As dry as a bone: how do banks cope with droughts?*

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Abstract

This study investigates the impact of severe droughts on U.S. commercial banks' agricultural lending from 2000 to 2020. Our results reveal that banks significantly reduced new lending to small farms during drought periods, with the sharpest declines occurring before the introduction of federal aid programs in 2012. Following the 2012 reforms, which provided targeted support for drought-affected areas, the contraction in agricultural lending was partially mitigated, but new credit growth remained constrained. We also find that drought-exposed banks contracted their agricultural loan portfolios more substantially in non-irrigated regions, whereas lending was more resilient in areas with irrigation infrastructure. Single-state and single-county banks exhibited deeper reductions in agricultural lending compared to multi-state and multi-county banks. While the federal aid programs helped stabilize lending in designated drought-affected areas post-2012, they did not fully counterbalance the broader decline in credit supply. Concurrently, we observe that banks in drought-affected regions increased their deposit holdings, indicative of liquidity hoarding behavior driven by precautionary motives. This behavior was especially pronounced among single-state and single-county banks, which tend to have closer ties to their local communities. However, the increased deposits did not translate into heightened lending activity; instead, much of the surplus liquidity was directed into the interbank market.

Keywords: Natural disasters, drought, banks, lending, deposits, agriculture, government assistance
JEL: G21, G28, Q54

*We thank Azizjon Alimov, Barbara Casu, Maxime Fajeau, Aneta Hryckiewicz, Alberto Pozzolo, Laurent Weill, and the participants of LEM Day, Lille; GdRE Conference in Lille; IFABS Conference in Oxford; the Community Banking Research Conference in Saint Louis; FMA Meeting in Chicago; AEFIN Finance Forum in Laguna for their helpful comments and suggestions.
We acknowledge support from the National Science Centre, Poland, research grant no. 2018/29/B/HS4/00594.

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1. Introduction

Intensive droughts have increasingly affected populations, leading to severe economic and social consequences (Wilhite and Hayes, 1998). According to the National Centers for Environmental Information, droughts rank as the second most costly natural disaster in the United States (US), with an average cost of $11.7 billion per event.[1] Over the past two decades, the frequency and severity of droughts in the US have escalated, further amplifying their economic impacts (Easterling et al., 2000). Smith and Katz (2013) documented 133 natural disaster events in the US between 1980 and 2011 that exceeded the billion-dollar loss threshold, including 16 droughts or heatwaves, resulting in total damages of approximately $210 billion.

Recognizing these risks, the Financial Stability Oversight Council (FSOC) identified climate change as a substantial threat to U.S. financial stability.[2] In its 2021 report, FSOC differentiates between physical risks, such as direct climatic events like wildfires and droughts, and transition risks arising from policy shifts toward a low-carbon economy. Against this backdrop, our research explores commercial banks' exposure to these physical risks by analyzing how drought conditions influence their deposit-taking behaviors and lending, especially within the agricultural sector.

Given the critical role of agriculture in the U.S. economy, which accounted for 5.6% of U.S. GDP in 2023,[3] the growing economic tolls of droughts have heightened their importance in the field of agricultural economics. Numerous studies, including those by Kuwayama et al. (2019), Cui (2020), and Lobell et al. (2014), have examined the effects of drought on agricultural outputs—representing about 0.7% of GDP in 2023—such as crop and maize yields in the U.S. In the banking literature, extensive research also exists on the impacts of climate-related events like floods (Koetter et al., 2020), hurricanes (Schüwer et al., 2019; Massa and Zhang, 2021), and natural disasters more broadly (Barth, Miller, Sun and Zhang, 2022; Barth, Hu, Sickles, Sun and Yu, 2022). However, the specific effects of droughts on the behavior of national and local commercial

[1]The National Oceanic and Atmospheric Administration's National Centers for Environmental Information provides data on aggregated loss perspectives for major weather and climate events in the US since 1980.

[2]https://home.treasury.gov/system/files/261/FSOC-Climate-Report.pdf

[3]For detailed information on the contributions of agriculture, food, and related industries to the U.S. economy, see U.S. Department of Agriculture Economic Research Service's data on "Ag and Food Sectors and the Economy" at `https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy/`.

banks—particularly their lending practices—remain largely unexplored. This study addresses the gap by examining how drought conditions influence banks' lending to the agricultural sector in the U.S. from 2000 to 2020. We hypothesize that the impact of drought on lending practices varies by bank type, with local banks potentially being more responsive to drought conditions due to their reliance on 'soft' information and closer community ties.

Access to finance is essential for stabilizing economies during natural disasters. Noy (2009) demonstrate that countries with well-developed credit markets are more resilient to economic disruptions. In agriculture, Rajan and Ramcharan (2023) show that in the 1950s U.S. farmers in drought-prone areas relied on bank credit to adopt irrigation technologies like center-pivot systems, improving access to groundwater and enhancing resilience. Later studies confirm that regions with irrigation infrastructure are less vulnerable to drought-induced agricultural losses, demonstrating the enduring benefits of such investments (Kuwayama et al., 2019).

The benefits of such investments shows Kuwayama et al. (2019), who find that drought has a much smaller effect on agricultural output in irrigated regions. While drought reduces agricultural output, Kuwayama et al. (2019) report no significant effects on cash receipts or production expenses in these areas, attributing this stability to price increases driven by scarcity. However, these price surges may exacerbate drought's broader economic effects, particularly on the food industry (Hong et al., 2019), amplifying financial pressures in agriculture and increasing demand for agricultural credit.

Reflecting this possibility, Scott et al. (2022) demonstrate a counter-cyclical relationship between farm income and credit demand, with agricultural credit demand tending to increase as farm incomes decline due to adverse conditions. This relationship aligns with established findings on income and investment smoothing within agriculture (Whitaker, 2009) and the inverse relationship between income levels and credit usage (Prager et al., 2018). Consequently, we expect that demand for agricultural loans may rise during droughts, particularly in regions with incomplete disaster insurance coverage (Froot, 2001).

However, the existing literature suggests that, at times, farmers cannot borrow as much as they need Turvey and Weersink (1997). Credit rationing may limit their ability to accumulate capital, which can suppress overall farm output (Briggeman et al., 2009). According to Blancard et al. (2006), barriers to credit access can arise from the relatively small size of most farms, collateral limitations, and significant delays between purchasing inputs and selling outputs. These challenges tend to worsen during drought periods, as farmers' income sources are generally less diversified, and their financial positions less transparent than those of larger, more diversified firms. Additionally, after natural disasters, credit markets often experience intensified problems with asymmetric information, as borrowers struggle to provide viable collateral and face job uncertainty. This situation is especially problematic in agriculture, where most commercial bank loans are collateral-based (Federal Reserve Bank of Kansas City, 2021).

These barriers, however, present an opportunity where local banks may be more affected by drought conditions than larger banks. Local banks, being closer to the communities they serve, can combine 'hard' financial data with 'soft' information—such as personal knowledge of a borrower's reputation and history—gained from ongoing relationships within the local economy. This advantage allows local banks to better screen and monitor borrowers, reduce the costs associated with lending processes, and support relationship-based lending more effectively (Petersen and Rajan, 1994). Consequently, local banks may play a crucial role in alleviating credit constraints during drought periods by being better positioned to extend credit to affected farmers and businesses within their communities (Degryse and Van Cayseele, 2000; Elsas, 2005). Research indicates that agricultural lending is even more localized than small business lending (Rajan and Ramcharan, 2023), which reinforces the hypothesis that lending responses during drought may differ between local and national banks, with local banks likely being more affected by drought conditions in particular in their agricultural lending activities.

To test this hypothesis, our study examines the lending and deposit activities of banks with varying geographic scopes in counties affected by drought over the 2000–2020 period. We measure drought exposure using data from the U.S. Drought Monitor (USDM), which publishes weekly maps on drought severity, categorizing conditions based on precipitation, soil moisture, and other indicators. Using USDM data, we construct an annual bank-level drought exposure index based on the duration and intensity of drought in areas surrounding branch networks. This measure enables an analysis of how varying levels of drought exposure impact banks' lending and deposit activities over time.

Our analysis reveals key insights into the effects of drought on bank lending behavior, particularly in relation to agricultural production. While natural disasters generally lead to higher credit demand for recovery and rebuilding (Cortés and Strahan, 2017), our findings suggest that overall bank lending remains relatively stable during drought periods, with some notable exceptions. Specifically, we observe a decline in agricultural lending across various bank types during droughts, particularly before the 2012 policy reforms. This includes a marked reduction in new loans to agricultural production and small farms, though this trend stabilizes following the reforms. At the same time, we find an increase in the volume of loans secured by farmland, potentially indicating a shift from unsecured to secured lending as banks seek to mitigate risk under drought conditions.

A more nuanced picture emerges when accounting for the role of irrigation. The negative impact of droughts on lending is more pronounced in dryland counties compared to irrigated ones. We find that lending reductions during drought are larger in dryland counties, suggesting that banks perceive greater risks in these areas. This finding aligns with Kuwayama et al. (2019), who report that irrigation mitigates the adverse effects of drought on crop yields, providing additional resilience in irrigated regions.

Differentiated behavior among single-county banks further supports this view. In dryland counties, single-county banks exhibit a limited response to drought conditions, likely reflecting a cautious lending approach informed by their knowledge of local risks. Conversely, single-county banks in irrigated regions are more likely to extend credit during droughts, as shown by positive coefficients in Panels A and B. This suggests that these banks view irrigated areas as more resilient, given the stabilizing role of irrigation on agricultural output.

Post-2012 findings reinforce this pattern. Only single-county banks increased lending in irrigated areas following the policy reforms, with no such expansion observed in dryland counties. Interestingly, these reforms do not appear to have significantly mitigated the negative effects of drought on lending by single-state banks. This suggests that the reforms primarily benefited local banks in irrigated regions, where the perceived risks of lending during droughts were lower. Meanwhile, banks with broader geographic exposure continued to reduce lending, especially in areas where agricultural production remained vulnerable to drought conditions.

These findings support Kuwayama et al. (2019)'s emphasis on monitoring drought conditions through the USDM to guide agricultural and disaster assistance programs. Our study underscores the essential role of bank lending in supporting economic resilience, demonstrating that access to credit varies according to geographic conditions and the presence of agricultural infrastructure, such as irrigation.

Beyond agricultural lending, our study also examines the broader impact of drought on small business and household lending, given our finding that banks generally do not alter overall lending levels in response to drought conditions. We find that lending to small businesses tends to decline during droughts, likely due to banks taking a more precautionary stance in response to heightened uncertainty and asymmetric information associated with natural disasters (Berg and Schrader, 2012; Stephane, 2021). In contrast, lending volumes for commercial and industrial ventures remain relatively stable, and general real estate lending shows minimal sensitivity to drought conditions. These results highlight the sectoral variations in banks' responses to drought, with agricultural and small business lending being more vulnerable to climate-induced economic pressures.

Our analysis additionally sheds light on the effects of drought on bank deposit growth and pricing—an area where few studies have examined climate impacts. We find that deposits tend to increase at single-county and single-state banks during droughts, suggesting that local banks play a key role in supporting regional liquidity. This increase in deposits may reflect both precautionary savings behavior among depositors in drought-affected areas and active competition among banks for liquidity, as indicated by elevated deposit rates prior to 2012. Our results suggest that drought-affected banks strategically adjusted deposit rates to attract funds, aligning with previous findings on liquidity hoarding during economic uncertainty (Berger et al., 2022). However, post-2012 reforms led to more stable deposit behavior, with less reliance on competitive rate adjustments, suggesting that federal support reduced the need for aggressive deposit rate setting during drought periods.

To the best of our knowledge, our study is the first to investigate the effects of drought on the lending and deposit dynamics across different types of commercial banks in the US. This focus fills a significant gap in existing literature, providing a deeper understanding of how droughts influence credit availability in local economies. While previous research has concentrated on the impact of droughts on agricultural productivity and farm investments Hong et al. (2019); Kuwayama et al. (2019); Rajan and Ramcharan (2023), our study extends the analysis to the financial sector, revealing how commercial banks, taking into account they geographic diversification, adapt their lending practices in response to climatic risks.

Moreover, our findings confirm the critical role that irrigation plays in mitigating the adverse effects of drought on agricultural lending. As highlighted by Kuwayama et al. (2019), irrigated regions are less vulnerable to drought-related reductions in crop yields, which helps explain the greater willingness of banks to extend credit in these areas. This observation is consistent with historical evidence from Rajan and Ramcharan (2023), who show that access to credit during the 1950s drought enabled farmers to invest in irrigation technologies, leading to long-term resilience. Our results suggest that a similar dynamic persists today, with banks more willing to lend in irrigated areas due to the perceived lower risks.

Our findings underscore the importance of irrigation infrastructure in mitigating drought impacts on agricultural lending. The disparities we observe in credit access between irrigated and dryland counties may contribute to increasing economic divergence, suggesting a need for policies that expand credit availability in vulnerable regions. Addressing these disparities may be crucial for supporting agricultural adaptation to climate risks and maintaining regional economic stability.

The post-2012 results reinforce these dynamics, as only single-county banks increased lending in irrigated regions, while dryland regions did not experience a similar expansion. This suggests that financial reforms may have mitigated the decline in agricultural lending in irrigated areas but were less effective in supporting banks in dryland counties, where risks remain more pronounced. Thus, our findings emphasize the importance of credit availability in shaping regional responses to droughts and highlight the role of irrigation infrastructure as a key factor in reducing banks' perceived risks in lending.

