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On the money: characterizing banking and lending in the California cannabis industry

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Abstract

Purpose – Despite 2016 legalization of recreational cannabis cultivation and sale in California with the passage of Proposition 64, many cannabis businesses operate without licenses. Furthermore, federal regulations disincentivize financial institutions from banking and lending to licensed cannabis businesses. The authors explore the impact of legal cannabis business activity on California financial institutions, the barriers to banking faced by cannabis businesses, and the nontraditional sources of financing used by the industry.

Design/methodology/approach – The authors use a mixed methods approach. The authors utilize call data for banks and credit unions headquartered in California and state cannabis licensing data to estimate the impact of the extensive and intensive margins of licensed cannabis activity on key banking indicators using difference-and-difference and fixed effects regressions. The qualitative data come from interviews with industry stakeholders in northern California's "Emerald Triangle" and add important context.

Findings – The quantitative results show economically and statistically significant impacts of licensed cannabis activity on banking indicators, suggesting both direct and spillover effects from cannabis activity to the financial sector. However, cannabis businesses report substantial barriers to accessing basic financial services and credit, leading to nontraditional financing arrangements.

Practical implications – The results suggest opportunities for cannabis businesses and financial institutions if regulations are eased and important avenues for further study.

Originality/value – The authors contribute to the nascent literature on cannabis economics and the literature on banking regulation and nontraditional finance.

Keywords Cannabis, Transaction costs, Regulation, Nontraditional lending, Controlled substances act, SAFE Banking Act, Mixed methods, Difference-in-difference, Fixed effects

Paper type Research paper

Introduction

California's economy is among the largest in the world, with only four national economies having a higher gross domestic product in 2020 (The World Bank, 2021; FRED, 2021b). In turn, the value of the California cannabis crop is estimated to be $16bn, making cannabis the state's highest value crop and generating more revenue than the top two legal crops—almonds and

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dairy—combined (Sumner *et al.*, 2018) [1]. However, despite legalization of recreational cannabis cultivation, processing, and sale in 2016 with the passage of Proposition 64, many cannabis businesses operate illegally. To operate legally in the state, businesses must obtain the appropriate state licenses, and these licenses and associated regulations impose substantial transaction costs on cannabis businesses. In addition, even when cannabis businesses are licensed, a variety of federal controlled substance and banking regulations severely constrain access to financial services by California cannabis industry stakeholders. These regulations impede access to very basic financial services, including bank accounts, as well as other financial services commonly used by many agricultural operations, such as capital, real estate and operational loans. Consequently, they force cannabis farmers and other cannabis businesses into relationships with nontraditional lenders and nontraditional arrangements with traditional lenders and financial service providers.

These challenges faced by cannabis businesses and financial institutions raise the question of whether and how increased economic activity due to cannabis legalization manifests in the financial sector. Several studies have examined the interdependence between the "real" sectors of the economy and the financial sector, both on a state level within the USA (e.g. Gunther *et al.*, 1995) and on a national scale. Şendeniz-Yüncü *et al.* (2008) look at 11 Organisation of Economic Co-operation and Development (OECD) countries and find a long-run interdependence between the banking sector and the real sector in the majority of countries they study. These and other studies suggest that growth in the real sector tends to lead to growth in the financial sector, and vice versa. Thus, cannabis business activity has the potential to impact the financial sector directly through activities such as deposits and loans as well as indirectly through spillovers from cannabis to other sectors of the economy (via increased economic activity). Furthermore, this indirect effect could also increase the magnitude of the effect of legalization on the banking sector, as increased bank deposits are considered a primary determinant of a bank's ability to make loans (Menicucci *et al.*, 2016).

In this paper, we have several key research questions. First, did recreational cannabis legalization have an impact on the banking sector, and if so, in what way? Second, does the extent of this impact differ by the type of licensed cannabis activity? Third, how do the barriers posed by federal banking regulations manifest for cannabis farmers, cannabis businesses, and financial institutions, and what kinds of nontraditional arrangements are used *in lieu* of these more traditional financial services and instruments? Finally, if banking and/or cannabis regulations were eased, what are some of the possible outcomes for cannabis industry stakeholders, the banking sector, and nontraditional lenders?

We focus on California, with a subset of our analysis focused in the "Emerald Triangle" region of northern California, made up of Humboldt, Mendocino, and Trinity counties. After passage of California Proposition 64 in November 2016, commercial production, sale, and taxation of cannabis for recreational use became legal in the state as of January 2018 (Marijuana Legalization. Initiative Statute, 2016). The Emerald Triangle region was well known for its cannabis production long before recreational legalization. Driven by back-to-the-landers arriving in the 1960s and accelerated by the decline of the lumber industry and blue-collar jobs in the 1970s and onward, cannabis production permeates the region's economy and culture (Meisel, 2017). MacEwan *et al.* (2017) estimate that the North Coast region and Intermountain region of northern California together (which encompass these three counties and others adjacent to them) were the site of 59–64% of all California production by volume in 2017. Although many of these characteristics make California's experience with cannabis unique, California's economy is among the largest in world, and federal banking regulations constrain cannabis growers and businesses in all US states, making this an important region to study and a topic of interest relevant to farmers, businesses, financial institutions, and policymakers around the USA.

To answer our research questions, we use a mixed methods approach combining quantitative and qualitative data. Our quantitative data come from several sources. We obtained call data for all banks and credit unions with headquarters in the state of California for the years 2015–2020. We also obtained state administrative data on cannabis cultivation licenses, cannabis retailer licenses, and cannabis manufacturing licenses by county. Our quantitative analysis consists of two main components. First, we examine the impact of the extensive margin of legal cannabis activity on key banking indicators using a difference-in-difference approach that exploits variation in legalization across counties within the state. This variation exists because despite recreational cannabis being legalized at the state-level, county-level regulations may be more restrictive, and some counties have chosen to remain "dry" counties when it comes to cannabis. Second, we use a fixed effects approach to estimate the impact of the intensive margin of legal cannabis activity (as measured by number of state licenses) on the same key banking indicators. Our qualitative data come from interviews conducted by members of the study team with cannabis producers, financial industry professionals, and other cannabis industry stakeholders in the Emerald Triangle and help inform and provide important context for our quantitative analysis. These interviews also help explain why farmers turn to nontraditional financing sources and the types of arrangements they use.

Our quantitative results suggest an economically and statistically significant impact of the extensive margin of legal cannabis activity in a county on banking indicators. For example, we find that after the passage of Proposition 64, total financial assets (summed across all banks and credit unions headquartered in a county) are $741,012,763 higher for counties with legal cultivation. This result is statistically significant at the 5% level. When we limit our analysis to those banks with branches in California only, we likewise find an economically significant and positive relationship, although not statistically significant. When we consider the intensive margin of cannabis activity, we find economically and statistically significant results as well. For example, we find an additional manufacturing license in a county is associated with an increase of $62,274,210 in total bank assets in a county; an additional retail license is associated with an increase of $42,088,024. Both are statistically significant at the 1% level. When we consider those banks with branches in California only, the magnitudes of these values decrease to the tens of thousands, but the results remain statistically significant at the same level. Interestingly, we find the number of cultivation licenses does not have a statistically significant relationship with any of the banking indicators, suggesting value-added businesses are more engaged with or have more of an impact on the banking sector. This result is corroborated by our qualitative analysis, which suggests that many cannabis growers remain severely underbanked and largely engage in a cash economy, even when conventional financial services are available to them, forcing them into nontraditional financing arrangements. We highlight these nontraditional arrangements in the discussion of our qualitative interviews and discuss some of the publicly marketed opportunities in this space. Most financial institution representatives we interviewed reported their institutions did not knowingly bank cannabis or lend to cannabis businesses, and those that do point to a variety of challenges and costs associated with doing so. That said, our results point to large impacts of the legal cannabis industry on financial institutions, providing suggestive evidence of sizable spillover impacts of these businesses to local economies and the financial institutions that serve them.

Our contributions with this work are threefold. First, we contribute to the nascent area of literature on the economics of cannabis production, business, and finance. This area of research will only become more important as more states move to loosen restrictions on cannabis. Second, our mixed methods approach, still relatively uncommon in economics journals, highlights the value of combining qualitative and quantitative data to provide both population-level evidence of relationships and community-level nuance for context. Third, we contribute to

this special issue by both studying a nontraditional crop and discussing and highlighting the nontraditional methods of financing that farmers and other cannabis businesses utilize to operate in a complex, high-risk, and rapidly shifting industry and regulatory environment.

In the article that follows, we first discuss the regulatory environment for cannabis, the production context for cannabis businesses, and the regulatory environment for financial institutions that engage with cannabis businesses. We then discuss our data and methods. We answer our research questions using qualitative and quantitative data and discuss policy implications, and finally, we conclude and provide suggestions for future research.

Regulatory context

State and federal cannabis regulations

The relevant regulatory environment is important for understanding the challenges facing producers and others in this industry. Cannabis is classified as a Schedule I drug by the federal government under the Controlled Substances Act (CSA), putting it in the most controlled and restricted class of drugs along with heroin, LSD, and others (DEA, 2021). In spite of its stringent federal classification, cannabis was legalized for medicinal use in California in 1996 under the Compassionate Use Act, also known as Proposition 215. The act allowed medical patients and designated caregivers, as well as physicians who prescribed cannabis, to avoid criminal charges for cultivation and possession (Grossman, 2019).

Cannabis cultivation, distribution and sale were not regulated by the state under Proposition 215, leaving each county in charge of how medical cannabis was to be handled. In some counties, officers arrested medical cannabis patients and caregivers, as the provisions of the Compassionate Use Act did not protect people from being arrested but rather could be used in courts as an "affirmative defense." In other counties, some authorities generally allowed medical cannabis patients to obtain cannabis without fear of arrest and tolerated the development of dispensaries, which were effectively and legally their customers' "primary caregivers." California Senate Bill 420 was enacted in 2003 and required counties to establish a process to issue patient ID cards and set maximum quantities for patient possession and authorized cultivation and distribution by nonprofit cooperatives and collectives for medicinal purposes (Grossman, 2019). With the passage of Proposition 64 in November 2016, production for personal, recreational use became legal almost immediately, and new regulations for commercial production for both recreational (or "adult use") cannabis and medicinal cannabis were scheduled to begin in January 2018 to enable time for regulators to develop a licensing system. The final regulations on which this analysis is based became effective in January 2019 (California Cannabis Portal, 2021b).

