**

	14	15	16	17	18	19	20
Mean	6.949	0.607	36.892	4.265	0.805	0.087	0.630
SD	1.231	0.105	11.155	0.956	0.396	0.282	0.483
Min	1.992	0.369	6.138	0.360	0.000	0.000	0.000
Max	9.808	1.012	55.715	5.460	1.000	1.000	1.000
No. of observations	169960	169960	169960	169960	169960	169960	150176
14 Human Population (logged)	1.000						
15 Median HH Income (\$100k)	0.297	1.000					
16 Percent Non White	0.585	0.005	1.000				
17 Local Competition (logged)	0.533	0.091	0.643	1.000			
18 Legal Unlicensed Regime	0.214	0.147	0.569	0.760	1.000		
19 Legal Licensed Regime	-0.105	-0.118	-0.486	-0.446	-0.628	1.000	
20 Local Ban	-0.018	0.017	0.203	0.483	0.507	-0.432	1.000

**Note:** This table presents statistics on all 169,960 observations on flower products sold by all 4,940 medical-cannabis providers operating in seven state markets in 2014 and 2015.

**Table 3: The Effect of Legal Regimes on the Price of 3.5g of Cannabis Flowers**

Model Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Mean				Variance			
Legal Unlicensed Regime		0.149*** (0.037)	0.142*** (0.042)	0.137** (0.042)		0.417*** (0.082)	0.347*** (0.091)	0.349*** (0.091)
Legal Licensed Regime		0.057** (0.021)	0.065** (0.021)	0.070** (0.023)		0.244** (0.081)	0.171 (0.088)	0.140 (0.090)
Local Ban				0.005 (0.008)				-0.092* (0.046)
Local Competition (logged)	0.036*** (0.010)	0.029** (0.010)	0.033** (0.011)	0.034** (0.011)	0.127*** (0.023)	0.024 (0.033)	0.031 (0.036)	0.060 (0.038)
Percent Non White	0.003*** (0.001)	0.002*** (0.001)	0.002** (0.001)	0.002** (0.001)	0.011*** (0.002)	0.009*** (0.002)	0.008** (0.003)	0.008** (0.003)
Median Household Income (\$100k)	0.216*** (0.058)	0.178** (0.060)	0.208** (0.073)	0.209** (0.073)	0.116 (0.175)	-0.042 (0.184)	-0.121 (0.208)	-0.136 (0.207)
Human Population (logged)	-0.018* (0.008)	-0.016 (0.009)	-0.016 (0.009)	-0.015 (0.009)	-0.068*** (0.018)	-0.034 (0.021)	-0.027 (0.023)	-0.036 (0.023)
Indica	0.023*** (0.003)	0.022*** (0.003)	0.023*** (0.004)	0.023*** (0.004)	-0.190*** (0.039)	-0.188*** (0.038)	-0.177*** (0.041)	-0.175*** (0.041)
Sativa	0.005 (0.004)	0.005 (0.004)	0.006 (0.004)	0.006 (0.004)	-0.172*** (0.040)	-0.171*** (0.040)	-0.148*** (0.042)	-0.148*** (0.042)
Low End	-0.093*** (0.006)	-0.090*** (0.006)	-0.087*** (0.006)	-0.086*** (0.006)	0.468*** (0.049)	0.457*** (0.051)	0.456*** (0.055)	0.455*** (0.056)
High End	0.057*** (0.003)	0.058*** (0.003)	0.058*** (0.003)	0.059*** (0.003)	-0.250*** (0.036)	-0.254*** (0.035)	-0.292*** (0.038)	-0.291*** (0.038)
Buy One Get One Free	0.206*** (0.012)	0.205*** (0.012)	0.205*** (0.013)	0.204*** (0.013)	0.405*** (0.073)	0.401*** (0.073)	0.392*** (0.074)	0.408*** (0.074)
Price Cap	-0.124*** (0.012)	-0.126*** (0.012)	-0.124*** (0.012)	-0.123*** (0.012)	-0.574** (0.179)	-0.581** (0.180)	-0.581** (0.181)	-0.592** (0.185)
Menu Heterogeneity	-0.055*** (0.015)	-0.059*** (0.015)	-0.062*** (0.016)	-0.063*** (0.016)	0.158 (0.162)	0.132 (0.162)	0.166 (0.174)	0.161 (0.174)