These insights not only support the conclusions drawn by Rajan and Ramcharan (2023) and Kuwayama et al. (2019) but also underscore the need for targeted financial policies that address the unique challenges of dryland regions. Expanding credit access in these areas could be crucial for enabling adaptation to increasingly frequent and severe droughts, potentially reducing the growing economic divides between irrigated and non-irrigated agricultural regions.

Moreover, our study contributes to the literature on deposit behavior under climate risk by revealing how drought conditions drive changes in both deposit volumes and pricing strategies across different bank types. While existing research, such as Heo (2024), has documented deposit withdrawals in banks exposed to climate risks like hurricanes and floods—where immediate asset damage heightens depositor concerns and prompts outflows—our findings show a contrasting response under drought conditions. Specifically, we find that deposits tend to increase at single-county and single-state banks during droughts, suggesting that local banks play a crucial role in regional liquidity management under climate stress. This increase may be driven by precautionary savings behavior among depositors in drought-affected areas, as well as by banks actively competing for deposits, reflected in higher deposit rates. Prior to the 2012 reforms, banks facing drought conditions frequently raised deposit rates to attract funds, a strategy consistent with liquidity-hoarding behaviors observed during periods of economic uncertainty (Berger et al., 2022). Post-2012, however, we observe more stable deposit levels and a decrease in competitive rate adjustments, suggesting that federal aid reduced the need for aggressive rate-setting during drought periods.

The remainder of the paper is organized as follows. In Section 2, we describe our data and the econometric framework. In Section 3, we present the results on new bank lending to small businesses and farms, while Section 4 discusses the impact on aggregate commercial banks' loan portfolio. In Section 5, we analyze the impact of droughts on the pricing and quantity of deposits. Finally, Section 6 closes the arguments.

2. Data

In this section, we describe the various databases we use, as well as the variables we obtain for the subsequent analysis.

2.1. Drought data

2.1.1. U.S. Drought Monitor

Our spatial designation of drought-affected areas is based on the U.S. Drought Monitor (USDM) database which is used amongst others for the disaster declaration process. The USDM consists of weekly maps jointly produced by the National Drought Mitigation Center at the University of Nebraska-Lincoln, the National Oceanic and Atmospheric Administration, and the U.S. Department of Agriculture. These maps classify U.S. regions into five different drought classifications: abnormally dry (D0), moderate (D1), severe (D2), extreme (D3), and exceptional (D4). The classification is based on five quantitative drought indicators, local condition and impact reports from expert observers, and anticipated drought impacts subjectively validated by the indicators used. The USDM has been shown to significantly capture the reduction in crop yields Kuwayama et al. (2019).

We identify drought-affected areas as those experiencing severe drought (D2) or above. D2 is also one of the threshold conditions for a county, or its neighboring counties, to be designated as drought disaster areas. We define our drought index at the locational (5km grid cell level) as the sum of the weeks within the growing season (May through October) that reach the D2 threshold, and zero otherwise.

To link branch-level information to our drought index, we used the geographic coordinates of the branch's address to determine its location within the USDM 5km grid cell schemata. This gives us an annual indicator of the number of weeks a branch was located in an area subject to at least D2 drought conditions. We assume that farming clients are likely to do business with branches closest to them. We generate bank-county (bank) level drought indices by weighting their current branch level drought indices within a county (bank) by the share of each branch's bank-county (bank) level total deposits in the previous year.

2.1.2. Disaster Declaration

For our regression analysis, it is important to control for government assistance targeted to the drought-affected areas. More specifically, the Secretary of Agriculture can authorize emergency loans for farmers who have suffered losses due to natural disasters in designated counties and counties adjacent to them. The U.S. Department of Agriculture (USDA) can designate a county if it has suffered severe physical property or production losses due to unusual and adverse weather conditions or natural phenomena. Severe physical property losses are considered as extensive damage to or destruction of physical farm property, including buildings, equipment, infrastructure, livestock, and poultry and their products, as well as growing and harvested crops. Severe production losses refer to a minimum of a 30% reduction of the normal annual value of crops that could not be replanted or replaced by a substitute crop, 30% of a single farm annual enterprise's value, or conditions that have caused significant production losses or generated extenuating circumstances warranting a finding that a natural disaster event has occurred.

Since 2012, the USDA Secretary can automatically designate a county as affected when, during the growing season, any portion of a county meets the severe drought (D2) intensity value for eight consecutive weeks or a higher drought intensity value for any length of time, as reported by the USDM. [4]

Emergency loan funds can be used for several purposes, including replacing or restoring essential property, paying some or all of the cost of production in the disaster year, covering essential family living expenditures, reorganizing the farming operation, and refinancing specific non-real estate operating debts. Loan amounts are limited to $500,000, and loans exceeding $300,000 require two letters of credit declination from commercial lending institutions, while those below $300,000 but above $100,000 require one letter. For loans below $100,000, this requirement is determined on a case-by-case basis at the FSA's discretion. It should be noted that loan applications must be received no later than eight months after the date of the disaster designation.

The terms of repayment are based on the useful life of the loan, the applicant's repayment ability, and the category of loss involved. The repayment schedule must include at least one payment per year. Loans intended to cover annual operating expenditures must be repaid within a year, although this can be extended to up to 18 months depending on the production cycle of the involved commodity. The interest rate is the lower of the rates at the time of loan approval or the closing of the loan, with interest rates calculated and posted on the first of each month. Borrowers who are unable to meet their scheduled payments may be authorized to have certain amounts set aside.

In addition, more than 1,000 credit unions were eligible to provide unlimited lending to small business owners, including farmers in drought-designated areas. Small business lending by credit unions is typically capped at 12.25% of their total assets, but this cap does not apply to institutions serving low-income communities. Despite these inroads made by credit unions, the U.S. banking industry remains the primary credit provider to the agricultural sector.

We sourced the list of primary and contiguous counties designated by the US Secretary of Agriculture due to drought from the U.S. Department of Agriculture (USDA) for the years 2012-2020.

[4] See information on Disaster Protection and Recovery at https://www.fsa.usda.gov/news-room/fact-sheets/index

2.2. *Banking data*

We have employed three distinct datasets, each offering different levels of geographic precision on banks' loan books and other financial information used to identify drought-related impacts. The first dataset is on the bank-county level and is derived from the Community Reinvestment Act (CRA). The second dataset is on the bank-level and is referred to as the Call Reports that originate from the Commercial Bank Database of the Federal Reserve Bank of Chicago. It encompasses all banks that file the Report of Condition and Income, supervised by entities such as the Federal Reserve System, Federal Deposit Insurance Corporation (FDIC), and the Comptroller of the Currency. And the final dataset zooms in on the branch level, offering detailed data about individual bank branches, including their geographic location. This dataset is a combination of two different databases: the FDIC's Summary of Deposits (SoD) and Rate Watch's records on deposit and loan rates.

Subsequent sections offer more detailed information about these datasets and elucidate the variables pivotal to our analysis.

2.2.1. *Community Reinvestment Act*

This data pertains to new loans originated by banks above a certain size to small farms and businesses from a given country. The CRA was enacted in 1977 with a view of requiring banks to report their lending activities in the areas of business, farming and community development at a county level. To alleviate regulatory burdens on smaller entities, only larger banks are obliged to report their lending activities to the FDIC.[5]

Table A1 presents detailed variable definitions along with summary statistics for our sample. As one can see, newly originated loans are classified into three size categories, i.e. those with a value of less than \$100,000, between \$100,000 and \$250,000, and those between \$250,000 and \$1 million. Even though the categorization refers to small farm and business loans, it may include loans to medium and larger farms and businesses. Moreover, it excludes loans to small farms and businesses with a value above US \$1 million. Finally, the data includes information on newly

[5] The threshold was initially set at \$250 million for independent banks and \$1 billion for affiliates of bank holding companies. These thresholds were raised to \$1 billion for independent banks in 2005, though smaller banks were encouraged to continue reporting voluntarily. Since 2007, these thresholds have been adjusted annually to account for inflation, ranging from \$1 billion to \$1.252 billion in 2018 (Cole and Damm, 2021).

originated loans issued to very small farms and businesses with an annual revenue of less than \$1 million. In terms of banks' total assets, the loan amounts tend to be very small, e.g. loans with a value of less than \$100,000 constitute on average 0.04% of assets with a maximum of 13.2%. The figures are somewhat larger for loans issued to farms and businesses with a revenue of less than \$1 million. Concerning our drought exposure variable, the average number of weeks under extreme drought conditions ranges from 1 to 3 depending on the drought intensity threshold with a maximal exposure of 27 weeks during the growing season. Given the small size of loans relative to banks' assets, we scaled the number of weeks by 100 when using information from the CRA.

2.2.2. Call Reports

The second dataset pertains to information on the bank-level stemming from the Consolidated Reports of Condition and Income for the period from 2000 to 2020. All federally insured banks are mandated to submit these financial reports to the Federal Deposit Insurance Corporation (FDIC). Our analysis focuses on loans issued by domestic branches with a decomposition of total loans into those provided to farmers, consumer, households, and firms. To complete our analysis, we also use data on mortgage loans, loan performance and bank deposits.

2.2.3. FDIC Deposits and Ratewatch

Our final dataset is comprised of information on the level of branches of commercial banks. It consists of two dataset, namely the Summary of Deposits (SoD) complied by the FDIC and Rate Watch's database on interest rates. The former consists of regulatory information on branch locations and the deposits held by them, while the later offers interest rate quotes on a range of loan and deposit products, encompassing the most common interest-bearing checking, savings, and term deposits in the US. We focus our analysis on three commonly offered core deposit products: an interest-bearing checking accounts with a minimum balance of \$0 (INTCK0K), money market deposit accounts with a minimum balance of \$25,000 as saving deposits (MM25K), and certificates of deposits with an account size of \$10,000 for a tenor of 12 months (12CD10K). The data is merged with the SoD database using the unique FDIC branch identifier.

The Rate Watch data covers approximately three-quarters of the branches in the SoD database. Not all branches actively set deposit rates; many follow the rate established by another branch, referred to as a rate setter. To prevent duplication, our analysis is limited to active rate setters, which constitute close to 10% of the branches represented in the Rate Watch data.

3. New Loans to Small Farms and Small Businesses

Natural disasters are likely to increase local credit demand due to the need of rebuilding damaged or destroyed physical capital (Berg and Schrader (2012); Cortés and Strahan (2017); Koetter et al. (2020); Rajan and Ramcharan (2023)). The availability of lending is essential as it accelerates the recovery and facilitates farm investment in productivity enhancements (Cortes (2014), Rajan and Ramcharan (2023)). We investigate whether banks increased lending to small farms and businesses in response to severe droughts using the first dataset stemming from the CRA. The baseline regressions are structured as follows:

$$loans_{i,c,s,t} = \beta_0 + \beta_1 \, Drought_{i,c,t} + \alpha_{i,c} + \mu_{s,t} + \varepsilon_{i,c,s,t} \quad (1)$$

where $loans_{i,c,s,t}$ denote new loans in percent of assets originated by bank *i* in county *c* within state *s* in year *t*. The drought variable is our bank-county specific measure of drought exposure, weighted by deposits of the bank branches situated in the drought area. The regressions control for bank-county fixed effects $\alpha_{i,c}$ and state-year fixed effects $\mu_{s,t}$. The former accounts for unobserved time-invariant bank-county factors, and the latter addresses common time- and state-specific shocks.

It is crucial to note that the remaining variation in the drought variable can be considered as random realizations from the location-specific drought distribution after accounting for bank-county specific effects. In other words, while banks and their branches may choose their locations based on expected drought shock distributions, this variation is absorbed by the bank-county specific effects as long as the distribution remains unchanged over time or changes over time are unbeknownst to the banks. Importantly, the drought variable is based solely on the climatic characteristics of the droughts and the pre-event weights of the branch sizes within the affected area. The drought variable can thus be considered as exogenous which implies that we do not need to include any other variables, if they themselves can be affected by droughts tropical storms, as they would be considered as 'bad regressors' (Angrist and Pischke, 2009).

The standard errors of the error term $\varepsilon_{i,c,s,t}$ are clustered by bank and year to allow for the clustering of shocks within a bank. Clustering at the county level, considering that our primary variable of interest (the drought variable) is county-specific, only enhances the precision of our estimates, hence our choice for a more conservative approach.

The baseline model is subsequently modified to include interactions with a post-2012 indicator variable. This modification is intended to account for potential changes in the impact of droughts on bank lending due to regulatory changes aimed at supporting local economies in the recovery process. It was a response to one of the severest droughts in the U.S. history with the federal government implementing support programs targeted to the affected farmers, businesses and communities, including the provision of subsidized emergency loans.[6] To account for these changes, we modify our baseline regression as follows:

$$\mathsf{loans}_{i,c,s,t} = \beta_0 + \beta_1\ \mathsf{Drought}_{i,c,t} + \beta_2\ \mathsf{Drought}_{i,c,t} * \mathsf{Post}^{2012} + \alpha_{i,c} + \mu_{s,t} + \varepsilon_{i,c,s,t} \quad (2)$$

where Post^{2012} is an indicator variable that takes the value of one for the years 2012-2020 and zero otherwise. This variable is interacted with our drought measure to account for a potentially heterogeneous response of bank lending due to the easing of access to emergency loans in drought-affected counties.