To complicate matters, California permits counties and cities to implement their own local ordinances related to cannabis under the "local control" provision of Proposition 64 (Sumner *et al.*, 2020) [2]. The level of restriction varies considerably, with some counties banning any commercial cannabis activity (i.e. "dry" counties), and some allowing all commercial cannabis activity (i.e. "wet" counties), often with zoning restrictions and additional local tax structures on top of state taxes. It is this variation in county policies that we use for identification in our difference-in-difference regressions. These local regulations are changing rapidly, as localities either encounter issues they had not anticipated or observe benefits accruing to other places and change their policies accordingly. This shifting regulatory environment also presents challenges for farmers who operate in multiple counties with conflicting regulations (Bodwitch *et al.*, 2019). Even if local laws in a grower's county are permissive, they are still subject to federal regulation; federal authorities' enforcement power is substantial and supported by case law, and consequences for growers or other businesses are potentially serious (Martirosyan, 2018).

Studying cannabis industries is also complicated by the fact that cannabis is now legal in some form in 36 out of 50 US states, the District of Columbia, and four out of five US

territories, each with its own regulatory framework, and interstate commerce involving cannabis is not currently legal (NCSL, 2021). For the purposes of our work, we focus primarily on California. While pressures facing cannabis producers are likely shared with farmers in other states and localities within them, the regulatory differences across these geographies may hamper external validity to some extent. Indeed, interviews with financial institutions in several other states suggest the challenges faced by cannabis businesses in California are shared by cannabis businesses in other parts of the USA.

Finally, it is important to distinguish between cannabis (using the term colloquially, as we have and will throughout this manuscript) and hemp. As noted briefly earlier (see Footnote 1), hemp and cannabis (as used for recreational or medicinal purposes) come from the same plant, but by federal law are distinguished only by their THC content. This federal distinction was made specifically in the 2018 Farm Bill. Defining hemp only via a THC concentration threshold of ($\leq$0.3%), the law decontrolled hemp entirely, while maintaining cannabis' status (with THC concentration $>$ 0.3%) as a Schedule I drug under the CSA. This action allowed for commercial cultivation of hemp for numerous purposes (e.g. fiber, food, CBD oil, etc.) throughout the USA (Hudak, 2018). Subsequently, federal farm programs administered by US Department of Agriculture (USDA) agencies are now available to hemp producers (USDA, 2021). Furthermore, certified hemp farmers in California, unlike their cannabis-producing counterparts, have the ability to directly market their agricultural product through California's Farmers Market program (CDFA, 2021).

The federal definitions of both cannabis and hemp set the stage for regulation in California. Division 24 of the California Food and Agricultural Code explicitly defines hemp following the 2018 Farm bill's definition and establishes three categories for hemp registration: growers of industrial hemp, hemp breeders, and established agricultural research institutions (CDFA, 2021). Hemp production in the state requires an application through a county's agricultural commissioner, but there is no state-level licensing process for hemp producers. In addition, counties can choose to restrict or ban hemp cultivation, as with cannabis. In counties that allow hemp cultivation, if hemp exceeds the allowable THC concentration of 0.3%, as determined via testing by a state-approved lab, then the hemp cannot be legally harvested (CDFA, 2021). An important question to consider is whether it is possible that the hemp and cannabis markets could be connected despite these regulatory differences. This seems unlikely for two reasons. First of all, producers of recreational and medicinal cannabis can fetch a much higher price for their product as cannabis than as hemp, so they have a strong price incentive to manage their crop to achieve a sufficiently high THC level for this purpose. Second of all, producers of industrial hemp would be in violation of state (and federal) laws if they sold a product regulated as hemp as cannabis instead due to intentionally or unintentionally producing a crop with THC concentration over the legal threshold. While we cannot rule out that some producers may be applying to produce hemp for regulatory purposes and then producing cannabis and selling it as such illegally, these regulatory and market factors suggest that cannabis can be looked at in isolation (as we do in this analysis) without simultaneously considering hemp production and licensing.

Production context

To understand cannabis growers' demand for credit and financial services, we need to understand their operations. Sumner *et al.* (2018, 2020) estimate that California produces about 16 million pounds of cannabis annually, valued at approximately $16bn, with 80% of this production shipped out of state, making cannabis the highest value crop in California. Sumner *et al.* (2020) find that of the 2.8 million pounds consumed in the state in 2019, about 2.3 million pounds were illegal (unlicensed), while 540,000 pounds were legal (licensed) and sold in California's legal market. At the time of writing, there are still no legal pathways for interstate commerce for cannabis, so the quantity of licensed production of cannabis for

recreational and medicinal use remains constrained by the size of the legal California market, limiting the ability of existing producers to enter the licensed market. Furthermore, not all counties allow retail sales and farmers have no access to direct marketing channels (e.g. farmers markets) under current state regulations.

Historically in California, cannabis has been grown in locations and using practices to avoid detection. For example, Sumner *et al.* (2018) found that the average size of outdoor plots was less than one acre (fragmentation can decrease risk of detection and mitigate risk to other sites if one site is found). Cannabis production on federal lands in interior California is well documented (Prestemon *et al.*, 2019; Koch *et al.*, 2016). Koch *et al.* (2016) found that local cannabis prices, law enforcement presence and environmental conditions likely impact productivity and growers' site choices. Likewise, Butsic *et al.* (2017) find that site choice in Humboldt County has been in part driven by a desire to evade law enforcement; areas with steep slopes, poor irrigation access, and far from roads are just as likely places for cultivation as areas that would be more agriculturally suitable. These features highlight some of the unique aspects of growing cannabis.

Cost of production for licensed cannabis is high due to regulatory costs and the need to meet other regulatory standards, such as environmental standards and water use regulations. Cannabis farmers producing for the unlicensed market are not required to meet any of these *other* state and federal regulations applicable to production of most agricultural crops. MacEwan *et al.* (2017) estimated that sample average operating expenses for outdoor, indoor, and mixed light operations in California to be $218,474, $1,730,493 and $875,062, respectively [3]. Furthermore, Schwab and Butsic (2017) find that the relationship between cannabis production and land prices in rural Humboldt County is positive; a higher density of cannabis production in a watershed is associated with higher land prices. They speculate there are two competing effects at play that drive this result: profitability of cannabis driving prices up and disamenities such as real or perceived increases in crime and nuisance impacts on noncannabis producers driving prices down. While these land price effects may benefit existing landowners, rising land prices may create a barrier for new entrants or previously illicit (i.e. "legacy") cannabis farmers looking to become licensed. Finally, a substantial cost for cannabis businesses is business taxes. Under Internal Revenue Code Section 280E, businesses cannot deduct expenses associated with "trafficking in controlled substances." Although some interpreted this to still allow for the deduction of Cost of Goods Sold (COGS), Kadish *et al.* (2020) describe a recent case where in which the judge implicitly rejected COGS as an allowable deduction. This unique tax situation for cannabis imposes further costs on cannabis growers relative to growers of other crops.

Regulatory costs for licensed cannabis are substantial. In California, mandatory tests are conducted for potency, possible biological contaminants, pesticides, and heavy metals (Valdes-Donoso *et al.*, 2020). Valdes-Donoso *et al.* (2020) estimate that for an average batch size (8 pounds), testing costs per pound can range from $89.58 to $186.01 depending on the rejection rate, but for the smallest batches (1 pound), testing costs per pound can be as high as $791.02 per pound. Sumner *et al.* (2020) estimate all taxes and regulatory costs to be $2,130 per pound (based on a $5,380 per pound retail price) in 2020. They estimate average retail price with taxes to be $5,200 in 2019, whereas unlicensed cannabis retails for $2,500 per pound [4]. As in other industries, retailers, distributors, and manufacturers add substantial mark-up, so farm prices are much lower than retail prices. In the first known survey of California cannabis production practices (conducted prior to the approval of cultivation licenses from recreational legalization), Wilson *et al.* (2019) found that growers were earning anywhere from $200 to $1,900 per pound in revenue for their cannabis flowers (with an average of $853 per pound in revenue for flowers).

Of course, given how much of California's cannabis crop is exported out of the state, not all growers can participate in the licensed, legal market, nor are they equally likely to seek

licenses. Schwab *et al.* (2019) find that larger farms were more likely to apply for recreational cultivation licenses when that option became available in 2018. Interestingly, new farms that were formed between 2012 and 2016 (while Proposition 215 was still in effect) were less likely to apply for licenses (Schwab *et al.*, 2019). Growers reported county-level cultivation bans, unformulated guidelines and cost constraints as barriers to applying for cultivation licenses (Bodwitch *et al.*, 2019). Growers also complained of regulatory inconsistencies among agencies within the same county. They also reported that small growers were excluded due to lack of resources and bemoaned an active unlicensed market with lower costs that was able to offer better pay to workers. A particular concern raised in this research and in our own qualitative interviews is that legalization as implemented is detrimental to the small farmers who were longstanding residents of these communities and were growing prior to legalization (sometimes referred to as "legacy" farmers).

Federal banking regulations and finance context

In 2020, 515 banks and 169 credit unions reported providing financial services to marijuana-related businesses, or MRBs (FinCEN, 2021). This represents less than 12% of all banks and less than 4% of all credit unions. The reason for this limited involvement has do with fear of federal enforcement, and a variety of studies in law journals demonstrate the regulatory quagmire facing financial institutions and highlight the need for clarity (e.g. Hill, 2020; Franck, 2020; Hoffman, 2019; Sater, 2019; Greaves, 2017). Hill (2020) points to several different avenues through which financial institutions could violate federal law by engaging with cannabis businesses. First, their activities to provide financial services could be viewed as "conspiring to distribute marijuana" or "aiding and abetting the distribution of marijuana," both violations of the Controlled Substances Act (CSA).