**Table 3: The Effect of Legal Regimes on the Price of 3.5g of Cannabis Flowers (continued)**

Model Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Mean				Variance			
Flower Count (logged)	-0.013*** (0.003)	-0.014*** (0.003)	-0.014*** (0.003)	-0.014*** (0.003)	0.031 (0.027)	0.032 (0.027)	0.041 (0.029)	0.040 (0.029)
Delivery Only	0.079*** (0.005)	0.082*** (0.005)	0.088*** (0.006)	0.089*** (0.005)	-0.376*** (0.041)	-0.407*** (0.042)	-0.394*** (0.046)	-0.385*** (0.046)
Popularity (logged)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.041 (0.023)	0.034 (0.023)	0.034 (0.024)	0.034 (0.024)
Provider Age (logged)	0.016*** (0.001)	0.016*** (0.001)	0.016*** (0.001)	0.016*** (0.001)	-0.016 (0.013)	-0.018 (0.013)	-0.022 (0.015)	-0.027 (0.015)
Time Trend (365 days)	0.005 (0.005)	0.007 (0.005)	0.004 (0.005)	0.003 (0.005)	-0.205*** (0.032)	-0.165*** (0.033)	-0.177*** (0.035)	-0.184*** (0.036)
Constant	3.394*** (0.061)	3.320*** (0.065)	3.302*** (0.071)	3.294*** (0.072)	-3.449*** (0.202)	-3.395*** (0.204)	-3.362*** (0.224)	-3.294*** (0.224)
N	169960	169960	150176	150176	169960	169960	150176	150176

**Note:** \* indicates  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ , two-tailed t tests. All models include fixed effects for municipality. Standard errors are clustered by provider-product.

**Table 4: Robustness Check on Model Specification for Price Dispersion**

	(1)	(2)	(3)	(4)
Legal Unlicensed Regime		0.347*** (0.079)	0.258** (0.088)	0.250** (0.087)
Legal Licensed Regime		-0.010 (0.081)	-0.077 (0.088)	-0.119 (0.089)
Local Ban				-0.127** (0.047)
Local Competition (logged)	0.045* (0.020)	-0.063* (0.031)	-0.053 (0.034)	-0.015 (0.037)
Percent Non White	0.019*** (0.002)	0.015*** (0.002)	0.015*** (0.002)	0.014*** (0.002)
Median Household Income (\$100k)	-0.067 (0.151)	-0.321* (0.160)	-0.353 (0.184)	-0.360 (0.184)
Human Population (logged)	-0.014 (0.016)	0.035 (0.019)	0.032 (0.020)	0.020 (0.020)
Indica	-0.074* (0.037)	-0.072 (0.037)	-0.076 (0.039)	-0.071 (0.039)
Sativa	-0.087* (0.039)	-0.087* (0.039)	-0.077 (0.042)	-0.075 (0.041)
Low End	0.181*** (0.044)	0.163*** (0.044)	0.154** (0.047)	0.153** (0.047)
High End	-0.018 (0.034)	-0.023 (0.034)	-0.048 (0.037)	-0.047 (0.036)
Buy One Get One Free	0.908*** (0.067)	0.896*** (0.066)	0.871*** (0.068)	0.899*** (0.068)
Price Cap	-0.886*** (0.149)	-0.895*** (0.151)	-0.892*** (0.151)	-0.908*** (0.152)
Menu Heterogeneity	-0.026 (0.154)	0.019 (0.154)	0.033 (0.167)	0.041 (0.165)
Flower Count (logged)	-0.009 (0.027)	-0.010 (0.027)	0.006 (0.029)	0.003 (0.029)
Delivery Only	-0.003 (0.042)	-0.054 (0.043)	-0.029 (0.046)	-0.006 (0.046)
Popularity (logged)	0.085*** (0.024)	0.072** (0.025)	0.073** (0.026)	0.072** (0.026)
Provider Age (logged)	-0.019 (0.013)	-0.015 (0.013)	-0.015 (0.014)	-0.022 (0.014)
Time Trend (365 days)	-0.025 (0.029)	0.013 (0.031)	-0.005 (0.033)	-0.016 (0.033)
Price (logged)	-2.552*** (0.078)	-2.556*** (0.080)	-2.475*** (0.085)	-2.478*** (0.083)
Constant	5.283*** (0.347)	5.431*** (0.363)	5.159*** (0.387)	5.257*** (0.377)
N	169960	169960	150176	150176

**Note:** \* indicates  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ , two-tailed t tests. All models include fixed effects for municipality. Standard errors are clustered by provider-product.