3.1. New Loans to Small Farms

The results of our analysis, presented in Table 1, indicate that overall, new bank lending to small farms decreases significantly during drought periods. Panel A shows that for severe drought conditions, new loan origination declines across all categories of loan sizes. For instance, new loans to farms with gross annual revenues of less than $1 million decrease by approximately 0.038 percentage points in response to severe drought conditions, evaluated at the maximum drought intensity. The economic significance of this decline is notable, as it represents roughly a 10 percent reduction in the volume of new loans to these small farms, relative to their average lending levels (see Table A1). This reduction is observed consistently across other loan categories suggesting

[6] In 2012, North America experienced one of the severest droughts in the history (Rajan and Ramcharan, 2023), leading to the legal declaration of 1,692 counties across 36 U.S. states as primary natural disaster areas. The drought affected over 62% of the contiguous U.S. and resulted in the designation of hundreds of additional counties as "contiguous" disaster areas, making them eligible for federal aid. This devastating drought cost the Midwest over $35 billion and reduced the U.S. GDP by 0.5-1%, equating to a loss of $75 to $150 billion.

that droughts broadly limit new lending to small-scale agricultural borrowers.

Panels B and D, which include interaction terms with a post-2012 indicator variable, suggest that the decline in new lending is more pronounced prior to the regulatory reforms of 2012. In these panels, the interaction term between drought exposure and the post-2012 period is not statistically significant, indicating that the regulatory changes may have mitigated the impact of droughts on the origination of new loans to small farms. In Panel D, the coefficient for moderate droughts is negative and significant for loans under $100,000, showing a decline of about 0.020 percentage points, but the interaction term is positive, suggesting some alleviation of this impact after 2012. This pattern is also reflected in loans to very small farms with revenues under $1 million, where the negative impact of droughts diminishes in the post-2012 period.

Overall, the results imply that the 2012 reforms, which included provisions for federal aid and subsidized emergency loans, helped stabilize the origination of new loans to small farms during droughts. Prior to the reforms, the reduction in new lending may have reflected banks' concerns about increased credit risk in drought-affected areas, as well as a precautionary tightening of credit. However, after the reforms, the availability of government support appears to have lessened these concerns, allowing banks to maintain more stable levels of new lending during subsequent drought periods.

Table 1

3.2. New Loans to Small Businesses

Berger et al. (2005) highlighted that credit scoring enabled larger banks to extend their market presence, particularly in small business lending. However, the uncertainties induced by droughts may exacerbate information asymmetries between lenders and borrowers, raising concerns about the future profitability of small businesses. While small businesses are not directly impacted by droughts in the same way as agricultural enterprises, heightened risk aversion among banks during drought periods may influence lending behavior. As a result, we hypothesize that lending trends for small businesses may resemble those observed for small farms.

The results of our analysis, presented in Table 2, confirm this hypothesis, indicating that bank lending to small businesses decreases significantly during drought periods, particularly before the 2012 reforms. Panel A shows that for severe drought conditions, lending to small businesses generally declines, especially in terms of loan amounts. The amount of loans for businesses with annual revenues of less than $1 million decreases by approximately 0.085 percentage points during periods of severe drought.

Moreover, this pattern is consistent across other loan categories. For instance, loans with amounts between $250,000 and $1 million decline by approximately 0.108 percentage points. This finding indicates that the reduction in lending is not confined to very small loans but affects a range of loan sizes, underscoring a broad contraction in credit availability for small businesses during severe droughts.

Panels B and D, which include interaction terms with a post-2012 indicator variable, suggest that the negative impact of droughts on small business lending is primarily concentrated in the pre-2012 period. After the implementation of the 2012 reforms, the interaction terms between drought exposure and the post-2012 period are generally not statistically significant, suggesting that the reforms may have mitigated the effects of droughts on lending. In Panel D, the coefficient for droughts of at least D2 intensity remains negative and significant for some loan categories, such as small loans under $100,000, but the positive interaction terms suggest a partial alleviation of this effect after 2012. This can be attributed to the extension of the aid programs to non-farm small businesses that were economically impacted by the drought.

Notably, the interaction term for loans between $100,000 and $250,000 is positive and significant, indicating a relative increase in lending to these small businesses in the post-2012 period. This suggests that the regulatory changes may have specifically supported the provision of larger loans to small businesses, possibly through the extension of government aid to non-farm small businesses economically affected by droughts. Federal assistance programs aimed to support small businesses facing economic challenges due to drought conditions, thereby facilitating their access to credit.[7]

Overall, these findings suggest that the 2012 reforms, including targeted support measures, helped stabilize the flow of new loans to small businesses during drought periods. Prior to the reforms, the reduction in lending likely reflected increased credit risk and caution among banks, but after 2012, government interventions appear to have mitigated these risks, allowing banks to

[7] https://obamawhitehouse.archives.gov/blog/2012/08/08/assistance-small-businesses-affected-drought

maintain more stable lending levels. This stabilization may have played a crucial role in supporting local economies by ensuring continued access to credit for small businesses during periods of drought-related uncertainty.

Table 2

3.3. *Designated counties and the impact of emergency loans*

To further explore the impact of the federal government's emergency programs on bank lending to farm, we focus solely on the post-2012 period and introduce interactions for counties that were designated for emergency loan eligibility. We focus on the period 2013-20, excluding the year of the extreme drought that covered roughly 81% of the country. In this way, we also make sure that our results are not skewed by the extraordinary drought and the introduction of the novel fast-track government assistance program. More specifically, in augment our model by including an indicator variable that is equal to one for counties that were eligible for government emergency loans (designated) and zero otherwise, as well as an interaction term with the drought indicator. The augmented model can be summarized as follows:

$$loans_{i,c,s,t} = \beta_0 + \beta_1 \ Drought_{i,c,t} + \beta_2 \ Drought_{i,c,t} * D^{desig}_{c,t} + \beta_3 \ D^{desig}_{c,t} + \alpha_{i,c} + \mu_{s,t} + \varepsilon_{i,c,s,t} \tag{3}$$

The results on new lending to farms, presented in Table 3, differ notably from our previous findings on the overall positive response to droughts. In the baseline regressions without interaction terms, shown in Panels A and C, the data indicate only a marginal increase in new lending to small farms during drought periods, limited to certain loan categories. For example, in Panel A, loans in the \$100,000–\$250,000 category increased by approximately 0.007 percentage points during severe drought conditions (Droughts3-4), with statistical significance at the 5% level. However, this increase is not observed for smaller loans or loans to farms with annual revenues below \$1 million, where the coefficients remain statistically insignificant.

When interaction terms for emergency aid eligibility in designated counties are introduced in Panels B and D, the earlier positive effects largely dissipate. Most coefficients become statistically insignificant across the loan categories, indicating that the designation of counties for federal assistance did not markedly enhance the lending response. The interaction terms for designated counties are typically negative, suggesting that any positive lending response to droughts is more pronounced in non-designated counties. For instance, in Panel D, the coefficient for the interaction term with loans in the \$100,000–\$250,000 range is -0.006, indicating that lending increases observed in non-designated counties were not replicated in counties receiving federal aid.

These findings imply that federal aid programs, intended to support small farms during drought periods, did not significantly alter the lending behavior of banks in designated areas post-2012. Instead, the observed marginal increases in new loans appear to be consistent across both designated and non-designated counties, suggesting that banks' lending strategies were relatively unaffected by the availability of federal aid. The robustness of these conclusions is reinforced by the inclusion of bank-time fixed effects in the analysis, as shown in Panel E, which controls for time-varying factors across banks and isolates the specific variation experienced by individual branches.

Adams et al. (2021) suggests that loans under \$100,000 may include credit card loans, which differ from traditional agricultural loans. If so, our results imply that small farms in drought-affected areas may have increased their reliance on credit card loans during drought periods, but this trend reversed following the reforms and the introduction of expedited aid in 2012. The federal aid might have contributed to reducing outstanding debt, particularly for these smaller loans, which could explain the observed decline in loans of less than \$100,000 in designated drought areas.

Overall, the analysis suggests that the 2012 reforms, including federal aid programs, did not significantly alter lending patterns for new loans to small farms during subsequent droughts. While certain loan categories show some increases in lending, these are not strongly tied to the designation of federal aid. The lending response to drought conditions seems uniform across designated and non-designated counties, implying that banks' lending decisions were more influenced by internal risk assessments and market conditions rather than by the availability of targeted federal assistance.

Table 3

4. Changes in Banks' Loan Portfolios

Our previous results indicate that drought-affected banks provided fewer new loans to small farms and businesses prior to the 2012 reforms and that thereafter there was little impact, particularly in counties eligible for emergency lending. This stands in contrast to some of the existing literature that stipulates that local credit demand increases in response to natural disasters because residents need to rebuild destroyed or damaged physical capital. Koetter et al. (2020) provide evidence that banks in areas exposed to flooding increased their lending after the Elbe flood in Germany relative to unexposed local banks. Bos et al. (2022) document for the U.S. that natural disasters destroy firm fixed capital and lead to a surge in loan demand and increased borrowing rates. Moreover, they observe that, while banks increase lending following a disaster, they also adjust their asset structure.

In our study, we hypothesize that droughts will affect in the first place the agricultural sector, and consequently, lending to it. While we do not expect that droughts will directly affect other types of loans, it is likely that banks change their loan portfolio. We investigate the impact of droughts on the composition of bank loan portfolios by using the Call reports and as outcome variables different types of credits as a percentage of total loans. The baseline regressions are as follows:

$$share_{i,c,s,t} = \beta_0 + \beta_1 \; Drought_{i,c,t} + \alpha_i + \upsilon_t + \varepsilon_{i,t} \tag{4}$$

Here, $share_{i,t}$ represents the ratio of a specific type of loan of bank *i* in year *t*. The drought exposure index is now bank-specific and weighted by the pre-drought deposits held in a bank's branches. The regressions controls for bank-fixed effects α_i and year-fixed effects υ_t, with the former accounting for unobserved time-invariant bank-specific factors and the latter accommodating for common time-specific shocks. The error term $\varepsilon_{i,t}$'s standard errors are clustered by county.

In line with our earlier approach, we include post-2012 interaction terms. To ascertain whether the results differ among banks with varying degrees of geographic diversification, we partition the sample into single- and multi-state banks, or alternatively into single- and multi-county banks. For the identification of the different bank types, we use information on the location of banks and their branches, defining single-county banks as those that only operate branches in a single county. We also focus exclusively on the post-2012 period, and introduce an indicator variable for designated counties and its interaction term with drought exposure.

4.1. Total Loans

The results presented in Table 4 show that the effect of severe droughts (at least D3 intensity) on total lending varies notably across different bank types. Panel A reveals that multi-county banks experienced a statistically significant increase in total loans during periods of drought. The results are in line with the literature, which indicate increased demand fur funds following a natural disaster. In contrast, for other types of banks, the analysis shows no statistically significant impact on total loans during severe droughts. This lack of response could indicate a more cautious approach to lending, which could be explained by limited capacity for risk diversification, among these banks during extreme weather events.

The introduction of policy reforms in 2012, aimed at mitigating the adverse effects of drought, has notably influenced lending behaviors across most bank types. Contrary to initial expectations, these reforms were associated with a reduction in lending activity. Specifically, we observe now a significant decline in lending for multi-county banks, with an estimated reduction of 0.075% per week of drought exposure, significant at the 10% level. Similarly, single-county banks saw a decrease in lending activity, with a coefficient of -0.061, significant at the 1% level, although the magnitude of the decline was smaller than that observed for multi-county banks. The more moderate reduction in lending by single-county banks could be attributed to their closer ties with local communities and greater reliance on relationship-based lending, which may make them less responsive to broader economic shocks.

Moreover, the results in Panel B, show that moderate drought conditions (D2 intensity) did not significantly influence lending decisions, as compared to more extreme drought events. The coefficient for droughts is statistically insignificant across all bank types. This suggests that banks may perceive moderate droughts as less threatening to their loan portfolios, allowing them to maintain normal lending practices even during periods of mild drought.

In the post-2012 period, as shown in Panel C, multi-state banks responded to drought conditions by significantly reducing lending in non-designated counties by -0.069% per week of drought, significant at the 5% level. However, lending in designated drought counties showed only a marginal change (0.008% per week of drought). This suggests that the presence of federal support in designated counties likely mitigated some of the risks associated with droughts, reducing the need for these banks to dramatically scale back their lending in these areas. Additionally, the results provide some evidence that single-state banks reduced lending in designated counties that were not affected by droughts, indicating that their lending behavior is potentially influenced by policy interventions.

Overall, these results underscore the role of droughts in shaping lending patterns, particularly for banks with larger geographic exposure, such as multi-county and multi-state banks.The different response may be the results of composition of the porfolio. Thus, we will conduct a deeper examination of banks' loan portfolios, analyzing the various categories of loans to determine if there are shifts in lending patterns in response to droughts.

Table 4

4.2. Agricultural Production and Farm Loans

Our analysis investigates how droughts affect the proportion of agricultural lending in banks' loan portfolios, with the expectation that this sector would be particularly vulnerable to drought conditions. As indicated in Columns (1)-(2) of Table 5 the coefficient for drought is consistently negative and significant across all specifications in the three panels at the 1% level. In Panel A, severe droughts (D3) result in a 2.3% weekly reduction in agricultural loans as a share of total loans for all the banks. In Panel C, a smaller reduction of 0.7% is observed for all the banks, corresponding with the introduction of of reforms that facilitated subsidized emergency loans in counties affected by drought.