In addition, the Bank Secrecy Act (BSA), enacted in 1970, requires banks to report businesses they suspect of laundering money associated with illegal activities. Because MRBs remain illegal at the federal level, financial institutions have long been concerned about the possibility of being prosecuted under the BSA for doing business with MRBs. In 2013, then US Deputy Attorney General James Cole issued a memo (known as the "Cole Memo") which instructed US Attorneys about priorities for enforcement of the Controlled Substances Act. Subsequently in 2014, the Financial Crimes Enforcement Network (FinCEN), an office of the US Department of the Treasury, issued guidance for financial institutions entitled "BSA Expectations Regarding Marijuana-Related Businesses" (FinCEN, 2014). This guidance further clarified how the Cole Memo enforcement priorities would be applied to the Bank Secrecy Act. While the intent of these documents was to loosen restrictions for businesses and provide pathways for navigating conflicting state and federal rules, Buckner (2015) highlights that because these were more like "guidelines" than rules, they did not provide sufficient assurance to most banks for them to get involved with MRBs.

The 2014 FinCEN guidance lays out three categories of MRBs and the requirements for Suspicious Activity Reports (SAR). The three categories (ranging from least likely to implicate Cole Memo priorities and/or violate state laws to most likely) are: Marijuana Limited, Marijuana Priority, and Marijuana Termination. Banks are required to file Suspicious Activity Reports (SARs) regarding any potential violation of federal law by MRBs associated with these three categories (Bronfein, 2016). An SAR must be filed for each MRB within 30 days of the bank become aware of the marijuana-related activity, and continuing reports must be filed every 120 days thereafter (FinCEN, 2021). In order to assess the risk associated with an MRB, banks must engage in extensive customer due diligence including ensuring the business meets all state-level cannabis licensing standards, tracking the business' transactions, and monitoring the accounts for suspicious activity (FinCEN, 2014). These reporting requirements extend to accounts for employees of MRBs, as these employees are being paid via funds that were gained via activities illegal at the federal level. In addition

to these restrictions, banks are required to report any deposits or withdrawals of more than $10,000 in cash per day by an account holder, which is not uncommon in the cannabis industry (FinCEN, 2014). Violations of the BSA, if prosecuted, can take the form of substantial fines or even imprisonment (Hill, 2015). Complicating matters, in 2018 then US Attorney General Jeff Sessions rescinded the 2014 FinCEN guidance, generating increased uncertainty in an already uncertain environment (Hill, 2020). The cost of compliance and uncertainty about what compliance with various federal guidelines would even due to mitigate risk of penalties has led banks to operate very cautiously in this space.

Recognizing the challenges facing banks and the public safety issues associated with cash-based economies, regulatory reforms have been in policymakers' sights for several years now. Franck (2020) discusses the SAFE Banking Act, which would amend the BSA so that banks could not be prosecuted for engaging with cannabis businesses under money laundering laws and would prevent federal regulators from withholding deposit insurance or conducting enforcement in relation to banks' lending to cannabis businesses. Although the 2019 version of this legislation cited by Franck (2020) ultimately did not get out of committee in the US Senate, Saldaña (2021) version of the same bill passed the US House of Representatives by a vote of 312–101 in April 2021 and is now again under consideration by the US Senate (Secure And Fair Enforcement Banking Act of 2019, SAFE Banking Act of 2021).

Given the lack of capital available from banks, other sources of capital serve a more important role in this industry than in other agricultural settings. Weisskopf (2020) highlights the continued barriers to investment in cannabis stocks: companies tend to be smaller ("small cap"). With relatively little information or research on performance available to investors, these investments remain high risk due to continued industry and regulatory uncertainty. However, venture capital and other forms of equity-based financing come with their own challenges (Franck, 2020). Andrikopoulos *et al.* (2021) find that the lack of congruence between the social mood in the USA toward cannabis (increasingly pro-legalization) and the behavior of regulators (mixed legal treatment) enhances uncertainty for potential investors, limiting herding among investors. While this is not necessarily a bad thing (e.g. herding could lead to asset bubbles, where stock prices diverge from their fundamental values), it also speaks to the barriers to investment in the industry.

Surprisingly, there has been very limited attention to the topic of financial services and credit in the cannabis industry, with two recent and notable exceptions. Merz and Riepe (2021) conducted an event study examining several federal banking regulation changes in the USA and their impact on the value of an equally weighted portfolio of cannabis business stocks in the USA. They also conducted a survey of cannabis businesses in the Denver, CO, area and at the 2017 National Cannabis Industry Association Seed-to-Sale Show, using similarly sized microbreweries as a control. Their event study results suggest that regulatory events that would ease restrictions on banks associated with banking cannabis have a positive and statistically significant relationship with the value of cannabis business stocks. In their survey, they find that while 54% of firms had a bank account, 55% have had a bank account closed or rejected by a bank. They found internal funds, private loans, and private equity to be the three most commonly reported sources of financing, with 80, 57 and 38% reporting use of these sources of financing, respectively. However, 68% of respondents reported bank loans to be desirable but inaccessible. In addition, 52% of firms reported a deposit/savings account would be the most useful banking service to them, and they reported the two most common challenges associated with their operations were tax rules and access to finance.

Berger and Seegert (2020), in an unpublished working paper, consider how cash management affects cannabis dispensary profitability in Washington State. The authors utilize bank data from the same federal sources we describe in the next section,

administrative data on dispensary transactions from the state of Washington, and survey data about businesses' financial transactions collected from dispensaries in Washington, Oregon, and Colorado. For their main empirical model, they estimate the impact of financial access on dispensary profitability, using distance from the dispensary to a cannabis-friendly credit union as an instrument for financial access. They find that access to cash management increases the profitability of dispensaries between 40 and 60%. Their work to address mechanisms suggests that this increase in profits is due to reduced supplier transaction costs. Our research complements this recent literature: first, we consider how legalization impacts banks rather than how bank access or bank regulations impact cannabis businesses, and second, we primarily focus on cultivation and cannabis growers rather than dispensaries.

As these two papers suggest, federal banking regulations are a barrier to cannabis businesses in other US states besides California. Other peer-reviewed and gray literature has discussed various ways that federal banking regulations impact cannabis businesses in California, Colorado, Illinois, Maryland, New York, Washington, as well as creative ways states and businesses are addressing these barriers (e.g. Boyd, 2020; Bronfein, 2016; Buckner, 2015; Chiang, 2017; Hoffman, 2019). These examples highlight the relevance of our work to cannabis industry stakeholders around the USA.

Data and methods

To answer our research questions, we employ a mixed methods analysis. The analytic rigor of mixed methods emerges from triangulation of multiple forms of data. Each iteration of data collection and analysis flows into the next, providing increasing levels of confidence in the data validity.

To understand whether and how recreational cannabis legalization has impacted the banking sector, we use bank call data. Quarterly call reports for all commercial banks with headquarters in the state of California were obtained from the Federal Financial Institutions Examination Council Central Data Repository for the years 2015–2020 (Federal Financial Institutions Examination Council, 2021). Analogous data for all credit unions with headquarters in California were obtained from the National Credit Union Administration for the same time period (National Credit Union Administration, 2021). Credit union and commercial bank call report variables of interest were renamed with common names based on a review of variable definitions in both data sets in order to combine data sets into a single data set of California financial institutions. We refer to these credit unions and commercial banks collectively as "banks" or "financial institutions" throughout the manuscript.

To measure legal cannabis business activity, we utilize state licensing data for cannabis businesses. The number of cannabis business licenses in a county, which is our variable of interest, is a proxy for legal cannabis business activity. We obtained data on cannabis cultivation licenses from the California Department of Food and Agriculture (CalCannabis Cultivation Licensing, 2021) [5]. License and location data for cannabis manufacturers were obtained from the Manufactured Cannabis Safety Branch of the California Department of Public Health, and license and location data for retailers were obtained from the California Bureau of Cannabis Control via the California Cannabis Portal (CDPH, 2021; California Cannabis Portal, 2021a) [6]. All license data used include business name; license type; dates of issue, update, and expiration; and county of premises [7]. The issue date and expiration date are used to determine the number of active licenses in a county-quarter.

Figure 1 shows total licenses by type through Quarter 4 of 2020 [8]. All licenses types are measured on the same scale, and retail licenses represent retail storefronts only (see Footnote 7). Figure 1(a) shows the highest concentration of cultivation licensing along much of the California coast, along with select interior portions of California. The three darkest green

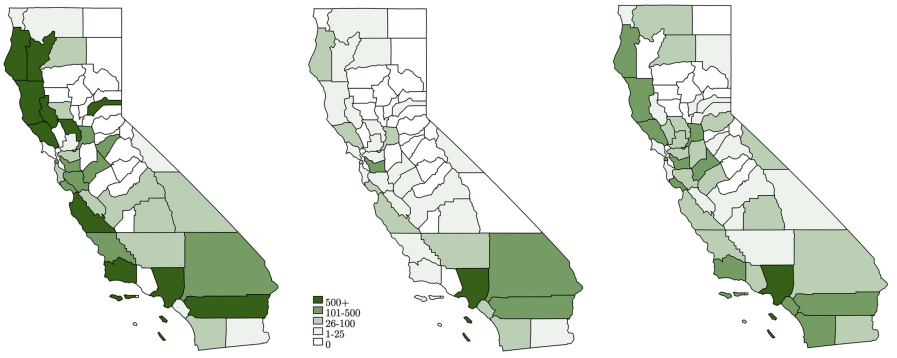

Figure 1.
Total number of licenses in county by license type through Quarter 4 of 2020

counties at the top left of Figure 1(a) are the Emerald Triangle counties (Humboldt, Trinity, and Mendocino, clockwise from top left). Other counties with a high concentration of licenses (the darkest green) are Sonoma, Lake, Yolo, Nevada, Monterey, Santa Barbara, Los Angeles, and Riverside. From Figure 1b and c, we see that Los Angeles county has the highest concentration of both manufacturing licenses and retail licenses. As discussed earlier, some counties have used the "local control" provision of Proposition 64 to remain "dry" counties when it comes to cannabis. Counties that are white in Figure 1a and b, or 1c have no licenses of the type described in that panel, and you will see some (Modoc, Tehama, Plumas, Butte, Glenn, Sierra, Sutter, Alpine, Amador, Mariposa, and Madera) have no licenses of any type.