**Table 5: Robustness Check for Measurement: The Effect of Legal Regimes on the Price of 3.5g of Cannabis Flowers**

Model Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Mean				Variance			
Legal Unlicensed Regime		0.149*** (0.037)	0.142*** (0.042)	0.140** (0.043)		0.417*** (0.082)	0.346*** (0.091)	0.340*** (0.091)
Legal Licensed Regime		0.057** (0.021)	0.065** (0.021)	0.097*** (0.023)		0.244** (0.081)	0.172 (0.088)	0.147 (0.090)
Local Ban				0.029*** (0.007)				-0.079* (0.039)
Local Competition (logged)	0.036*** (0.010)	0.029** (0.010)	0.033** (0.011)	0.035** (0.011)	0.127*** (0.023)	0.024 (0.033)	0.032 (0.037)	0.050 (0.037)
Percent Non White	0.003*** (0.001)	0.002*** (0.001)	0.002** (0.001)	0.002** (0.001)	0.011*** (0.002)	0.009*** (0.002)	0.009** (0.003)	0.009** (0.003)
Median Household Income (\$100k)	0.216*** (0.058)	0.178** (0.060)	0.210** (0.073)	0.208** (0.073)	0.116 (0.175)	-0.042 (0.184)	-0.120 (0.208)	-0.139 (0.208)
Human Population (logged)	-0.018* (0.008)	-0.016 (0.009)	-0.016 (0.009)	-0.016 (0.009)	-0.068*** (0.018)	-0.034 (0.021)	-0.028 (0.023)	-0.034 (0.023)
Indica	0.023*** (0.003)	0.022*** (0.003)	0.023*** (0.004)	0.022*** (0.004)	-0.190*** (0.039)	-0.188*** (0.038)	-0.177*** (0.041)	-0.174*** (0.041)
Sativa	0.005 (0.004)	0.005 (0.004)	0.006 (0.004)	0.005 (0.004)	-0.172*** (0.040)	-0.171*** (0.040)	-0.148*** (0.043)	-0.148*** (0.043)
Low End	-0.093*** (0.006)	-0.090*** (0.006)	-0.088*** (0.006)	-0.087*** (0.006)	0.468*** (0.049)	0.457*** (0.051)	0.457*** (0.055)	0.454*** (0.056)
High End	0.057*** (0.003)	0.058*** (0.003)	0.058*** (0.003)	0.058*** (0.003)	-0.250*** (0.036)	-0.254*** (0.035)	-0.291*** (0.038)	-0.287*** (0.038)
Buy One Get One Free	0.206*** (0.012)	0.205*** (0.012)	0.205*** (0.013)	0.203*** (0.013)	0.405*** (0.073)	0.401*** (0.073)	0.393*** (0.074)	0.412*** (0.074)
Price Cap	-0.124*** (0.012)	-0.126*** (0.012)	-0.124*** (0.012)	-0.119*** (0.013)	-0.574** (0.179)	-0.581** (0.180)	-0.581** (0.181)	-0.586** (0.187)
Menu Heterogeneity	-0.055*** (0.015)	-0.059*** (0.015)	-0.061*** (0.016)	-0.061*** (0.016)	0.158 (0.162)	0.132 (0.162)	0.169 (0.175)	0.172 (0.176)

**Table 5: Robustness Check for Measurement: The Effect of Legal Regimes on the Price of 3.5g of Cannabis Flowers (continued)**

Model Number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Mean				Variance			
Flower Count	-0.013***	-0.014***	-0.014***	-0.014***	0.031	0.032	0.042	0.043
(logged)	(0.003)	(0.003)	(0.003)	(0.003)	(0.027)	(0.027)	(0.029)	(0.029)
Delivery Only	0.079***	0.082***	0.088***	0.093***	-0.376***	-0.407***	-0.393***	-0.408***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.041)	(0.042)	(0.046)	(0.047)
Popularity (logged)	0.001	0.001	0.001	0.000	0.041	0.034	0.034	0.036
	(0.003)	(0.003)	(0.003)	(0.003)	(0.023)	(0.023)	(0.025)	(0.025)
Provider Age (logged)	0.016***	0.016***	0.016***	0.017***	-0.016	-0.018	-0.023	-0.028
	(0.001)	(0.001)	(0.001)	(0.001)	(0.013)	(0.013)	(0.015)	(0.015)
Time Trend (365 days)	0.005	0.007	0.004	0.002	-0.205***	-0.165***	-0.178***	-0.182***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.032)	(0.033)	(0.035)	(0.036)
Constant	3.394***	3.320***	3.301***	3.285***	-3.449***	-3.395***	-3.366***	-3.328***
	(0.061)	(0.065)	(0.071)	(0.071)	(0.202)	(0.204)	(0.225)	(0.225)
N	169960	169960	150176	150176	169960	169960	150176	150176

**Note:** \* indicates  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$ , two-tailed t tests. All models include fixed effects for municipality. Standard errors are clustered on provider-product.