A closer look, however, indicate significant heterogeneity depending on the presence of government aid and the type of bank. When considering both drought exposure measures for the entire sample in Column (2) of Panels A and B, it becomes clear that drought-exposed banks reduced their lending, especially after 2012. Before 2012, these banks reduced lending by approximately 0.01 percent of assets per week of drought compared to non-exposed banks. However, the lending contraction intensified after 2012, reaching a 0.045% reduction. This indicates that banks generally scaled back agricultural lending more significantly following the introduction of the reforms.

However, the adjustments in agricultural lending varied across different types of banks. A more detailed analysis shows that the largest reductions were primarily driven by single-state and single-county banks (Columns (3) and (5) of Panels A and B). These banks reduced their exposure to farm and agricultural lending more sharply than non-exposed banks, especially after 2012. This could be due to their higher exposure to counterparty risk during droughts, given their limited geographic diversification.

In contrast, multi-state and multi-county banks showed greater resilience to drought exposure, with no significant changes in their lending behavior. This resilience can likely be attributed to the benefits of geographic diversification and less reliance on local agricultural lending. Geographic diversity may explain why multi-county banks reduced agricultural lending post-2012 (Column (6) of Panels A and B), but to a lesser extent than single-state and single-county banks.

Focusing only on the post-2012 period and distinguishing between designated and non-designated counties (Panel C), we find similar patterns with some important differences. Drought-exposed single-state and single-county banks reduced lending in non-designated counties more than their non-exposed counterparts. However, in designated counties—where government aid is available—the combined effect of drought exposure was less severe, although still negative. This suggests that while government aid helped to stabilize lending activities to some extent, it did not completely offset the negative impact of drought conditions on agricultural lending, particularly for banks with limited geographic diversification.

Table 6

4.2.1. Agricultural Banks

The overall findings confirm that droughts lead to a significant reduction in agricultural lending across most bank types, with the effect being more pronounced for single-state and multi-county banks, likely due to their limited geographic diversification. To better understand this relationship, we further categorized the banks into agricultural banks—those with agricultural loans constituting at least 15% or 25% of total loans—and other banks, as suggested by the literature (Scott et al., 2022).

The results presented in Panel A of Table 6 indicate that the coefficients for drought exposure are negative across all columns, showing that both agricultural banks and other banks reduce their agricultural lending during severe drought conditions. For agricultural banks, this reduction is consistent across different thresholds (15% and 25%), as seen in Columns (1) and (3), indicating a uniform vulnerability to drought among these banks.

In contrast, non-agricultural banks exhibit a more heterogeneous response, particularly during droughts of at least D2 severity (Panel B) and in the post-2012 period (Panel C). This heterogeneity may suggest that access to information about local conditions is crucial, and that more specialized banks might have an advantage in adapting their lending practices. While other banks reduced lending more significantly before 2012, there is no significant difference in the behavior of agricultural banks during this earlier period. However, after 2012, all banks reduced agricultural lending more substantially, with negative effects partially mitigated in designated counties for non-agricultural banks, where government aid programs provided some relief. Despite this, the coefficients suggest that the reduction in lending was more substantial for agricultural banks in the post-2012 period, potentially reflecting their deeper exposure to the agricultural sector.

When focusing on the post-2012 period (Panel C), agricultural banks do not curtail agricultural lending more than non-exposed banks, regardless of whether they operate in designated or non-designated counties. On the other hand, other drought-exposed banks reduce lending relative to non-exposed banks, with a more pronounced impact in non-designated counties (-0.02) compared to designated counties, where the reduction is mitigated to -0.007 (calculated as -0.02 + 0.013). This differential response may underscore the importance of access to information regarding drought severity, suggesting that more specialized banks might have an informational advantage that allows them to manage lending more effectively than less specialized institutions during periods of climatic stress.

Table 6

4.2.2. Irrigation technology

Rajan and Ramcharan (2023) reports that farmers in drought-afflicted areas in the 1950s with better access to credit invested in new technologies, including the emerging irrigation technology. This technological adoption proved advantageous to the extent that the average impact of droughts on crop yields is smaller in irrigated counties than in dryland counties (Kuwayama et al. (2019)). Accordingly, we reiterate our estimations for agricultural production and farm loans, now accounting for irrigated and dryland counties using the data of Kuwayama et al. (2019).

The results providing a more granular view of the impact of drought on agricultural lending are shown in Table 7. In Table 5, the results showed a uniform negative impact of drought across all categories of banks. However, when controlling for irrigation, we observe that the negative impact of droughts on lending is generally more severe in dryland counties compared to irrigated counties. In Panel A, the coefficient for drought is negative and larger in dryland counties than in irrigated counties.

An exception is observed with single-county banks, where the coefficient for drought is insignificant across all panels, but positive and significant in Panel A and B for irrigated regions. This suggests that local banks behave differently from others, potentially due to their better knowledge of local market conditions. One explanation could be that in dryland counties, local banks have lower exposure as they are more aware of the risks. In contrast, in irrigated counties, local banks are more likely to lend as they assume that local farmers will be less affected by the drought. Consequently, our results suggest that irrigation serves as a mitigating factor, reducing the sensitivity of banks to drought conditions in irrigated regions, where agricultural production may be less dependent on natural rainfall.

Moreover, the results for post-2012 show that only single-county banks expanded lending in irrigated areas, with no similar trend observed in dryland counties. Unlike prior findings, we do not see evidence that the reforms mitigated the negative effects of drought on lending by single-state banks. This suggests that post-2012 reforms may have specifically benefited single-county banks in irrigated regions, while lending by other banks, particularly in dryland areas, continued to decline.

These findings align with historical patterns observed by Rajan and Ramcharan (2023), who emphasize that access to credit during the 1950s drought enabled farmers in affected areas to adopt new technologies, including the then-emerging center pivot irrigation systems. Such investments helped mitigate the negative effects of droughts, contributing to long-term economic resilience in regions with better credit access. Our results show a similar trend in contemporary settings, where banks are more willing to extend credit in irrigated areas, suggesting that perceptions of reduced risk continue to shape lending decisions. This continuity underscores the role of credit as a critical facilitator of agricultural adaptation, helping regions cope more effectively with climatic shocks. Additionally, as highlighted by Kuwayama et al. (2019), the impact of droughts on crop yields is significantly smaller in irrigated regions compared to dryland counties. This difference in agricultural vulnerability further explains why banks perceive lending in irrigated regions as less risky, leading to higher willingness to lend. The combination of better credit access and lower production risks in irrigated counties may therefore contribute to more stable lending patterns and economic resilience in these areas. Consequently, our findings suggest that the availability of credit and irrigation infrastructure can lead to long-term disparities between irrigated and dryland regions, potentially creating a widening gap in financial access and economic opportunities. This pattern not only echoes past observations but also highlights the importance of targeted financial policies that could reduce such disparities by improving credit flows to drought-prone dryland areas, fostering broader adaptation and economic stability.

Table 7

4.3. Other Loans

4.3.1. Commercial and Industrial Loans

In our preceding analysis, we demonstrated that the response of bank lending to droughts varies depending on the bank type and the time period. Building on this, we now turn to the influence of droughts on the proportion of commercial and industrial (C&I) loans in a bank's total lending portfolio. This focus is motivated by Ding et al. (2011), who suggest that droughts can disrupt the operations of non-agricultural firms, especially those that rely heavily on water, potentially influencing their credit needs.

Our findings, as shown for bravity in Appendix Table A2, indicate that most drought-affected banks did not alter the proportion of their lending to non-agricultural firms. The coefficients for droughts are generally insignificant across bank types and time periods. Moreover, in Panel A (droughts of at least D3 severity), the coefficients remain close to zero for both single- and multi-state banks, as well as single- and multi-county banks, suggesting that drought exposure does not lead to a significant shift in C&I lending overall.

However, a notable exception emerges in the behavior of multi-county banks during the post-reform period (Panel C). In this context, multi-county banks appear to increase C&I lending in designated drought counties, with a positive and significant coefficient for the interaction term

Drought and Designated. This result suggests that these banks may be leveraging in counties that benefit from extensive government support during droughts. This support likely reduces counterparty risks, making lending to non-agricultural firms in these areas more attractive.

Overall, the results suggest that while droughts have a pronounced impact on agricultural lending, their influence on the lending activities to non-agricultural sectors is more muted. The observed stability in C&I lending, even during periods of drought, implies that most banks do not perceive drought conditions as significantly altering the creditworthiness of non-agricultural firms.

4.3.2. Loans to Individuals

Our previous findings indicated that while banks' overall lending remained relatively stable during drought periods, there was a more significant reduction in agricultural lending, with less pronounced changes in C&I lending. This led us to consider whether banks might adjust their consumer lending practices in response to drought conditions, potentially to help households manage adverse income shocks or to counterbalance the decline in agricultural lending. Such adjustments could also be driven by increased demand for credit from consumers facing reduced purchasing power due to diminished work opportunities in the agricultural sector or rising food prices during droughts.

The results, presented in Table 8, support this hypothesis. In Panels A and B, we find that most drought-exposed banks increased their lending to individuals for household, family, and other personal expenditures compared to non-exposed banks. This trend is consistent across various bank types. In Panel A, the coefficients indicate that banks typically increased consumer lending by approximately 0.4 to 0.5 percentage points of assets per week during periods of severe drought, while in Panel B, the increase is lower, around 0.25 percentage points of assets per week during periods of moderate drought. Consequently, the results suggest that the severity of drought conditions is associated with variations in consumer lending, with more severe droughts prompting a stronger lending response.

However, a closer examination reveals some differences by bank type. Multi-state banks deviate from this general pattern, as they do not significantly increase consumer lending during drought periods. Additionally, the results indicate that other banks have reduced their consumer lending following the introduction of the post-2012 reforms, but this change is observed only in the context of severe droughts. Although the overall effect of severe drought on consumer lending remains positive, this shift suggests that government assistance may have reduced the need for additional consumer loans, as aid programs likely provided direct support to households, easing their financial strain. In contrast, during periods of moderate drought, no significant change in consumer lending is observed for the post-2012 period.

The results in Panel C, which focus on the post-2012 period, confirm that consumer lending by drought-exposed banks remains generally positive, particularly for single-state and single-county banks. This indicates a continued willingness to lend to households even in drought-affected regions. However, the interaction term for drought and designated counties is negative across all bank types, with significant effects for the whole sample and multi-county banks. This suggests that the positive effect of drought on consumer lending is tempered in designated areas, possibly because the availability of government support reduces the immediate need for banks to provide additional credit to households, thereby dampening the increase in lending that might occur in non-designated areas.

Overall, these findings indicate that droughts can lead to an increase in consumer lending as banks respond to heightened demand for credit from households facing income disruptions. This response is particularly strong before the 2012 reforms but remains positive even after the introduction of government support programs. The increase in consumer lending may serve as a strategy for banks to balance their loan portfolios in drought-stricken areas, offsetting the decline in agricultural loans with loans that address the financial needs of households.

Table 8

4.3.3. Real Estate Secured Loans

Prior research has documented that bank lending, particularly through home mortgage originations, tends to increase following natural disasters as affected residents rebuild damaged property. For instance, Cortés and Strahan (2017) found significant increases in mortgage originations after such events, while Bos et al. (2022) confirmed that U.S. commercial banks typically expand real estate lending in the aftermath of disasters.

Unlike sudden disasters that directly damage physical structures, droughts do not cause immediate physical damage to real estate. However, they can indirectly affect real estate markets by influencing property values, as seen in studies like Baldauf et al. (2020), which suggest that climate risks and perceptions significantly impact real estate prices. Similarly, Bernstein et al. (2019) showed that properties vulnerable to risks like sea-level rise tend to sell at a discount, reflecting the influence of climate change perceptions on property values. Additionally, Nguyen et al. (2022) observed that properties facing higher climate risks tend to be subject to higher mortgage interest rates, reflecting lenders' risk adjustments.

While existing research has explored the effects of natural disasters on property prices, the impact of droughts on real estate-secured lending remains ambiguous. The results in Table A3 show rather a weak response of banks to drought. We find no evidence of changes in lending during serve draught, while the results show that multi-county and single-state banks tend to increase the share of loans secured by real estate relative to non-exposed banks during moderate draught. This increase is observed both prior to and after 2012, as shown by positive and significant coefficients for multi-county banks.

However, this pattern changes when we focus on the post-reform period, as detailed in Panel C. Here, we observe that drought-exposed multi-county banks reduce their share of real estate-secured lending compared to other banks, regardless of whether a county was designated for federal assistance. Specifically, the coefficient for drought exposure in multi-county banks is negative and significant, indicating a contraction in real estate lending in these banks during the post-2012 period. Moreover, the negative coefficients for the interaction between drought exposure and designation status suggest that drought-affected banks in designated counties reduce real estate lending more than banks in non-designated areas.

4.3.4. Secured by Farmland vs. Family Residential Properties

The previous analysis indicates that droughts, although not directly damaging real estate, can have significant economic repercussions for both agricultural and residential sectors. Given the impact of drought on farmers and consumers, we examine how banks adjust their lending practices for loans secured by farmland and those secured by 1–4 family residential properties. The results, presented in Table 9, highlight key differences in loan dynamics across these two categories.

The findings suggest that banks tend to increase their lending secured by farmland during drought periods. In Panels A and B, coefficients for single-state and multi-state banks are positive and significant, indicating an increase in such loans during both moderate and severe droughts. For multi-county banks, the increase in lending is significant only in the context of severe droughts (Panel A). This tendency to expand loans secured by farmland might reflect banks' desire for increased collateral during uncertain periods, where farmland serves as a more stable security amidst agricultural downturns. Single-county banks, however, do not exhibit the same positive trend, possibly due to their closer relationships with local farmers, which may allow for a more nuanced understanding of credit risks and the ability to maintain lending without requiring additional collateral.