Interviews with stakeholders (discussed in detail in the results section) suggested that banks were not providing agricultural loans to cannabis cultivators because the collateral for the loan (the product or other assets of the businesses) could be seized by federal law enforcement authorities, even for licensed operations. However, they indicated that we would be likely to see activity in other variables, particularly in the amount of deposits in financial institutions. Thus, our dependent variables are total assets, total liabilities, total shares and deposits, total loans, total agricultural loans, interest income, fee income and the number of full-time equivalent employees [9]. In addition, the finance literature has established that there is a significant relationship between a bank's level of deposits and the amount of loans it can make (Lee and Hsieh, 2013; Menicucci *et al.*, 2016); this is one potential spillover from cannabis legalization mediated through the financial sector. For our primary specifications, we aggregate these to county-quarter level by summing each measure across all banks headquartered in that county in that quarter [10]. This county-level aggregation allows us to match the bank data with county license data and other county-level controls, all of which vary at the county level [11].

We then explore two different groups of banks. First, we consider all banks with headquarters in the county. Second, we consider "California-only" banks, a subset of the first group; these are banks with headquarters in the county that only have branches in California. This latter group is important for understanding a more localized effect, as the effect on the "all banks" group may be attributable to changes outside the state. Nonetheless, these California-only banks are analyzed separately primarily for robustness, as the median bank in our sample is quite local already, with only three branches. The changes in these variables over time are shown in Figures 2 and 3 and reported in Appendix 1, Tables A2 and A3, for all banks and the California-only banks, respectively. The vertical line indicates when

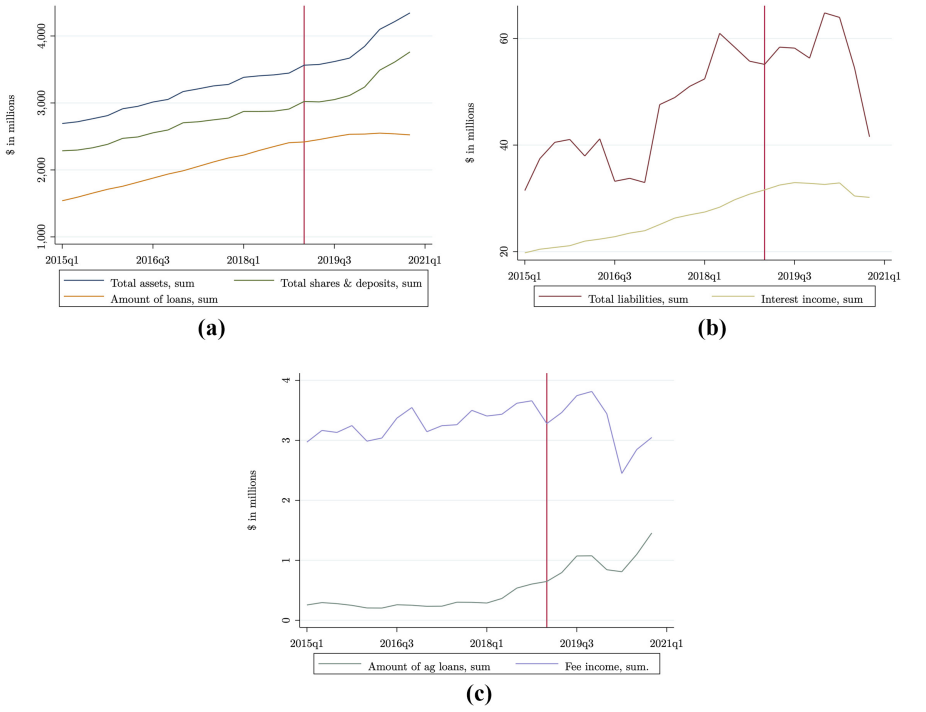

Figure 2.
Dependent variables over time, all banks

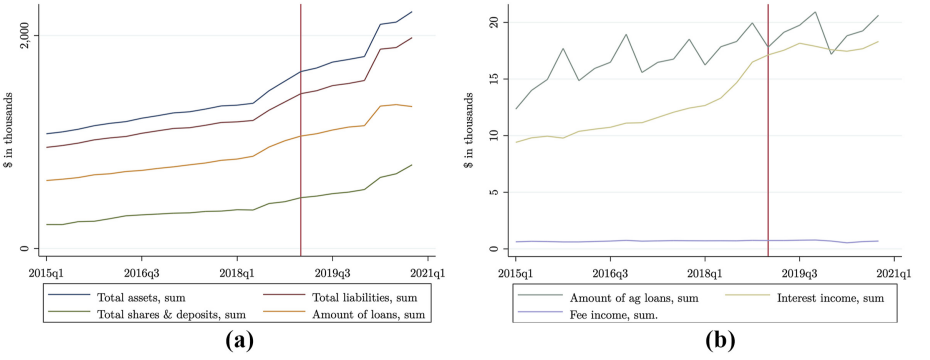

Figure 3.
Dependent variables over time, California-only banks

permanent licenses became available from the state licensing agency under the newly developed regulations. Variables are grouped by order of magnitude (and vertical axis scales vary by panel) to better visualize trends over time.

Aggregating data to the county-quarter level, we first use a difference-in-difference approach to estimate the relationship between the extensive margin of legal cannabis business activity and key banking indicators before and after legalization. Counties with any state cannabis cultivation licenses postlegalization are our treatment counties, and counties with no state cannabis cultivation licenses postlegalization are our control counties. Referring

back to Figure 1(a), control counties are the white counties, and counties with any shade of green are the treatment counties. Our coefficient of interest is therefore β_1, the coefficient on the interaction between the treatment indicator (legal cultivation in county) and the indicator for time period postlegalization. For controls we include real GDP (measured in $2012), the average weekly wage, the employment level across all private industries, and the employment level in agriculture; these are summarized before and after legalization in Table 1. We also include year fixed effects. We test for parallel trends between legal and nonlegal counties in the pre-legalization period without these control variables and find no significant difference for six out of eight of the dependent variables from all banks and for seven out of eight from the California-only banks [12]. The p-values for these joint significance tests are included in the results tables. Our difference-in-difference specification is:

$$y_{ctz} = \beta_0 + \beta_1 LC_c \times post_t + \beta_2 LC + \beta_3 post + \beta \boldsymbol{G_{ctz}} + \tau_z + \varepsilon_{ctz}, \quad (1)$$

where y_{ctz} represents the banking outcome variable for county c in quarter t in year z; LC_c indicates that county c had at least one cultivation license and $post_t$ indicates that cannabis is legal in that quarter t. $\boldsymbol{G_{btz}}$ is a vector of the control variables summarized in Table 1. We run two regressions, one for all banks, and one for California-only banks. As a robustness check that explores the heterogeneity by year of the impact of cannabis legalization in a county, we also run the following specification:

$$y_{ctz} = \beta_0 + \beta_1 LC_c \times \tau_z + \beta_2 LC_c + \beta \boldsymbol{G_{ctz}} + \tau_z + \varepsilon_{ctz}, \quad (2)$$

where each variable is defined as in equation (1). The results of this specification are particularly interesting given the negative shock to the economy in 2020 as a result of the COVID-19 pandemic.

We expect a more robust banking sector in counties with cannabis cultivation licenses following legalization, particularly in terms of the amount of deposits and the assets held by the banking institutions in that county. This could be due to either direct use of banks by cannabis businesses or to indirect economic impacts associated with cannabis business activity. In addition, representatives of banking institutions indicated in interviews that they charge cannabis-related businesses higher fees and have hired additional staff to work on cannabis accounts, so we also expect a positive relationship with these outcomes.

	Legal county		Nonlegal county	
	Mean	sd	Mean	sd
Pre-legalization				
GDP ($2012, thousands)	$79,959,122	$70,311,488	$5,068,080***	$3,659,768
Avg. weekly wage	$1,195	$424	$892***	$193
Population employed	1,763,265	1,563,918	128,944***	89,525
Population employed in ag	8,391	13,834	8,394	9,619
n	7,565		662	
Post-legalization				
GDP ($2012, thousands)	$83,375,353	$73,110,556	$5,138,374***	$3,739,385
Avg. weekly wage	$1,370	$552	$991***	$225
Population employed	1,768,861	1,570,926	128,522***	96,428
Population employed in ag	8,448	14,650	8,058	9,455
	3,316		262	

Note(s): (a) ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; indicates significant difference in means between legal and non-legal counties in each period
(b) The post-legalization period begins in the first quarter of 2019

Table 1. Time-variant county-level controls before and after legalization, by cannabis legality in county

Because banks were unequivocal that they do not loan to cannabis businesses, we do not expect a strong relationship between legalization and loan volume, particularly agricultural loans.

To explore our second research question, about whether the extent of any observed impact differs by the type of licensed cannabis activity, we use a fixed effects approach. We estimate the relationship between the intensive margin of licensed cannabis activity and key banking indicators separately for each license type (cultivation, manufacturing and retail). In this regression, our coefficient of interest (again represented by β_1) is on the cannabis license variable showing the number of active cultivation, manufacturing, or retail licenses in a county in a quarter. Our specification is:

$$y_{ctz} = \beta_0 + \beta_1 n_{lctz} + \beta \boldsymbol{G}_{\mathbf{ctz}} + \tau_z + \eta_c + \varepsilon_{ctz}, \tag{3}$$

where n_{lctz} measures the number of licenses of type l in county c and quarter t in year z. In addition, we include county fixed effects (η_c) along with year fixed effects and controls. We run six regressions, one for each license type for all banks, and one for each license type for California-only banks. As before, we expect a positive relationship between the number of licenses in a county-quarter and the level of banking activity, particularly deposits and assets. Given the legal difficulties associated with securing loans for cannabis cultivation or production, we expect limited impacts of license numbers on these measures, especially agricultural loans. We expect stronger financial effects from retail and manufacturing than from cultivation, as both activities generate more value-added for the industry than cultivation alone. In addition, we estimate two fixed effects regressions (one for all banks, one for California-only banks) using only cultivation licenses, including the number of licenses for each of the three production types (indoor, mixed light, and outdoor) in each regression. We expect more technology intensive indoor and mixed light production techniques to have a stronger effect; as highlighted earlier, these are higher cost operations designed with a goal of increasing yield via more precise climate control, and thus may yield higher operational revenue.