Panel C, focusing on the post-2012 period, reveals that lending tends to decrease overall in drought-affected areas. However, there is a positive interaction effect in designated disaster counties for single-state and multi-county banks. This suggests that while banks generally reduce their exposure to real estate loans post-2012, they remain more willing to lend in counties eligible for federal disaster aid, likely due to the perceived reduction in risk provided by such support.

In contrast to loans secured by farmland, lending secured by family residential properties shows a different response to drought conditions. Panel A demonstrates that during severe droughts, banks reduce their lending for residential properties, as reflected by negative coefficients across most bank types. This decline likely reflects the economic strain faced by households, leading to a reduced demand for residential mortgages.

However, the interaction term for the post-2012 period is positive and significant across multiple bank types. This indicates that after the 2012 regulatory changes, banks significantly increased their lending for residential properties during drought periods. The effect is economically substantial, leading to increases in lending ranging from approximately 0.034 percentage points for single-state banks to 0.078 percentage points for multi-state banks. This increase in lending secured by residential properties may reflect an effort by banks to diversify their portfolios and counterbalance the decline in agricultural lending. The availability of federal support in the aftermath of the reforms might have improved the financial stability of households in drought-affected areas, allowing banks to increase their mortgage lending. For single-county banks, the pattern differs as the interaction with state aid is not strong enough to reverse the overall reduction in lending, suggesting a more cautious approach compared to other banks.

These findings highlight the contrasting behaviors of banks when lending against different types of real estate during droughts. Loans secured by farmland see an increase in lending during droughts, particularly among single-state and multi-state banks, possibly due to the relative stability of farmland as collateral. This trend remains even after 2012, though the presence of government aid appears to mitigate the extent of lending adjustments. Conversely, loans secured by residential properties experience a reduction during droughts, reflecting declining demand from households. Yet, post-2012 reforms have allowed banks to expand lending for residential properties during droughts, likely supported by improved aid mechanisms that bolster household resilience in affected areas.

4.4. Construction Loan Rates

So far, our results have shown that drought conditions affect real estate lending patterns, particularly those secured by residential properties and farmland. We further analyzed the impact of droughts on interest rates for construction loans, focusing specifically on construction loans of $175,000. This loan size is commonly observed in our dataset from Bankrate, and it allows us to assess how banks adjust their pricing strategies in response to changing risk conditions. The estimation approach mirrors that used in our analysis of deposit behavior in the following section.

The results presented in Online Appendix Table OA1 suggest that, overall, drought conditions do not lead to substantial changes in construction loan rates across most bank types. The coefficients for drought exposure are generally insignificant and close to zero, indicating that banks do not systematically adjust construction loan rates in response to drought conditions. This finding suggests that the earlier observed effects on lending volumes were likely driven primarily by shifts in demand for agricultural and consumer loans, rather than changes in interest rates.

However, single-county banks—those with strong ties to their local communities—emerge as an exception once again. These banks tend to increase construction loan rates in response to severe droughts, particularly in the post-2012 period and in counties not designated for federal assistance. This increase in rates likely reflects a higher risk premium charged by these smaller, more localized banks, which may perceive greater financial risks in drought-prone areas. This finding aligns with our previous results showing that single-county banks are more sensitive to drought conditions, often reducing their agricultural lending more significantly than multi-county or multi-state banks.

When focusing specifically on the post-2012 period, Panel C reveals that single-county banks increased interest rates on construction loans in response to severe drought conditions, with an economically significant increase of approximately 0.049 percentage points for each week that counties experienced severe drought. However, when a county faces drought conditions and is also designated as a federal disaster area, the single-county banks are likely to lower their interest rates on construction loans by about 0.041 percentage points. This reduction suggests that federal support may have alleviated some of the perceived risks, reducing the need for higher rates. Nonetheless, single-county banks maintain generally higher loan rates in drought-affected areas, reflecting a continued perception of risk despite the presence of federal aid.

Overall, the results indicate that single-county banks require higher risk premiums in their pricing of construction loans during drought conditions, while other bank types show no significant changes in rates. This suggests that the response to droughts varies significantly depending on the bank's perceived risk, with smaller, community-focused banks being more reactive in their pricing strategies.

4.5. Non-Performing Loans

Until now, our analysis has focused on understanding how drought conditions influence the quantity of bank lending without examining the quality of the loans. It is plausible that extreme drought conditions affect borrowers' ability to meet repayment obligations. Klomp (2014) and Brahmana et al. (2016) have shown that natural disasters can heighten credit risks, as borrowers often experience significant income shocks, damage to property or equipment, and increased working capital needs for essential inputs like crops, livestock, and machinery. A decline in loan quality, particularly in the agricultural sector, could contribute to the observed reductions in lending during drought periods and drive pro-cyclical lending patterns. To explore this hypothesis further, we analyze the impact of droughts on non-performing loans (NPLs), with our findings presented in Table 10.

The results suggest that, contrary to expectations, drought-affected banks tend to experience lower NPL ratios compared to non-affected banks, particularly after the introduction of policy reforms in 2012. In Panels A and B, the coefficients for droughts are consistently negative and highly significant across most bank types. In Panel A, severe droughts are associated with a reduction of -0.017 percentage points in the NPL ratio for the whole sample, which could represent a meaningful reduction in the proportion of defaulted loans. The results are particularly strong for single-state and multi-county banks, where the reductions in NPL ratios suggest that the perceived increase in credit risk may have been overstated by these banks.

This pattern is somewhat unexpected, considering the potential for income shocks among borrowers. However, it may be explained by a time lag between the onset of financial stress and loans becoming classified as non-performing. Banks may opt to restructure or roll over loans until economic conditions improve, aligning with findings by Brei et al. (2024), who suggest that such practices can delay the recognition of defaults. Additionally, government assistance programs, such as federal aid or disaster relief, might provide temporary financial relief to borrowers, helping them manage short-term repayment challenges and reducing immediate default risks.

In the post-2012 period, as shown in Panel C, the results continue to indicate lower NPL ratios for drought-affected banks, with the negative impact being more pronounced in non-designated counties. Single-county banks report a 0.024 percentage point reduction in the NPL ratio in drought-affected areas. This translates into a significant improvement in loan quality over extended drought periods. However, this difference in NPL ratios is notably smaller in designated counties that receive federal disaster aid. The interaction term for Drought and Designated is positive and significant for most bank types, suggesting that while the quality of loan portfolios improves during drought periods, the availability of government aid in designated areas reduces the extent of this improvement. This could be due to delayed recognition of defaults or increased flexibility in repayment terms, as borrowers benefit from temporary support measures.

Overall, the results suggest that droughts have not significantly deteriorated loan quality, even in the most severely affected regions. In fact, affected banks tend to see improvements in their non-performing loan ratios relative to non-affected banks, especially following the 2012 reforms. This implies that the earlier reductions in lending volumes during drought periods may not have been primarily driven by concerns about deteriorating loan quality but rather by other factors such as shifts in demand for loans or precautionary adjustments to lending strategies.

Table 10

5. The pricing and quantity of deposits

Natural disasters can affect banks' liquidity risk through withdrawals of deposits, increases in funding costs and drawdowns of credit lines (BCBS, 2021). In areas where disaster insurance is limited, households and small businesses tend to use their private savings to finance the recovery from disasters (Brei et al. (2019)). If such a funding shock is large, banks will likely to adjust their asset portfolio, first draw down on liquid assets and later reduce lending. In the U.S., especially after the 2012-reforms, the impact on banks might be different given that insurance coverage is larger and government emergency assistance is in place. Indeed, Steindl and Weinrobe (1983) showed that banks witnessed a marked increase in deposits following four significant natural disasters linked to insurance payments. Increases in deposits could also be observed when depositors start hoarding liquidity in the aftermath of disasters for precautionary motives Skidmore (2001).

Banks might not just be passive receivers of deposits. Any shortage of funding can be compensated through more intense competition for deposits by increasing deposit rates, as has been shown by Barth, Miller, Sun and Zhang (2022) and Dlugosz et al. (2022), but this depends on their market power. Alternatively, banks can try to access the market for brokered deposits to make up any shortfall in funding (Barth, Miller, Sun and Zhang (2022)).

To investigate these channels in the context of droughts, we utilize data from the FDIC's Summary of Deposits (SOD). We also evaluate shifts in deposit rates using data sourced from Rate Watch. Both datasets are on the branch-level and encompass the majority of commercial banks operating in the US. The baseline regressions are structured as follows:

$$\mathtt{rate}_{i,b,c,s,t} = \beta_0 + \beta_1\ \mathtt{Drought}_{b,i,c,s,t} + \alpha_{i,b,c,s} + \mu_{s,t} + \varepsilon_{i,b,c,s,t} \tag{5}$$

where $\mathtt{rate}_{i,b,c,s,t}$ denotes either the annual growth rate of deposits or the deposit rate charged by bank *i*'s branch *b* located in county *c* of state *s* in year *t*. Three rates on common deposit products are examined: (i) interest-bearing checking account with a minimum balance of $0 (INTCK0K), (ii) money market deposit account with a minimum balance of $25,000 as a saving deposit (MM25K), and (iii) certificates of deposit with an account size of $10,000 for a tenor of 12 months (12CD10K). As previously stated, we only focus on active rate setters (approximately 10% of the sample) when using Rate Watch data to avoid double-counting. Therefore, the number of observations will be significantly lower in the case of interest rates compared to the analysis of deposits.

As in prior analyses, we control for time-invariant branch-specific factors ($\alpha_{i,b,c,s}$) and state-year fixed effects ($\mu_{s,t}$). The standard errors of the error term $\varepsilon_{i,b,c,s,t}$ are clustered at the branch-level, as our primary variable of interest, the drought variable, is now branch-specific.

5.1. Deposits

The analysis of deposits in Table 11 reveals that drought conditions lead to varying effects on deposit growth rates across different bank types, with single-state and single-county banks displaying distinctive patterns of response.

In Panels A and B, we observe that drought conditions are associated with increased deposit growth for single-state and single-county banks. Specifically, in Panel A, the coefficient for drought exposure is positive and significant for single-county banks, suggesting that deposits at these branches grew more rapidly during periods of severe drought compared to non-exposed branches. The magnitude of this effect is notable—single-county banks saw an increase in deposit growth rates of approximately 0.212 percentage points during drought periods. The positive coefficient for single-state banks indicates a similar pattern, though with a slightly smaller effect compared to single-county banks. This stronger impact for single-county banks may reflect their deeper ties to local communities, making them more responsive to local economic conditions, including the effects of drought.

However, this behavior changes following the 2012 reforms, with the growth of deposits slowing down. In Panel C, the results indicate that federal aid mitigated the changes in deposits in drought-affected areas. Furthermore, significant deposit outflows are observed in designated counties not affected by droughts, particularly for multi-state and multi-county banks. This suggests that while federal support helped stabilize deposits in designated areas, banks without exposure to droughts saw reduced deposit growth, potentially reflecting shifts in depositor behavior towards banks in designated areas.

Overall, the results indicate that single-state and single-county banks initially benefited from increased deposits during drought periods, but their deposit growth became more contingent on the availability of federal aid after 2012. Importantly, there is no strong evidence to suggest that access to additional deposits directly explains the changes in lending behavior observed during drought periods.

Table 11

5.2. *Deposit rates*

The prior results revealed that there were deposit inflows at drought-exposed single-county and single-state banks. This increase could be attributed to banks' liquidity hoarding behavior rather than depositor actions. Existing literature highlights that banks tend to hoard liquidity during periods of economic uncertainty (Berger et al., 2022), particularly during crisis periods (Acharya and Merrouche, 2013).

Following Berger et al. (2022), we analyze deposit interest rates to differentiate whether the observed deposit growth is driven by depositors or by banks. If depositors were increasing their savings, we would expect banks to reduce deposit rates in response to growing liquidity. Conversely, if banks were actively seeking additional deposits, we would expect an increase in deposit rates as banks compete to attract more funds.

We begin by examining checking account rates (INTCK0K), which are typically held for transactional purposes and may be less sensitive to interest rate changes. The results in Table 12 reveal that, overall, drought-affected banks adjusted their checking account rates differently before and after the 2012 reforms. In Panels A and B, single-state and multi-county banks tended to increase their deposit rates during drought periods. For instance, single-state banks raised their checking account rates by approximately 0.0012 percentage points in response to severe droughts prior to 2012. This suggests that these banks were actively competing for deposits to build their liquidity buffers during periods of uncertainty.

This pattern shifts after the 2012 reforms. We observe a reduction in interest rates for most bank types, including single-state banks, with a decrease of about 0.0016 percentage points in checking account rates across the whole sample after 2012. Additionally, the results in Panel C indicate that banks did not significantly adjust their interest rates following the 2012 reforms, as most coefficients are statistically insignificant.

Table 12

We further investigate savings account rates to understand whether the observed increases in deposits during droughts were primarily driven by banks' liquidity-hoarding strategies or by depositor behavior. Specifically, we examine the impact of droughts on interest rates for 12-month CDs (12MCD10K) with a minimum account size of $10,000, a common savings product in the U.S. (Granja et al., 2021).

Granja et al. (2021) found that banks often apply uniform deposit rates across their branches but adjust them in response to local economic conditions. Our results align with these findings, showing that local and medium-sized banks adjust their deposit rates in response to droughts, while multi-state banks display less significant changes.

The results in Table 13 indicate that, before the 2012 reforms, drought-exposed banks increased interest rates on CDs relative to non-affected banks. In Panel A, single-state banks raised their rates by approximately 0.0034 percentage points during severe droughts, while single-county banks increased their rates by about 0.0043 percentage points. This suggests that these banks actively competed for deposits, likely to strengthen their liquidity during times of economic stress.

After 2012, however, the situation changes. The interaction terms for droughts and post-2012 are negative and significant across most bank types, suggesting a shift in strategy. For example, single-state banks decreased their CD rates by approximately -0.0028 percentage points post-2012, indicating a reduced need for aggressive rate-setting due to improved liquidity from federal support. A decrease of 0.0028 percentage points, while seemingly small, reflects a strategic adjustment by banks, reducing the premium they previously offered to attract deposits.

In the post-2012 period, there is weak evidence that multi-county banks reduced their CD rates in non-designated counties relative to designated ones (Panel C). This pattern suggests that banks adjusted their deposit pricing based on the stability of funding flows, with designated counties benefiting from federal aid or insurance payments. In contrast, banks in non-designated areas likely felt greater pressure to attract deposits actively.

Overall, the observed trends suggest that banks' responses to droughts shifted from active competition for liquidity pre-2012 to a more stable approach post-2012, supported by public aid. This transition suggests that increased deposits at drought-exposed banks, especially those in designated areas, were driven more by precautionary savings behavior than by banks' competition for liquidity.

Table 13

In conclusion, our results reveal that local banks adjust their deposit policies in response to shifts in local economic conditions, particularly during periods of drought. We found that local banks, such as single-state and single-county banks, tend to increase deposit interest rates during drought periods, which likely reflects a strategy to bolster liquidity. This is corroborated by the observed increase in deposits at these banks during drought episodes. However, our findings suggest that this increase in liquidity does not directly translate into greater lending activity by these banks. Instead, it appears that the excess liquidity is channeled into the interbank market, where local banks lend to other financial institutions during drought periods. This behavior indicates that while local banks respond to drought-induced shifts in deposits, their lending practices remain largely unaffected, and their focus shifts towards managing liquidity through the interbank market.

6. Conclusion

This research provides insights into the adaptation strategies of commercial banks in response to drought periods within the US. We observe a surprising decrease in the issuance of new loans to small farms during drought conditions, diverging from the commonly held belief that loan demand increases following natural disasters. We posit that this anomaly stems from the unique characteristics of droughts which primarily affect agricultural yields rather than physical infrastructure, consequently decreasing the requirement for reconstruction-oriented loans.

An intriguing aspect of our analysis lies in the differential lending responses of banks in dryland versus irrigated counties. Single-state and single-county banks curtail lending in drought affected areas, particularly in dryland counties. Meanwhile, multi-state banks step in to fill the lending void in irrigated counties, potentially catering to the productivity enhancement needs of less affected farms.

Our exploration into the impact of droughts on non-agricultural sectors uncovers that such climatic events do not significantly modify the distribution of bank lending to these sectors. However, we note a strategic shift in lending behavior, as banks appear to increase their share of loans to individuals within drought-impacted regions. We hypothesize that this may be an intentional move to offset the decline in agricultural lending in these locales.

In assessing the efficacy of government intervention, we discern a stabilizing effect on new bank loans to farms during post-2012 drought periods, attributable to reforms aimed at improving access to emergency loans. This finding underscores the important role of policy measures in mitigating the financial impacts of climate shocks on the farming sector.

Interestingly, our findings indicate that drought conditions also induce changes in bank deposit behaviors. Local banks experience an increase in deposit growth during drought periods, which reversely post-2012 reforms. This, combined with an observed elevation in deposit rates during droughts, suggests that these banks may be adopting precautionary liquidity hoarding strategies.

Regarding deposit interest rates, our research indicates that local banks boost rates during drought seasons, perhaps as a mechanism to attract increased deposits and thereby strengthen their liquidity positions. Post-2012, however, these institutions seem to reduce their deposit rates, a trend which we speculate may be a response to enhanced liquidity brought about by expedited state-aid transfers to drought-impacted areas.

In essence, our findings illuminate the nuanced ways in which banks navigate local economic fluctuations and emphasize the crucial role of government intervention in alleviating the adverse effects of natural disasters on banking operations. These results underscore the necessity for carefully tailored policy responses to climatic events, which adequately account for variations in bank types and their geographical purview.

In the face of mounting climate change challenges, where increased incidence and severity of droughts are becoming a pressing reality, our understanding of banking adaptations to such conditions is crucial for the development of robust agricultural and financial policies. Future research that delves into the long-term consequences of shifts in lending behavior on agricultural sectors and rural economies could offer valuable direction for policy design.

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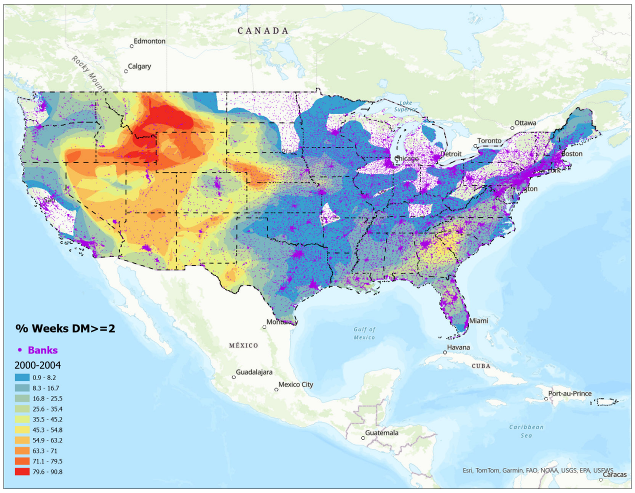
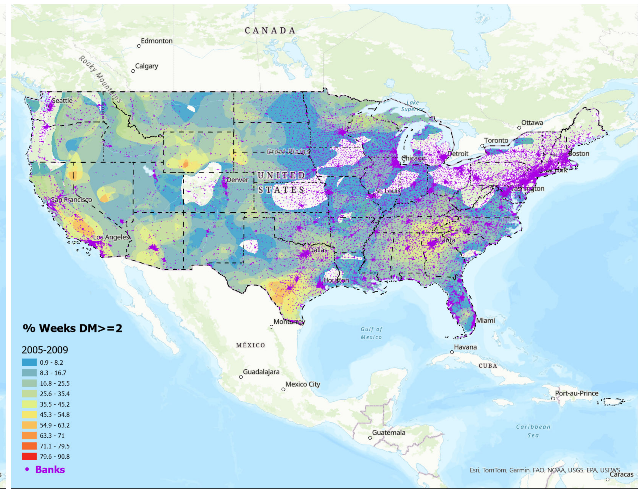
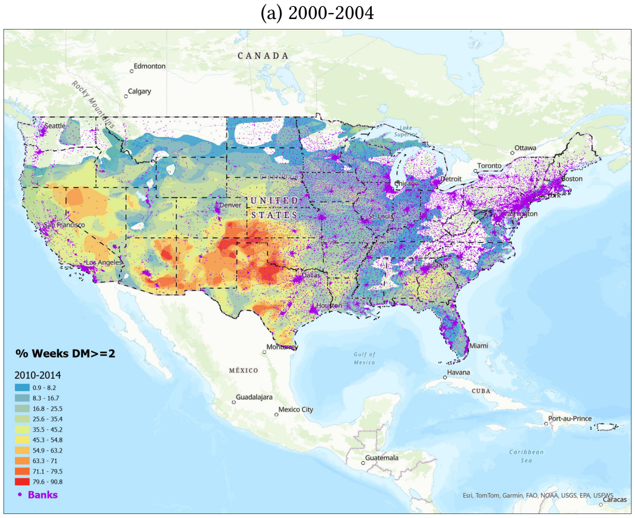
Figure 1: Weeks (%) of Growing Season with DM $\geqslant 2$



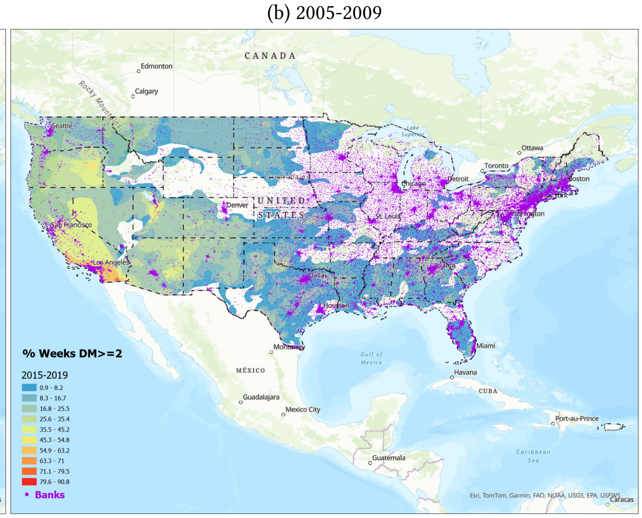
(a) 2000-2004



(b) 2005-2009



(c) 2010-2014



(d) 2015-2019

Table 1: Droughts and loans originated to small farms

The estimation period is 2000-2019. The estimations are done with the fixed effects estimator including bank-county and state-year fixed effects. The data covers lending to small farms reported by CRA regulations. ¡100k are small farm loans originated with loan amount of less than $100,000, as percentage of total assets. Similar definitions apply to columns (2)-(3) with higher loan amounts. The column 4 revenue ¡1m are loans originated to small farms with gross annual revenues of less than $1 million, as percentage of total assets. Standard errors are clustered by bank and year. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Loan amount			Revenue
	<100k	>100k <250k	>250k <1m	<1m
Panel A Drought index at least of level D3				
$Droughts_{3-4}$	-0.011*	-0.012**	-0.016***	-0.038**
	(-1.93)	(-2.03)	(-2.75)	(-2.55)
Observations	119,294	119,294	119,294	119,294
R^2	0.875	0.846	0.817	0.860
Panel B Drought index at least of level D3 with interaction				
$Droughts_{3-4}$	-0.010	-0.009	-0.015	-0.033
	(-0.99)	(-0.95)	(-1.59)	(-1.27)
$Droughts_{3-4}$*post 2012	-0.002	-0.006	-0.003	-0.011
	(-0.22)	(-0.46)	(-0.26)	(-0.36)
Observations	119,294	119,294	119,294	119,294
R^2	0.875	0.846	0.817	0.860
Panel C Drought index at least of level D2				
$Droughts_{2-4}$	-0.016***	-0.009*	-0.013**	-0.039***
	(-2.90)	(-1.69)	(-2.39)	(-2.71)
Observations	119,294	119,294	119,294	119,294
R^2	0.875	0.846	0.817	0.860
Panel D Drought index at least of level D2 with interaction				
$Droughts_{2-4}$	-0.020**	-0.007	-0.011	-0.042*
	(-2.40)	(-0.88)	(-1.34)	(-1.83)
$Droughts_{2-4}$*post 2012	0.011	-0.004	-0.004	0.007
	(1.25)	(-0.46)	(-0.46)	(0.27)
Observations	119,294	119,294	119,294	119,294
R^2	0.875	0.846	0.817	0.860

Table 2: Droughts and loans originated to small businesses

The estimation period is 2000-2019. The estimations are done with the fixed effects estimator including bank-county and state-year fixed effects. The data covers lending to small business reported by CRA regulations. ¡100k are small business loans originated with loan amount of less than $100,000, as percentage of total assets. Similar definitions apply to columns (2)-(3) with higher loan amounts. The column 4 revenue ¡1m are loans originated to small business with gross annual revenues of less than $1 million, as percentage of total assets. Standard errors are clustered by bank and year. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Loan amount			Revenue
	<100k	>100k <250k	>250k <1m	<1m
Panel A Drought index at least of level D3				
$Droughts_{3-4}$	-0.023*	-0.034**	-0.108***	-0.085**
	(-1.90)	(-2.21)	(-3.29)	(-2.38)
Observations	248,989	248,989	248,989	248,989
R^2	0.797	0.759	0.733	0.753
Panel B Drought index at least of level D3 with interaction				
$Droughts_{3-4}$	-0.020	-0.033	-0.110**	-0.107*
	(-1.00)	(-1.27)	(-2.17)	(-1.76)
$Droughts_{3-4}$*post 2012	-0.005	-0.002	0.005	0.047
	(-0.24)	(-0.08)	(0.09)	(0.70)
Observations	248,989	248,989	248,989	248,989
R^2	0.797	0.759	0.733	0.753
Panel C Drought index at least of level D2				
$Droughts_{2-4}$	-0.025***	-0.026**	-0.071***	-0.078***
	(-2.69)	(-2.19)	(-2.76)	(-2.71)
Observations	248,989	248,989	248,989	248,989
R^2	0.797	0.759	0.733	0.753
Panel D Drought index at least of level D2 with interaction				
$Droughts_{2-4}$	-0.030**	-0.025	-0.062	-0.101**
	(-2.08)	(-1.39)	(-1.63)	(-2.28)
$Droughts_{2-4}$*post 2012	0.012	-0.002	-0.022	0.056
	(0.72)	(-0.09)	(-0.50)	(1.20)
Observations	248,989	248,989	248,989	248,989
R^2	0.797	0.759	0.733	0.753