To answer our third research question, about how barriers posed by federal banking regulations manifest for cannabis industry stakeholders and what kinds of nontraditional arrangements are used *in lieu* of these services and instruments, we use primary qualitative data. Interview guides for various stakeholders were developed by our interdisciplinary team of researchers to provide insight about financing as well as a variety of topics associated with our team's larger project on economic development in Northern California cannabis-growing regions. Interviews with respondents provided important context to the quantitative data. A number of financial institutions with headquarters or a branch in the Emerald Triangle region were contacted to request an interview. Additional financial institutions in neighboring counties known to bank cannabis (based on other farmer and key stakeholder interviews) were also contacted. Several financial institutions in other US states were also contacted, and we note whether an interviewee is from a bank outside of California in our discussion. Qualitative data from people other than financial institution representatives were collected using a snowball sampling approach. Interviewees were identified through trusted gatekeepers in the local county government and local industry groups and in partnership with staff and faculty at the University of California Hopland Research and Extension Center located in the Emerald Triangle. All interview subjects were asked to fill out a survey identifying additional research subjects. Our team conducted interviews with 15 research subjects with information relevant to grower financing (a mix of growers, financial institution representatives, distributors and financial service providers).

Interviews are themselves "interchanges of views between [. . .] persons conversing about a theme of common interest" and semi-structured interviews, which we used, are for "the

purpose of obtaining descriptions of the life world of the interviewee with respect to interpreting the meaning of the described phenomena" (Kvale, 2007). Interview reliability (dependability of responses as observed during the coding process) and validity (or trustworthiness and credibility of data, achieved by verification against the primary data) was achieved through audio and video recording of research participants, verbatim transcriptions and coded using a combined deductive/inductive coding methodology informed by thematic analysis (pulling themes from the data after all is collected) and grounded theory (refining data collection as coding proceeds). "Coding" in the qualitative data setting is the process of categorizing qualitative data for analysis and is done by reading the transcript of an interview, highlighting statements and assigning them to categories. Deductive coding involves using predetermined categories. We began with categorizing responses by the interview questions, and thus this initial coding was deductive (based on a structure developed prior to data collection). Inductive coding is the process of developing the codes based on what respondents say. This process was used to code the most open-ended questions (for example, when respondents were asked about barriers to financing or legal market participation). Coding methods relied on Saldaña's (2021) coding methods. We utilized a long coder, where a member of our interview team also generated a codebook inductively from the data using the program MaxQDA. The coding was further refined in a process known as postcoding, performed in a work session analyzing and refining the first round of code.

Due to both the continuing illicit nature of a large share of the industry and the challenge of obtaining high quality data associated with this "gray" industry and the shifting regulatory environment, as well as the geographically limited nature of our qualitative analysis, we want to be cautious about drawing strong conclusions from our work or claiming external validity. However, the experiences of interviewees sheds light on some of the important issues facing cannabis industry stakeholders, and together our local qualitative analysis and more expansive quantitative analysis suggest a variety of pathways for future study and important policy implications.

Results

Extensive and intensive margin impacts of cannabis business activity on the banking sector

Table 2 presents results from Equation (1) on our dependent variables of interest, measured for all banks. As a reminder, the level of observation is a county-quarter, and the dependent variables are summed across all banks (or banks with branches only in California) that are headquartered in the county. Table 3 shows the equivalent results for the California-only banks [13]. As shown in these two tables, the extensive effect of cannabis business activity is concentrated primarily in all banks headquartered in California, rather than the California-only banks; thus, this specification may be picking up some time-variant characteristics of the counties that selected into legalizing cannabis cultivation. Although the trends in many of these dependent variables were quite similar in the period prior to legalization, the levels were starkly different. The "legal county" group includes all of California's major urban centers, and these bank indicators include the bank's entire customer base (i.e. including branches outside of California). Additionally, we know that legalization was not a perfect treatment. There was and still is a significant portion of the industry that operated before licenses were implemented and operate today without a license.

With these caveats in mind, we see that counties with cannabis cultivation licenses experience significantly greater banking activity across almost all measures. Banks headquartered in these counties have higher levels of assets in the post-legalization period, but are not taking on additional liabilities. The primary component of assets that has increased in cannabis-cultivating counties in the post period is deposits and shares. This

Table 2.
Extensive effect of cannabis licensing on all banks

	(1) Total assets	(2) Total liabilities	(3) Total shares and deposits	(4) Amount of loans	(5) Amount of ag loans	(6) Interest income	(7) Fee income	(8) Full-time employees
Post × legal county	741,012,763**	−995,334	653,136,763**	501,089,391**	1,085,672*	7,398,084**	−120,853	117
	(323,369,260)	(8,193,280)	(281,331,824)	(221,192,888)	(612,830)	(3,111,552)	(230,093)	(75)
Controls					Yes			
Year FE					Yes			
Obs	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391
# of counties	58	58	58	58	58	58	58	58
R^2	0.88	0.43	0.88	0.88	0.24	0.89	0.91	0.66
Joint sig. p-val:	0.012	0.176	0.049	0.108	0.251	0.105	0.180	0.271

Note(s): (a) p-value from the joint significance test on pre-treatment effects; tests for jointly significant differences between the treated (legal) counties and untreated counties in the each pre-treatment period. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$ indicate significant differences at the 1, 5, and 10% levels, respectively. $p > 0.1$ indicates no significant difference and therefore parallel pre-treatment trends. Given the parallel trends observed in the pre-treatment period for most of these outcomes, we also estimated these results without control variables and provide them in Table A15

(b) Standard errors robust to correlation at the county level in parentheses

(c) Includes year fixed effects and time variant controls for county characteristics. Full results available in Table A6. Results of this specification run with the equivalent bank-level data are available in Table A17

(d) ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

	(1) Total assets	(2) Total liabilities	(3) Total shares and deposits	(4) Amount of loans	(5) Amount of ag loans	(6) Interest income	(7) Fee income	(8) Full-time employees
Post × legal county	368,893	332,788	188,397	299,605*	2,623	3,435	87	18
	(265,915)	(231,863)	(127,771)	(171,557)	(1,817)	(2,528)	(117)	(21)
Controls				Yes				
Year FE				Yes				
Obs	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391
# of counties	58	58	58	58	58	58	58	58
R^2	0.88	0.43	0.88	0.88	0.24	0.89	0.91	0.66
Joint sig. *p*-val:	0.392	0.401	0.213	0.181	0.152	0.313	0.114	0.052

Note(s): (a) *p*-value from the joint significance test on pre-treatment effects; tests for jointly significant differences between the treated (legal) counties and untreated counties in the each pre-treatment period. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$ indicate significant differences at the 1, 5, and 10% levels, respectively. $p > 0.1$ indicates no significant difference and therefore parallel pre-treatment trends. Given the parallel trends observed in the pre-treatment period for most of these outcomes, we also estimated these results without control variables and provide them in Table A16

(b) Standard errors robust to correlation at the county level in parentheses

(c) Includes year fixed effects and time variant controls for county characteristics. Full results available in Table A5. Results of this specification run with the equivalent bank-level data are available in Table A18

(d) ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 3.
Extensive effect of cannabis licensing on California-only banks

measure was frequently reported by interviewees as where we would see the impact of legalization, as those in the industry who had in the past kept large sums of cash in their home or business are now able to deposit them with institutions that are willing to bank cannabis. We also observe that these counties' financial institutions are making a greater amount of loans, including agricultural loans. The latter is somewhat surprising and should be interpreted with caution, as it is unlikely cannabis cultivators are securing agricultural loans for their operations. Nonetheless, these banks are earning greater interest income as well, suggesting more robust loan activity as well as the possibility of higher interest rates.

However, the same results are not present for the analogous analysis using the California-only banks. These local banks are smaller by almost any measure and are fewer in number: there are 575 banks that are headquartered in California and are therefore included in the "all banks" analysis. Of those, 87 (15%) are a California-only bank, meaning a bank that only has branches in California. As such, only 30 of California's 58 counties have a California-only bank, versus 43 for any bank. It is possible that these local banks were already banking cannabis extensively prior to the adoption of the official regulations in the first quarter of 2019.

Next we consider the intensive effect of a county's cannabis sector using the results of Equation (3). This estimation approach complements the difference-in-difference (and does not suffer from some of the same issues, such as the lack of a clear control group). The following tables show the relationship between one additional license of each type on each of our banking indicators for all banks (Table 4) and for the California-only banks (Table 5), within a particular county and year. They represent the relationship between the intensity of the cannabis sector in a county and the banking sector.

We see that the overall relationship is largely positive and is driven primarily by additional manufacturing or retail licenses rather than cultivation licenses. Cultivation licenses are much more numerous than the other types, and represent the least value-added to the product. An additional manufacturing or retail licenses, on the other hand, is associated with an increase in the sum of the total assets of a county's banks: $62m for an additional manufacturing license and $42m for a retail license. Although large in absolute terms, each is less than 0.1% of a standard deviation for this measure. The average county in our sample with manufacturing licenses has 11 such licenses; the conditional average of retail licenses is 13. As in the extensive margin analysis, the primary driver of this increase in assets is through an increase in the amount of shares and deposits. Somewhat surprisingly, we also continue to observe a positive relationship between manufacturing and retail licenses and loans, including agricultural loans. This is suggestive of a more tolerant, "do not ask, do not tell" style banking policy to which some interviewees made allusions. It also could indicate loan activity in states other than California and so unrelated to the state's cannabis industry. Another possibility, and one observed in other sectors, is that banks are able to make more loans as a result of their increased asset and deposit levels.

There is no such contamination for the subset of banks that only have branches in California. For these banks, we also see significant evidence of cannabis legalization impacting local banks. Once again, the influence comes only from additional manufacturing or retail licenses. We observe similar positive effects on asset values, through shares and deposits, but at much smaller magnitudes, which is unsurprising given the overall smaller size of these institutions. Although the magnitudes are smaller, the size of the coefficients relative to the pretreatment means is larger for the local banks than it is for those with a national presence. The $40,000 dollar increase in asset values from an additional manufacturing license represents slightly more than 1% of a standard deviation.