Table 3: Droughts and loans originated to small farms after 2012

The estimation period is 2012-2019. The estimations are done with the fixed effects estimator including bank-county and state-year fixed effects. The data covers lending to small farms reported by CRA regulations. ¡100k are small farm loans originated with loan amount of less than $100,000, as percentage of total assets. Similar definitions apply to columns (2)-(3) with higher loan amounts. The column 4 revenue ¡1m are loans originated to small farms with gross annual revenues of less than $1 million, as percentage of total assets. Standard errors are clustered by bank and year. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Loan amount			Revenue
	<100k	>100k <250k	>250k <1m	<1m
Panel A: Drought index at least of level D3				
$Droughts_{3-4}$	0.001	0.007**	0.007*	0.008
	(0.59)	(2.51)	(1.77)	(1.46)
Observations	49,630	49,630	49,630	49,630
R^2	0.962	0.942	0.930	0.963
Panel B: Drought index at least of level D3 with interactions				
$Droughts_{3-4}$	0.005	0.011	0.009	0.008
	(0.60)	(0.92)	(0.53)	(0.33)
Designated	0.000	0.000	0.000	0.000
	(1.31)	(0.75)	(0.73)	(0.54)
$Droughts_{3-4}$*Designated	-0.005	-0.005	-0.002	-0.001
	(-0.58)	(-0.41)	(-0.12)	(-0.03)
Observations	49,630	49,630	49,630	49,630
R^2	0.962	0.942	0.930	0.963
Panel C: Drought index at least of level D2				
$Droughts_{2-4}$	0.001	0.005**	0.006*	0.005
	(0.96)	(2.33)	(1.86)	(1.11)
Observations	49,630	49,630	49,630	49,630
R^2	0.962	0.942	0.930	0.963
Panel D: Drought index at least of level D2 with interactions				
$Droughts_{2-4}$	0.006	0.009	0.013	0.015
	(0.96)	(1.12)	(1.10)	(0.80)
Designated	0.000	0.000	0.000	0.000
	(1.37)	(0.64)	(0.71)	(0.77)
$Droughts_{2-4}$*Designated	-0.006	-0.006	-0.010	-0.014
	(-0.94)	(-0.69)	(-0.78)	(-0.69)
Observations	49,630	49,630	49,630	49,630
R^2	0.962	0.942	0.930	0.963
Includes in addition bank-time fixed effects				
$Droughts_{2-4}$	0.003	0.002	0.003	-0.002
	(0.95)	(0.47)	(0.60)	(-0.32)
Designated	0.000	0.000	0.000	0.000
	(1.32)	(0.19)	(0.54)	(0.95)
$Drought_{2-4}$*Designated	-0.002	0.0001	0.0003	0.006
	(-0.84)	(0.03)	(0.06)	(0.71)
Observations	49,061	49,061	49,061	49,061
R^2	0.962	0.952	0.946	0.966

Table 4: Total loans

The estimation period is 2001-2020. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are total loans in percent of assets reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	0.001	0.015	0.012	0.046	0.006	0.021*
	(0.09)	(1.47)	(1.15)	(1.40)	(0.41)	(1.89)
Droughts*post 2012		-0.039*	-0.038*	-0.075*	-0.032	-0.061***
		(-1.89)	(-1.85)	(-1.84)	(-1.17)	(-3.32)
Observations	136,322	136,322	126,108	10,087	67,698	68,165
R^2	0.787	0.787	0.789	0.842	0.816	0.787
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	-0.002	0.003	0.004	-0.019	-0.001	0.005
	(-0.32)	(0.53)	(0.58)	(-0.97)	(-0.06)	(0.70)
Droughts*post 2012		-0.028	-0.030	-0.009	-0.025	-0.045**
		(-1.43)	(-1.56)	(-0.29)	(-1.02)	(-2.57)
Observations	136,322	136,322	126,108	10,087	67,698	68,165
R^2	0.787	0.787	0.789	0.842	0.816	0.787
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.023***	-0.019	-0.019	-0.069**	-0.040	-0.014
	(-2.91)	(-1.21)	(-1.09)	(-2.14)	(-1.39)	(-0.82)
Designated		-0.126	-0.153	-0.297	-0.321*	0.003
		(-1.38)	(-1.54)	(-1.27)	(-1.96)	(0.03)
Drought*Designated		-0.001	-0.002	0.077**	0.031	-0.010
		(-0.07)	(-0.12)	(2.01)	(1.00)	(-0.53)
Observations	52,471	52,471	46,865	5,524	22,508	29,783
R^2	0.902	0.902	0.901	0.916	0.909	0.896

Table 5: The impact of droughts on agricultural production and farm loans

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans to finance agricultural production and other loans to farmers in percent of total loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	-0.023***	-0.010***	-0.013***	0.014	-0.017***	-0.006
	(-6.39)	(-3.06)	(-3.74)	(1.41)	(-3.39)	(-1.41)
Droughts*post 2012		-0.035***	-0.033***	-0.016	-0.031***	-0.028***
		(-5.15)	(-4.67)	(-1.37)	(-2.92)	(-4.56)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.946	0.946	0.947	0.968	0.955	0.952
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	-0.014***	-0.006***	-0.008***	0.010*	-0.010***	-0.004
	(-5.83)	(-2.88)	(-3.59)	(1.84)	(-3.19)	(-1.51)
Droughts*post 2012		-0.038***	-0.037***	-0.014	-0.037***	-0.030***
		(-5.57)	(-5.17)	(-1.57)	(-3.38)	(-5.20)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.946	0.946	0.947	0.968	0.955	0.952
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.007**	-0.017***	-0.020***	0.003	-0.040***	0.002
	(-2.39)	(-3.19)	(-3.26)	(0.31)	(-4.28)	(0.32)
Designated		-0.061	-0.063	-0.028	-0.089	-0.010
		(-1.57)	(-1.50)	(-0.42)	(-1.34)	(-0.23)
Drought*Designated		0.015**	0.017***	0.001	0.037***	-0.006
		(2.46)	(2.61)	(0.05)	(3.69)	(-0.79)
Observations	52,817	52,817	46,805	5,929	22,384	30,251
R^2	0.973	0.973	0.974	0.979	0.976	0.974

Table 6: The impact of droughts on agricultural production and farm loans at agricultural banks

The estimation period is 2001-2020. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans to finance agricultural production and other loans to farmers in percent of total loans reported in the call reports. In column (1) and (3) agricultural bank are defined as banks were agricultural production and farm loans represent at least 15% and 25% of total loans, respectively. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Agricultural banks	Other banks	Agricultural banks	Other banks
Panel A Drought index at least of level D3				
$Droughts_{3-4}$	-0.044**	-0.006***	-0.052*	-0.008***
	(-2.38)	(-2.83)	(-1.84)	(-2.80)
Droughts*post 2012	-0.115***	-0.012***	-0.102***	-0.024***
	(-4.52)	(-3.14)	(-2.72)	(-4.40)
Observations	24,884	111,569	13,309	123,144
R^2	0.809	0.825	0.705	0.884
Panel B Drought index at least of level D2				
$Droughts_{2-4}$	-0.012	-0.006***	-0.017	-0.006***
	(-1.02)	(-4.63)	(-0.98)	(-3.44)
Droughts*post 2012	-0.144***	-0.011***	-0.135***	-0.026***
	(-6.01)	(-3.24)	(-4.09)	(-4.70)
Observations	24,884	111,569	13,309	123,144
R^2	0.809	0.825	0.705	0.884
Panel C Drought index at least of level D2, post-2012				
$Droughts_{2-4}$	-0.026	-0.017***	-0.011	-0.020***
	(-0.84)	(-4.76)	(-0.23)	(-4.89)
Designated	-0.095	-0.032	-0.133	-0.027
	(-0.53)	(-1.45)	(-0.50)	(-0.87)
Drought*Designated	0.018	0.013***	0.017	0.013***
	(0.62)	(3.28)	(0.37)	(2.76)
Observations	9,600	43,217	5,098	47,719
R^2	0.907	0.924	0.852	0.950

Table 7: The impact of droughts on agricultural production and farm loans for dryland and irrigated counties
The estimation period is 2001-2020. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is loans to agriculture in percent of total loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Dryland Counties				Irrigated Counties			
	Single state	Multi state	Single county	Multi county	Single state	Multi state	Single county	Multi county
Panel A: Drought index at least of level D3								
$Droughts_{3-4}$	-0.018***	-0.019***	-0.010	-0.021***	-0.012**	-0.016***	0.035*	-0.019**
	(-4.15)	(-4.24)	(-1.16)	(-3.05)	(-2.12)	(-2.72)	(1.74)	(-2.57)
Droughts * post 2012	-0.054***	0.021	-0.058***	-0.042***	-0.015*	-0.039*	-0.015	-0.020**
	(-4.45)	(1.21)	(-3.15)	(-3.67)	(-1.78)	(-1.80)	(-1.25)	(-2.16)
Observations	92,803	85,980	6,698	46,106	37,716	34,728	2,895	18,978
R^2	0.944	0.944	0.968	0.950	0.950	0.951	0.971	0.960
Panel B: Drought index at least of level D2								
$Droughts_{2-4}$	-0.009***	-0.009***	0.003	-0.009*	-0.010***	-0.013***	0.017*	-0.016***
	(-3.00)	(-3.21)	(0.36)	(-1.91)	(-2.81)	(-3.40)	(1.70)	(-3.30)
Droughts * post 2012	-0.061***	0.008	-0.068***	-0.045***	-0.019**	-0.021*	-0.019	-0.020***
	(-4.80)	(0.40)	(-3.62)	(-3.72)	(-2.35)	(-1.74)	(-1.59)	(-2.88)
Observations	92,803	85,980	6,698	46,106	37,716	34,728	2,895	18,978
R^2	0.944	0.944	0.968	0.950	0.950	0.951	0.971	0.960
Panel C: Drought index at least of level D2, post-2012								
$Droughts_{2-4}$	-0.022***	-0.026***	0.018	-0.039***	-0.015	-0.015	-0.009	-0.045**
	(-2.97)	(-3.23)	(1.49)	(-3.59)	(-1.58)	(-1.42)	(-0.47)	(-2.58)
Designated	-0.052	-0.104	-0.065	-0.018	-0.042	0.208	-0.043	0.062
	(-1.00)	(-1.16)	(-0.76)	(-0.34)	(-0.51)	(1.37)	(-0.36)	(0.66)
Drought * Designated	0.012	-0.004	0.021	-0.011	0.016	0.002	0.046***	-0.011
	(1.34)	(-0.26)	(1.63)	(-1.15)	(1.34)	(0.12)	(2.60)	(-0.87)
Observations	36,411	32,587	3,750	15,707	13,811	12,153	1,601	7,852
R^2	0.974	0.974	0.982	0.975	0.972	0.973	0.979	0.978

Table 8: Loans to individuals for household, family, and other personal expenditures

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans secured by real estate in percent of loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
Droughts_{3-4}	0.039***	0.050***	0.050***	0.022	0.050***	0.045***
	(6.99)	(10.46)	(10.29)	(1.27)	(7.06)	(8.77)
Droughts*post 2012		-0.029**	-0.027**	-0.025	-0.013	-0.034***
		(-2.27)	(-1.99)	(-1.19)	(-0.60)	(-3.42)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.657	0.657	0.661	0.738	0.691	0.680
Panel B Drought index at least of level D2						
Droughts_{2-4}	0.026***	0.028***	0.028***	0.007	0.032***	0.022***
	(8.24)	(10.34)	(10.24)	(0.87)	(7.80)	(7.46)
Droughts*post 2012		-0.011	-0.008	-0.011	0.003	-0.012
		(-0.93)	(-0.65)	(-0.76)	(0.17)	(-1.48)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.657	0.657	0.660	0.738	0.691	0.679
Panel C Drought index at least of level D2, post-2012						
Droughts_{2-4}	0.023***	0.033***	0.034***	0.019*	0.038***	0.027***
	(7.99)	(5.70)	(5.40)	(1.66)	(3.62)	(4.71)
Designated		-0.016	-0.028	0.033	-0.128**	0.046
		(-0.46)	(-0.76)	(0.50)	(-2.22)	(1.38)
Drought*Designated		-0.013*	-0.013	-0.006	-0.011	-0.015**
		(-1.82)	(-1.64)	(-0.51)	(-0.87)	(-2.27)
Observations	52,817	52,817	46,805	5,929	22,384	30,251
R^2	0.919	0.919	0.921	0.929	0.929	0.920

Table 9: Loans Secured by Real Estate: Farmland vs. 1–4 Family Residential Properties