In addition to the more significant local impact, we see no evidence that local banks in areas with more cannabis licenses are making more agricultural loans, although the total amount of loans does increase significantly with the number of manufacturing and retail

	(1) Total assets	(2) Total liabilities	(3) Total shares and deposits	(4) Amount of loans	(5) Amount of ag loans	(6) Interest income	(7) Fee income	(8) Full-time employees
Cultivation licenses, all	98,323	−1,089	91,480	−17,148	354	−937	26	0.0076
	(433,693)	(9,230)	(389,107)	(202,991)	(674)	(2,153)	(397)	(0.053)
R^2	0.39	0.23	0.37	0.51	0.18	0.52	0.19	0.32
Manufac. licenses, all	62,274,210***	−504,935	56,205,102***	24,015,580***	67,905***	207,899**	−43,094***	1.2
	(7,083,166)	(624,484)	(6,209,156)	(5,480,745)	(10,242)	(102,162)	(1,975)	(1.1)
R^2	0.59	0.23	0.58	0.57	0.29	0.54	0.32	0.32
Retail licenses, all	42,088,024***	−1,089,832	37,236,126***	20,180,931***	82,077***	211,106**	−29,053***	0.73
	(8,841,685)	(816,547)	(7,827,353)	(5,906,300)	(13,554)	(88,323)	(4,690)	(1.4)
R^2	0.52	0.25	0.50	0.56	0.39	0.55	0.27	0.32
Controls				Yes				
County FE				Yes				
Year FE				Yes				
Obs	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391
# of counties	58	58	58	58	58	58	58	58

Note(s): (a) Standard errors robust to correlation at the county level in parentheses
(b) Each panel above represents a separate regression of the indicated licensing measure on the dependent variables. Each regression includes year, county fixed effects and time variant controls for county characteristics. Full results for panel A are available in Table A6, for panel B in Table A7, and for panel C in Table A8. Results of this specification run with the equivalent bank-level data are available in Table A18 (panel A), Table A19 (panel B), and Table A20 (panel C)
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 4.
Intensive effect of cannabis licensing on all banks, by license type

Table 5.
Intensive effect of cannabis licensing on California-only banks, by license type

	(1) Total assets	(2) Total liabilities	(3) Total shares and deposits	(4) Amount of loans	(5) Amount of ag loans	(6) Interest income	(7) Fee income	(8) Full-time employees
Cultivation licenses, all	189	185	−7.2	210	−0.11	0.81	0.046	0.0054
	(378)	(345)	(154)	(273)	(2)	(2.6)	(0.071)	(0.022)
R^2	0.27	0.26	0.23	0.29	0.04	0.34	0.05	0.13
Manufac. licenses, all	40,777***	37,352***	20,085***	26,608***	25	199***	−2.2	0.74
	(4,282)	(3,680)	(2,405)	(2,956)	(35)	(48)	(6)	(0.52)
R^2	0.48	0.49	0.45	0.49	0.04	0.39	0.06	0.14
Retail licenses, all	32,421***	29,613***	15,650***	20,391***	−2.1	222***	3.4*	0.71
	(5,196)	(4,646)	(2,292)	(3,204)	(20)	(55)	(1.9)	(0.65)
R^2	0.46	0.46	0.41	0.46	0.04	0.43	0.06	0.15
Controls					Yes			
County FE					Yes			
Year FE					Yes			
Obs	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391
# of counties	58	58	58	58	58	58	58	58

Note(s): (a) Standard errors robust to correlation at the county level in parentheses
(b) Each panel above represents a separate regression of the indicated licensing measure on the dependent variables. Each regression includes year, county fixed effects and time variant controls for county characteristics. Full results for panel A are available in Table A9, for panel B in Table A10, and for panel C in Table A11. Results of this specification run with the equivalent bank-level data are available in Table A22 (panel A), Table A23 (panel B), and Table A24 (panel C)
(c) Sample is limited to banks that only have branches in California
(d) ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

licenses. Also increasing significantly is the amount of interest income, which supports the qualitative evidence that those operating in the cannabis industry are charged higher interest rates. We also heard qualitative evidence in interviews with representatives of financial institutions that they charge those who are banking cannabis higher fees; we see a significant increase in fees associated with an increase in the number of retail licenses from local banks as well. One element of a county's financial institutions that appears uninfluenced by the cannabis licenses there is the number of workers; despite hearing from interviewees that more person-hours were needed to assist those banking cannabis with navigating regulations, we do not see that borne out in these quantitative results.

We also wanted to explore differences across production types. First, using quantitative data, we examine whether the results discussed above are driven by a particular type of cannabis production. We are able to observe the number of licenses for the three primary production types: outdoor, indoor, and mixed-light. Indoor is the most controlled production method and is associated with the highest production costs, while outdoor growers give up control over factors of production in exchange for cost savings. Mixed-light falls somewhere between indoor and outdoor, both in terms of cost and level of control. Indoor production is most prevalent in the urban counties, particularly Los Angeles County, while production in the Emerald Triangle is characterized by an almost even mix of outdoor and mixed-light, with very little indoor production.

When the cultivation licenses are disaggregated by production type, we see that there is a significant relationship only between indoor licenses and the bank measures from all banks headquartered in California (Table 6). This relationship is likely picking up, to some extent, the fact that the high-cost and high-yield indoor production method is an urban phenomenon, and national banks are more likely to be headquartered in urban areas. Nonetheless, these specifications include county fixed effects, which will absorb the impact of the overall urbanity of a county. As such, an increase in the number of indoor cultivation licenses within a county and year is associated with a significantly greater level of bank assets, primarily driven by increased shares and deposits. In addition, these banks make significantly more loans, including agricultural loans, and make more income from interest payments.

The relationship between the kinds of cultivation licenses and the bank measures for only the local California banks is slightly more balanced across types of production (Table 7). While the majority of the relationship is again driven by indoor licenses, there is also a positive and significant relationship between the number of outdoor licenses in a county-quarter and the assets held by banks in the county, as well as the amount of loans and the amount of interest income earned by those banks. Unlike in any other specification, we see a positive and significant relationship between the number of indoor and the number of outdoor licenses on the amount of liabilities for these local banks; this suggests that local financial institutions are more likely to take on risk in response to growth in the county's cannabis industry. Indeed, much of our qualitative evidence points to local institutions, particularly credit unions, as those most willing to blaze the trail in terms of banking cannabis. Interestingly, in a result that needs more unpacking, there is a significant negative relationship between the number of mixed-light licenses and many of our dependent variables, including total assets, total liabilities, and loans.

Barriers posed by banking regulations and cannabis stakeholder response

While our quantitative results discussed above suggest that conventional financial institutions are benefiting from state-level cannabis legalization and active in the industry, our qualitative data collection highlighted several key themes related to barriers posed by federal banking regulations. First, cannabis businesses are severely underbanked and largely still operate on a cash basis, although this varies across business type. Second, financial institutions face high costs or high risk, or some of both, when engaging with

Table 6.
Intensive effect of cannabis licensing on all banks, by production type

	(1) Total assets	(2) Total liabilities	(3) Total shares and deposits	(4) Amount of loans	(5) Amount of ag loans	(6) Interest income	(7) Fee income	(8) Full-time employees
Indoor	40,328,178*** (4,203,864)	−644,665 (615,414)	36,272,193*** (3,851,716)	16,675,429*** (2,541,303)	54,324*** (11,273)	151,911*** (50,056)	−30,084*** (1,379)	0.73 (0.88)
Outdoor	784,216 (904,935)	−10,412 (9,472)	743,181 (785,525)	443,456 (507,339)	2,212** (1,009)	5,187 (5,724)	−758* (380)	0.14* (0.078)
Mixed-light	−1,839,577 (1,211,223)	27,962 (20,743)	−1,683,953 (1,051,285)	−981,001 (644,641)	−3,019** (1,161)	−11,547 (7,642)	1,753*** (271)	−0.13 (0.098)
County-level controls				Yes				
County FE				Yes				
Year FE				Yes				
Obs	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391
# of counties	58	58	58	58	58	58	58	58
R^2	0.54	0.24	0.53	0.56	0.30	0.54	0.30	0.32

Note(s): Standard errors robust to correlation at the county level in parentheses
Regression includes year, county fixed effects and time variant controls for county characteristics. Treatment variable is the number of licenses of each type in a county-quarter. Full results are available in Table A12. Results of this specification run with the equivalent bank-level data are available in Table A25
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

	(1) Total assets	(2) Total liabilities	(3) Total shares and deposits	(4) Amount of loans	(5) Amount of ag loans	(6) Interest income	(7) Fee income	(8) Full-time employees
Indoor	31,624*** (4,181)	28,682*** (3,558)	15,642*** (2,145)	21,070*** (3,191)	29 (36)	186*** (51)	0.051 (3)	0.63 (0.47)
Outdoor	1,564*** (664)	1,465*** (600)	480 (321)	1,247*** (461)	4.1 (5)	11** (5)	0.012 (0.11)	0.077* (0.046)
Mixed-light	−2,069*** (572)	−1,890*** (514)	−961** (363)	−1,395*** (350)	−4.8 (3.1)	−15*** (4.4)	0.09 (0.16)	−0.077** (0.031)
County-level controls				Yes				
County FE				Yes				
Year FE				Yes				
Obs	1,391	1,391	1,391	1,391	1,391	1,391	1,391	1,391
# of counties	58	58	58	58	58	58	58	58
R^2	0.51	0.51	0.48	0.53	0.04	0.43	0.05	0.15

Note(s): Standard errors robust to correlation at the county level in parentheses
Regression includes year, county fixed effects and time variant controls for county characteristics. Treatment variable is the number of licenses of each type in a county-quarter. Full results are available in Table A13. Results of this specification run with the equivalent bank-level data are available in Table A26
Sample is limited to banks that only have branches in California
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 7.
Intensive effect of cannabis licensing on California-only banks, by production type

cannabis businesses, and pass these costs on to cannabis businesses. Third, cannabis businesses appear to be accessing loans and financial services through nontraditional means and informal arrangements. Finally, some banks are not knowingly lending to or banking cannabis farmers, but there is a "do not ask, do not tell" among others.

A key theme across all our grower interviews was the continued presence of a cash economy despite the industry's transition to legalization. When asked about banking, one grower replied, "Well, we do not have a bank. Our bank is in the ground." Growers we spoke to reported burying their money, putting it in a "secure location" other than a bank or literally stuffing it under a mattress or in the sofa cushions. Some reported that they did have bank accounts but that those accounts were shut down by the bank once the bank realized they were in the cannabis industry. Along with cash, one grower mentioned using money orders and peer-to-peer mobile payment apps for transactions. We also spoke with several distributors. Both reported using banks; one distributor indicated the bank did not know they were in the cannabis business, while the other indicated they were "out" to their bank about their involvement in the industry. That said, one of the distributors reported they still do 80% of their business in cash. One of the distributors also reported having trouble finding banking for their employees; indeed, one financial institution with a presence in the region just recently started banking cannabis business employees as their first foray into this industry.

Largely our grower interviewees did not differentiate between indoor, mixed light and outdoor production methods or medicinal and recreational marketing channels. However, our grower interviewees, who predominately have small operations, did suggest that financing challenges may differ across farm size. These small farmers we interviewed reported they feel that regulations are stacked against them. While on the outside, it would appear that the passage of Proposition 64 represents a loosening of restrictions on cannabis, for small cultivators who previously provided medicinal cannabis to medical card holders through cooperatives and collectives, the regulations enacted following passage appear to have increased the regulatory burdens they face. Whereas prior to the passage of Proposition 64 small farmers were able to sell medical marijuana directly to consumers who had the appropriate card indicating permission for use, after passage smaller farmers were required to sell their product through distributors [14]. Smaller farmers also reported challenges with the federal tax code, as they are not able to write off expenses for their business other than possibly the Cost of Goods Sold, as discussed earlier.

Without access to even the most basic financial services, growers we spoke with indicated drawing on savings or seeking informal arrangements to access credit. Some reported seeking loans from friends and acquaintances. While this sounds like it would be a relatively limited resource, in a region with a large cash economy, these informal arrangements could be substantial. One grower reported that their family collectively raised $4–5m among themselves to fund their operations. One distributor we interviewed observed, "it's [. . .] mostly people that [. . .] have cash and they need somewhere to park it." The interviews with financial institution representatives largely corroborate these results that most banks and credit unions are not knowingly banking cannabis. Of the banks we contacted for an interview, only 17% were knowingly involved in the cannabis industry. In addition, one bank declined to be interviewed, citing the illegality of cannabis at the federal level. As noted earlier, one of the substantial barriers for banks is the continued fear of federal prosecution for money laundering under the Bank Secrecy Act (BSA), a likely reason for these reactions. Along with the BSA, there is another hurdle associated with federal regulation that banks described – the possibility of asset forfeiture. In order to provide agricultural loans or other loans to cannabis growers and other cannabis businesses, the banks want to have some assurances about the assets of the borrower. This concern of banks has less to do with the BSA, as the concern is not that the *bank* will be prosecuted for money laundering but rather

that the *grower* could be prosecuted for their activities (illegal under federal law even if all state laws are followed to the letter), and this would prevent the grower from being able to pay back the bank and the illegal nature of the product would prevent the bank from seizing the assets of the grower. For these reasons, even those California financial institutions that report banking cannabis businesses indicate they do not provide *loans* to cannabis businesses, and so growers must be seeking their loans elsewhere. In addition, even nontraditional lenders require growers to have a bank account in which to deposit the loan money, another barrier for businesses seeking loans.

There are, however, a few financial institutions we spoke with whom have chosen to be more involved in the industry. One financial institution, a credit union, indicated they participate in the industry to support their community and owners (and their own existence, given the economic importance of cannabis in the region). This community orientation is not surprising for a credit union, which is owned by its members and may act more quickly than other banks to adapt to member needs. The same credit union indicated they saw this shift to legalization as inevitable and considered the amount of cash being moved through these businesses a "public safety issue." Indeed, Kelly and Formosa (2020) find that cannabis production is economically and culturally important for residents in the Emerald Triangle's Humboldt County and suggest this relationship of cannabis production to rural economies, particularly in this region, is underappreciated. A representative from another financial institution that we interviewed outside of California discussed nontraditional loan arrangements they used to mitigate risk. They indicated their "ideal opportunity" would be providing a loan to a dispensary for a multi-tenant commercial property (e.g. a strip mall), where only one of the spaces would be used for the dispensary and the rest would be used for low-risk commercial retailers (CVS or Jiffy Lube were given as examples). This would provide rental income for the cannabis business, plus the presence of the other retailers as well as the collateral provided by the building would reduce risk for the lender.

These banks that are willing to publicly participate in the industry claim to follow the 2014 FinCEN guidance. These costs present a challenge for both the banks and the cannabis businesses that bank with them. For the banks, the FinCEN guidelines require banks to only work with growers who meet all state legal requirements, putting the burden on banks to do due diligence not only related to licenses but related to tracking all product. One financial institution indicated that the costs and obligations associated with meeting these requirements made them wary of getting into cannabis banking. Another financial institution indicated they were working with a California company to track all products using blockchain technology, were integrated with state licensing systems and partnered with an armored car service to move large sums of money directly to the Federal Reserve Bank of San Francisco. Not only does engaging in these activities increase costs for the banks, but it also requires more personnel, another cost. It should come as no surprise that banks pass these costs on to growers. Growers we interviewed report paying fees ranging from $200–$3,000 per month for bank accounts, which they found to be cost prohibitive. One distributor indicated they did not have the same problem paying the higher fees. One grower commented on the relative ease of doing business when they did have a bank account for a short period.

The importance of tracking product closely mentioned by one of the banks is apparent when one recalls the large size of the unlicensed market in California. One bank representative we spoke with expressed concern that licensed, legal activities done with the help of the banks' financial services could be used by an operation to support or engage in unlicensed activities that were also part of their operation, increasing risk for the lender. This remark highlights the importance of the estimate, discussed earlier, that approximately 80% of cannabis produced in California is exported outside of the state. This reality means that banks must either participate in the industry without following FinCEN guidelines (high risk)

or take care to only bank cannabis businesses engaged in activities legal at the state level in California (high cost).

While we cannot draw any overall conclusions from these various statements about the behavior of the average bank or bank manager in this space across the state, our interviews do indicate there is substantial heterogeneity in financial institutions' attitudes toward risk related to cannabis and their activities in this space. Furthermore, together with all these barriers (both barriers to become licensed for businesses and barriers to banking facing both businesses and financial institutions), it should be no surprise that a vast swath of the industry remains unbanked or underbanked.

Although no growers we spoke with used "hard money-backed loans," multiple interviewees spoke about the presence of these lenders as an option, and one grower indicated their lender asked them to sign a nondisclosure agreement, which may be indicative of a hard money-backed loan. Hard money-backed lenders are those that offer loans secured by collateral (e.g. property) and do not base their loans on the creditworthiness of the operation. They generally offer worse loan terms for individuals (e.g. higher interest rates and shorter payoff periods) than conventional loans and they are high risk for the grower or other borrower because they require quick repayment and leave little recourse if the grower cannot payback the loan due to unforeseen circumstances. However, one distributor we interviewed indicated that hard money-backed loans seemed to be more prevalent in the past (four or five years ago). Given the shift toward legalization, more private investors (both individuals and institutions) are participating in this market. A representative of a financial services firm that we interviewed suggested that cannabis lending is either treated as a regular deal and cannabis is ignored, or the cannabis aspect is fully embraced and the lender can charge more for the risk.

The presence of these nontraditional lenders offering other types of loans is no secret in the cannabis industry. A web search provides examples of some of the companies operating publicly in this space. Founded in 2018, Los Angeles, CA-based Bespoke Financial bills itself as "the first licensed commercial lender focused on the cannabis industry" and offers invoice and inventory financing for cultivators (Bespoke Financial, 2021). Boulder, CO-based Dynamic Alternative Finance offers real estate loans, working capital loans, equipment leases, bridge loans, and tenant improvements (Dynamic Alternative Finance, 2021). They advertise real estate loan (fixed) interest rates starting at a minimum of 8.9% (Real Estate, 2021). A representative of an industry financial services firm we interviewed suggested interest rates for loans were often in the range of 12–18%. Compare these to the current US bank prime loan rate of 3.25% on which banks base their short-term commercial interest rates (FRED, 2021a). West Hollywood, CA-based venture capital firm Casa Verde Capital touts relationships with a variety of cannabis businesses, including Bespoke Financial, but stays mum about how the financing process works (Casa Verde Capital, 2021). Lender420 (location not disclosed publicly) offers unsecured capital loans, real estate loans, and equipment loans (Lender42, 2021). New Vista Financing claims to have provided $2bn in loans to cannabis industry businesses to date (New Vista Financing, 2021). Guttery and Poe (2018) highlighted the role of Real Estate Investment Trusts as possible sources of capital for marijuana businesses. Indeed, examples of businesses with this structure include Inception REIT and NewLake Capital Partners (Inception REIT, 2021; NewLake Capital Partners, 2021).

Finally, while most banks report not knowingly banking or lending to cannabis businesses, both growers and distributors utilizing banking services at various times described methods that they use to try to avoid detection as cannabis businesses in their banking activities. Several interviewees also provided indications that some banks are willing to look the other way. One interviewee called it a "do not ask, do not tell" culture.

Interestingly, our qualitative results, which suggest financial institutions are not very active in the cannabis industry, do not fully square with the results of the quantitative analysis, which suggest that banks are seeing a substantial increase in assets and other key indicators post legalization. However, this contradiction could suggest a few things. First, banks may be engaging in the cannabis industry more than they realize or let on in interviews. Second, banks may not be engaging in the cannabis industry, but the local economy may be seeing substantial positive spillover effects from the industry, leading to higher assets among non-cannabis businesses who bank with California-based financial institutions (although we do control for county GDP, which should be a good indicator of legal economic activity). This is an important area for future study, as it could suggest a key role for cannabis in community economic development. Finally, our small sample interviewed as part of qualitative data collection may well not be representative of the industry. Indeed, a financial broker outside of California indicated they thought these concerns were overblown: "despite the popular notion that cannabis businesses deal in all cash and they can't get access to bank accounts that's not actually accurate and what's even also another inaccuracy is that cannabis businesses are unable to get bank loans. Now, they're not very prevalent, but for the right people, with the right connections, they can go ahead and get loans from banks, as long as their bank-credit worthy, which means you've got to be a very strong borrower with all of the things that a bank wants." That said, these comments highlight the challenges for small businesses in this sector, particularly those legacy growers who have previously operated illegally and have limited credit history. Largely our results suggest there remain substantial barriers when it comes to banking in the cannabis industry.

Policy implications

Our final research question asks, if banking and/or cannabis regulations were eased, what are some of the possible outcomes for cannabis industry stakeholders, the banking sector, and nontraditional lenders? First, we expect that the impacts of cannabis business activity have not been fully realized by the banking sector, because although the quantitative results of our work demonstrate that legalization alone is having a significant impact on the banking sector, our qualitative work suggests substantial barriers to banking remain for cannabis businesses. However, as we have yet to observe the easing of any such banking regulations, we are limited in our ability to provide realistic and defensible *numerical* estimates for what would occur in any of these sectors if money earned from cannabis-related businesses were to be banked freely. The unmet need for banking services, particularly around depositing cash, suggests that moving the cannabis industry from cash-only or the current gray area of limited banking access would positively affect banks' loan volumes and profitability (Lee and Hsieh, 2013). Thus, removing the barriers that are preventing financial institutions from meeting this unmet need would increase the total volume of deposits and assets at these institutions.

In addition, there may be distributional benefits, as the removal of these financial barriers could protect smaller or more risk-averse financial institutions from the risks and costs currently associated with banking cannabis. There would also be risk reduction on the demand side, as growers would see less risk with their money in the bank, allowing them more security in transactions, and allowing them to earn low-risk interest. There appears to be mixed evidence in the literature about the impact of providing banking services to those who are unbanked, like some of our interviewees. Literature focused more on the demand side (low demand for financial services combined with access) seems to show minimal impacts (e.g. Dupas *et al.*, 2018; Washington, 2006), whereas literature that focuses more on the supply side (changes in banking regulations that impact access) show more of an effect (e.g. Célerier and Matray, 2019). Our situation is more in line with the latter and supports the idea that growers would benefit.

However, it seems unlikely that the lending environment will change with an ease in federal banking regulations without additional provisions or creative problem-solving, as banks are currently more concerned about asset forfeiture than they are about the BSA when it comes to lending to cannabis operations or businesses. As long as cannabis remains heavily regulated at the federal level, assets associated with any cannabis business (licensed or unlicensed), which are usually used as loan collateral in other industries, are at risk of federal seizure. It is likely that, given current trends, legalization of recreational cannabis (either nationally or state-by-state) will be the first regulatory domino to fall. This would in turn clear the way for the protection of cannabis-related assets used as collateral for loans.

Thus, perhaps the most pressing question is what would happen if cannabis were no longer classified as a controlled substance or was moved to a less restrictive schedule of the Controlled Substances Act at the federal level. This would essentially solve the banking problems, as the BSA would no longer be relevant if cannabis were a legal crop around the USA. However, a cascading set of events would likely occur following widespread legalization; these would upend the industry in California and elsewhere far more than any single change in banking regulations. Loosening of federal restrictions on cannabis would pave the way for legal interstate commerce of cannabis, opening a pathway to legal "export" for the portion of the California industry that currently markets unlicensed product out of state. An entirely new regulatory framework would need to be put in place at the federal level, which may or may not align with current state regulations in the states where cannabis is legal in some form, especially as the current state level policies in these states are not all fully aligned with each other. In addition, legalization would likely have far-reaching effects in terms of new market entry, as has already been observed in California, as well as general equilibrium effects. Enterprising financial institutions and nontraditional lenders may be able to make short-term profits and enterprising cannabis business owners may find ways to differentiate and brand their product, but the long-term outlook is significantly more ambiguous for all industry participants as it opens to a wider array of participants. For instance, a substantial increase in the supply of legal cannabis, if it exceeded the pent-up demand for legal cannabis, could lead to lower cannabis prices, to the detriment of all cannabis farmers. This, in turn, would lead to the potential dissipation over time of the positive impact of legalization on banks' assets, deposits, and loan volume. Thus, the overall impact on financial institutions or even on cannabis businesses from federal cannabis deregulation is well outside the scope of this paper, as this simple discussion suggests, the industry would almost surely be transformed.

Conclusion

This research suggests a variety of important research avenues moving forward, especially if the current trends of more widespread legalization continue. There is a pronounced need for banking regulations to keep pace with these policies; this requires assurance for banks that they can safely bank and even fund cannabis-related operations. Previous guidance in this area was not adequate, and it remains an open question whether the SAFE Banking Act will be sufficient. Some studies, particularly in law journals, highlight the possibility for regulations moving forward, as well as other models for firms in the intervening period of uncertainty. For example, Greenbaum (2019) suggests that modeling the rules for cannabis businesses after the treatment of casinos (classified as "financial institutions" under the BSA) would allow the federal government to address concerns about money laundering in these businesses [15]. Sater (2019) suggests closed-loop payment systems (e.g. PayPal) as an options for businesses (indeed these types of services were in use by some interviewees) and have explored the idea of using cryptocurrencies for payment.

There are important outstanding questions on the demand side around what determines demand for credit among cannabis farmers and businesses overall, and what drives different businesses to pursue different sources of funding. There are also implications for equitable access to credit if certain growers or businesses are more likely to secure equity-funded, rather than debt-funded, credit. Many industry stakeholders, including growers themselves, have voiced concerned about how cost prohibitive the legal industry remains for growers. This is especially true for small and legacy growers, who share the production space with start-ups and larger, investor-backed businesses. Thus, another open question or area for future research is understanding the kinds of investment and policies that enhance community economic development. For example, based on community interviews in Humboldt County, Everett (2018) suggests a combination of further legalization to continue to disincentivize black market production and investment in National Forests to support environmental restoration in those areas.

In this work, we use mixed methods analysis to examine the relationship between the cannabis and financial sectors in California. While our quantitative results suggest that the economic importance of the crop to the state's economy, we encountered hesitation on the part of banks and other financial institutions to discuss their cannabis-related activities or policies. We also consistently heard concerns from growers about their inability to access credit as well as the most basic financial services available to most businesses. These diverging narratives highlight the difficulties that arise from conflicting and contradictory levels of legality in the industry. Overall, the industry is characterized by significant frictions in terms of banking and credit access; a uniform set of standards around banking cannabis, particularly at the national level, would reduce these frictions. Tension would remain, as certain operations may be better positioned to take advantage of different sources of credit. As with credit access for "traditional" crops and activities, smaller farms and cannabis businesses are at a disadvantage. Unlike in the more traditional agricultural credit space, however, it is new entrants, rather than the legacy growers, who are better equipped to navigate the gray areas and secure access to funding, non-traditional or otherwise, for their operations. Thus, even for this nontraditional crop, the fundamental financing story remains the same: those demanding credit and financial services want equitable, affordable, and convenient access to them, and those supplying credit and financial services want to ensure sufficient insulation from the risks associated with banking these customers.

Notes

1. Following the definition of Wartenberg *et al.* (2021) and in the 2018 Farm Bill, we use the term "cannabis" to describe genus *Cannabis* (subspecies "indica" or "sativa") with a dry weight delta-9-tetrahydrocannabinol (THC) concentration $> 0.3\%$, colloquially called "pot" or "weed", and the term "hemp" to describe the same plant but with a dry weight THC concentration $\leq 0.3\%$ (Agriculture Improvement Act of 2018). Cannabis is also commonly referred to as marijuana, a name with Mexican origins (Campos, 2012).
2. Links to many of these ordinances are available from the California State Association of Counties (https://www.counties.org/county-cannabis-ordinances) and California League of Cities (https://www.cacities.org/Policy-Advocacy/Hot-Issues/Cannabis).
3. Mixed light operations refer to greenhouse operations with "mixed" controlled and natural lighting, temperature, and humidity to increase yield efficiency and extend the growing season. Whereas outdoor growers can typically only produce one crop per year, mixed light and indoor operations (even more controlled than mixed light) can harvest multiple crops per year, increasing both their costs and revenue.
4. Childs and Stevens (2019, 2021) suggest that the current tax structure is sub-optimal as it leads to a higher price of cannabis for consumers, causing illicit cannabis to become relatively cheaper.

Because this illicit cannabis has comparable production costs and higher externalities (e.g. criminal justice costs and public health costs), while cannabis taxes may yield revenue for the state and municipalities, they are not welfare-enhancing. This result is without consideration of environmental externalities associated with illicit production, which are recognized in the literature to be substantial. Likewise, in their study of marijuana taxation in Washington state, Mace *et al.* (2020) find that whether consumers or producers bear more of these taxes depends on the nature of competition in the cannabis market. Importantly they also find the deadweight loss of these taxes can be substantial. While taxation is important and interesting in this context, further discussion is outside the scope of this paper and will be left for future research.

5. Although the data are public through this license search, we obtained the county of the operation via an e-mail request to CalCannabis.
6. Since these data were obtained, the governing agency for cannabis in California has gone through a restructuring and is now called the Department of Cannabis Control.
7. In the retail license data, locations are only provided for retail storefronts, so those are the only retailers we include. Thus, non-storefront retailer, distributor, microbusiness (a business with less than 10,000 square feet of cultivation area, which can also act as an integrated distributor, Level 1 manufacturer, and retailer), testing center, and event organizer license types are not included in the analysis.
8. Table A1 in Appendix 1 shows the total licenses, by type, for each quarter.
9. The variables in this data set are measured in dollars and standardized to 2012 dollars.
10. The bank and credit union call data do not disaggregate these variables by branch location.
11. While we considered reporting estimates at the bank-level, we ultimately decided not to for two reasons. First, all controls and variables of interest are measured at the county level. Second, the county-level results are also more directly relevant to policymakers in local government, which is the level at which the decision to legalize cannabis operations is made. For robustness, however, we include the equivalent bank-level results for each of our specifications in Appendix 2.
12. Given this support for our parallel trends assumption, we also run a version of our difference-in-differences specification without control variables; we present the results of this specification in Table A15 for all banks and Table A16 for the California-only banks in Appendix 2.
13. In addition, results showing the estimation of the year-specific effects from equation (2) are available in Appendix 2, Table A14.
14. Indeed, when we looked at whether there was an effect of cultivation licenses when disaggregated by medicinal versus recreational, we found no significant results. This indicates that in the post-legalization period, when both uses were equally permissible, there is no difference between these license types. Instead, the much more salient difference is now in terms of production method, which proxies for both grower involvement and production cost. As such, these are the results we report.
15. While the SAFE Banking Act, if passed, would no longer allow for prosecution of banks under the BSA, it does not address the issue of money laundering that might occur within cannabis businesses themselves, as much of the industry remains illicit.

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Appendix

The Appendix file is available online for this article.

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