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans secured by real estate in percent of loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown, and *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Secured by Farmland				Secured by Family Residential Properties			
	Single state	Multi state	Single county	Multi county	Single state	Multi state	Single county	Multi county
Panel A: Drought index at least of level D3								
$Droughts_{3-4}$	0.010***	0.010***	0.003	0.007*	-0.042***	-0.038***	-0.106***	-0.030***
	(3.03)	(3.07)	(0.30)	(1.65)	(-5.79)	(-5.12)	(-3.57)	(-3.05)
Droughts * post 2012	-0.010	0.004	-0.006	-0.013**	0.076***	0.116***	0.060***	0.074***
	(-1.37)	(0.35)	(-0.58)	(-1.96)	(5.93)	(3.29)	(2.98)	(6.09)
Observations	136,453	125,790	10,538	67,307	136,453	125,790	10,538	67,307
R^2	0.901	0.900	0.951	0.906	0.908	0.911	0.916	0.925
Panel B: Drought index at least of level D2								
$Droughts_{2-4}$	0.005**	0.005**	-0.001	0.002	-0.020***	-0.018***	-0.046**	-0.015***
	(2.38)	(2.34)	(-0.18)	(0.80)	(-4.69)	(-4.24)	(-2.54)	(-2.60)
Droughts * post 2012	-0.005	0.007	-0.002	-0.009	0.058***	0.062**	0.046***	0.055***
	(-0.82)	(0.86)	(-0.16)	(-1.62)	(5.48)	(2.01)	(2.58)	(5.53)
Observations	136,453	125,790	10,538	67,307	136,453	125,790	10,538	67,307
R^2	0.901	0.900	0.951	0.906	0.908	0.911	0.916	0.925
Panel C: Drought index at least of level D2, post-2012								
$Droughts_{2-4}$	-0.029***	-0.031***	-0.006	-0.019*	-0.030**	-0.027*	-0.031	-0.008
	(-4.90)	(-4.62)	(-0.79)	(-1.89)	(-2.26)	(-1.92)	(-0.97)	(-0.36)
Designated	-0.138***	-0.030	-0.030	-0.215***	0.092	0.264	0.158	0.016
	(-3.18)	(-0.45)	(-0.41)	(-4.99)	(1.16)	(1.60)	(1.24)	(0.19)
Drought * Designated	0.033***	0.008	0.018	0.032***	0.007	-0.021	-0.008	0.018
	(4.37)	(0.78)	(1.64)	(3.94)	(0.49)	(-0.60)	(-0.36)	(1.15)
Observations	52,817	46,805	5,929	22,384	52,817	46,805	5,929	22,384
R^2	0.956	0.955	0.974	0.954	0.959	0.960	0.959	0.964

Table 10: The impact of droughts on non-performing loans

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is 100*NPL/TL reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets, t-statistics are shown, and *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	-0.017***	-0.014***	-0.014***	-0.003	-0.014***	-0.011***
	(-6.90)	(-4.36)	(-4.22)	(-0.22)	(-3.49)	(-3.04)
Droughts*post 2012		-0.009**	-0.009**	-0.008	-0.005	-0.014***
		(-2.20)	(-2.18)	(-0.62)	(-0.92)	(-2.94)
Observations	134,572	134,572	125,054	9,390	66,949	67,167
R^2	0.490	0.490	0.487	0.660	0.496	0.546
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	-0.009***	-0.006***	-0.006***	-0.002	-0.007**	-0.005**
	(-4.68)	(-2.84)	(-2.71)	(-0.27)	(-2.19)	(-2.33)
Droughts*post 2012		-0.015***	-0.015***	-0.009	-0.012**	-0.019***
		(-4.22)	(-4.10)	(-0.91)	(-2.30)	(-4.56)
Observations	134,572	134,572	125,054	9,390	66,949	67,167
R^2	0.490	0.490	0.487	0.660	0.496	0.546
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.017***	-0.028***	-0.027***	-0.024**	-0.025**	-0.029***
	(-6.96)	(-4.52)	(-4.03)	(-2.04)	(-2.46)	(-4.60)
Designated		-0.078***	-0.087***	-0.010	-0.073	-0.084***
		(-2.93)	(-2.95)	(-0.18)	(-1.50)	(-3.12)
Drought*Designated		0.017***	0.017**	0.016	0.017*	0.016**
		(2.74)	(2.40)	(1.29)	(1.72)	(2.49)
Observations	52,170	52,170	46,636	5,453	22,282	29708
R^2	0.665	0.666	0.661	0.760	0.661	0.687
Panel D Drought index at least of level D2, post-2013						
$Droughts_{2-4}$	-0.016***	-0.037***	-0.063***	0.000	-0.063**	-0.031***
	(-6.32)	(-3.81)	(-4.63)	(0.02)	(-2.56)	(-3.11)
Designated		-0.076***	-0.086***	0.019	-0.081*	-0.068**
		(-2.90)	(-3.00)	(0.35)	(-1.71)	(-2.48)
Drought*Designated		0.024**	0.050***	-0.012	0.053**	0.015
		(2.44)	(3.65)	(-0.87)	(2.13)	(1.50)
Observations	45,236	45,236	40,269	4,875	19,026	,
R^2	0.683	0.683	0.677	0.785	0.676	0.703

Table 11: The impact of droughts on deposits

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is the annual growth rate of branch deposits. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown, and *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	0.0171	0.0280	0.144***	-0.0382*	0.212***	0.0071
	(1.56)	(1.62)	(4.92)	(-1.77)	(3.35)	(0.39)
Droughts*post 2012		-0.022	-0.076*	0.0145	-0.183**	-0.0024
		(-1.03)	(-1.95)	(0.54)	(-2.28)	(-0.11)
Observations	167,2750	167,2750	594,728	1,072,780	129,378	1,541,466
R^2	0.194	0.194	0.253	0.201	0.295	0.196
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	0.0163**	0.0308**	0.0886***	0.0020	0.130***	0.0204
	(1.99)	(2.43)	(4.24)	(0.13)	(2.97)	(1.54)
Droughts*post 2012		-0.0307*	-0.0252	-0.0400**	-0.0785	-0.0253
		(-1.92)	(-0.89)	(-2.02)	(-1.32)	(-1.52)
Observations	167,2750	167,2750	594,728	1,072,780	129,378	1,541,466
R^2	0.194	0.194	0.253	0.201	0.295	0.196
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.0162	-0.108	0.0253	-0.157	0.0102	-0.110
	(-1.51)	(-1.38)	(0.20)	(-1.62)	(0.05)	(-1.32)
Designated		-0.472***	-0.326	-0.641***	-0.231	-0.512***
		(-3.04)	(-1.21)	(-3.33)	(-0.45)	(-3.15)
Drought*Designated		0.101	0.0153	0.126	-0.0168	0.104
		(1.28)	(0.12)	(1.31)	(-0.09)	(1.26)
Observations	679,516	679,516	205,383	471,219	40,850	637,645
R^2	0.286	0.286	0.347	0.277	0.364	0.286

Table 12: The impact of droughts on the interest rate on checking accounts (INTCK0K)

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is the interest rate on 0k interest checking accounts. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	0.0001	0.0008**	0.0012***	0.0003	0.0007	0.0009**
	(0.53)	(2.14)	(2.88)	(0.37)	(1.15)	(1.98)
Droughts*post 2012		-0.0016***	-0.0017***	-0.0013	-0.0013*	-0.0018***
		(-3.74)	(-3.50)	(-1.60)	(-1.73)	(-3.42)
Observations	132,841	132,841	92,332	30,690	40,027	82,838
R^2	0.730	0.731	0.743	0.751	0.737	0.753
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	0.0001	0.0006**	0.0010***	0.0001	0.0007	0.0007**
	(0.36)	(2.44)	(3.39)	(0.15)	(1.56)	(2.34)
Droughts*post 2012		-0.0013***	-0.0015***	-0.0009	-0.0014***	-0.0013***
		(-4.53)	(-4.36)	(-1.61)	(-2.58)	(-3.79)
Observations	132,841	132,841	92,332	30,690	40,027	82,838
R^2	0.730	0.731	0.743	0.751	0.737	0.753
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.0001	-0.0001	-0.0001	-0.0003	0.0001	-0.0003
	(-1.52)	(-0.84)	(-0.63)	(-1.49)	(0.20)	(-1.24)
Designated		-0.0028	-0.0046	-0.00004	-0.0101	-0.0010
		(-1.03)	(-1.17)	(-0.02)	(-1.04)	(-0.74)
Drought*Designated		0.0001	0.00002	0.0002	-0.0003	0.0002
		(0.29)	(0.07)	(0.76)	(-0.88)	(1.00)
Observations	56,266	56,266	37,297	12,468	15,968	33,693
R^2	0.635	0.635	0.573	0.707	0.510	0.728

Table 13: The impact of droughts on the interest rate of certificates of deposits (12MCD10K)

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is the interest rate on 12-month 10k certificates of deposits. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	0.0016***	0.0030***	0.0034***	0.0016	0.0043***	0.0019***
	(5.32)	(6.62)	(6.65)	(1.60)	(5.39)	(3.41)
Droughts*post 2012		-0.0032***	-0.0032***	-0.0028**	-0.0039***	-0.0026***
		(-5.78)	(-4.84)	(-2.24)	(-3.78)	(-3.72)
Observations	138,284	138,284	94,884	31,845	41,202	85,384
R^2	0.958	0.958	0.959	0.962	0.961	0.959
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	0.0011***	0.0020***	0.0023***	0.0011	0.0024***	0.0017***
	(4.84)	(6.04)	(5.97)	(1.57)	(3.99)	(4.08)
Droughts*post 2012		-0.0022***	-0.0026***	-0.0010	-0.0028***	-0.0020***
		(-5.22)	(-5.27)	(-1.10)	(-3.63)	(-3.78)
Observations	138,284	138,284	94,884	31,845	41,202	85,384
R^2	0.958	0.958	0.959	0.962	0.961	0.959
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.0001	-0.0004	-0.00003	-0.0007	0.0006	-0.0012**
	(-0.28)	(-0.84)	(-0.06)	(-0.72)	(0.87)	(-2.22)
Designated		-0.0002	-0.0038	0.0096	-0.0073	0.0024
		(-0.04)	(-0.79)	(1.20)	(-0.98)	(0.47)
Drought*Designated		0.0004	-0.00001	0.0010	-0.0008	0.0012*
		(0.75)	(-0.01)	(0.83)	(-0.87)	(1.89)
Observations	59,874	59,874	39,024	13,155	16,678	35,394
R^2	0.753	0.753	0.756	0.763	0.770	0.761

Table A1: Summary statistics

Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Panel A: CRA dataset						
Amount <100k	The total amount of small farm loans originated, with loan amount with less than $100,000, as a percentage of bank assets	119,294	0.04	0.21	0	13.19
Amount >100k <250k	The total amount of small farm loans originated, with loan amount in the range of $100000-$250000, as a percentage of bank assets	119,294	0.04	0.18	0	9.08
Amount >250k<1m	The total amount of small farm loans originated, with loan amount in the range of $250000-1 million, as a percentage of bank assets	119,294	0.03	0.16	0	8.16
Amount firms revenue <1m	The total amount of loans originated to small businesses, with gross annual revenues < $1 million, as a percentage of banks assets	119,294	0.10	0.44	0	22.10
$Droughts_{3-4}$	Number of weeks (divided by 100) within the growing season for which the drought index is at least level D3	119,294	0.03	0.06	0	0.27
$Droughts_{2-4}$	Number of weeks (divided by 100) within the growing season for which the drought index is at least level D2	119,294	0.01	0.04	0	0.27

Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Panel B: Call Reports dataset						
Total loans	Total loans as a percentage of total assets	136,453	63.75	15.93	0.01	91.40
Agriculture loans	Loans to finance agricultural production and other loans to farmers as a percentage of total loans	136,453	7.26	12.33	0	55.91
Industry loans	Commercial and industrial loans to U.S. address as a percentage of total loans	136,453	3.46	7.99	0	53.87
Individual loans	Loans to individuals for household, family and other personal expenditures as a percentage of total loans	136,453	2.62	5.26	0	33.02
Real estate loans	Loans secured by real estate as a percentage of total loans	136,453	58.62	25.49	0.91	99.66
Loans, RE, farmland	Loans secured by farmland as a percentage of total loans	136,453	6.97	9.28	0	39.56
Loans, RE, 1-4 residential	Loans secured secured by 1–4 family residential properties as a percentage of total loans	136,453	29.04	19.65	0	92.34
Loans, RE, multi-residential	Loans secured by by multifamily (5 or more) residential properties as a percentage of total loans	136,453	2.39	3.63	0	21.17
Loans, RE, non-farm	Loans secured by nonfarm nonresidential property as a percentage of total loans	136,453	15.58	17.27	0	65.74
NPL, RE, farmland, non-accrual	Loans secured by real estate (in domestic offices): for which the secured by farmland - nonaccrual, as percent of total loans	136,453	0.05	0.18	0	1.29
$Droughts_{3-4}$	Number of weeks within the growing season for which the drought index is at least level D3	136,453	1.11	3.91	0	27
$Droughts_{2-4}$	Number of weeks within the growing season for which the drought index is at least level D2	136,453	2.60	5.97	0	27

Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Panel C: *SoD dataset*						
Deposit growth	Annual growth rate of branch deposits	1,672,750	11.44	35.95	-100	248.15
Droughts_{3-4}	Number of weeks within the growing season for which the drought index is at least level D3	1,672,750	1.17	4.46	0	27
Droughts_{2-4}	Number of weeks within the growing season for which the drought index is at least level D2	1,672,750	2.63	6.44	0	27
Panel D: Rate Watch dataset						
MM25K	Money market deposit account with minimum balance $25,000	131,804	0.73	0.78	0	5.40
12MCD10K	Certificates of deposit with an account size $10,000 for a tenor of 12 month	138,303	1.52	1.32	0	6.60
INTCK0K	Interest-bearing checking account with minimum balance $0	132,855	0.27	0.34	0.001	10.47
Construction loans 175K	Construction loans of less than $170,000	14,025	5.95	1.39	0	11.98
Droughts_{3-4}	Number of weeks within the growing season for which the drought index is at least level D3	131,804	1.08	3.91	0	27
Droughts_{2-4}	Number of weeks within the growing season for which the drought index is at least level D2	131,804	2.55	6.01	0	27

Table A2: Commercial and industrial loans to U.S. address

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans secured by real estate in percent of loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	0.005	-0.000	-0.002	0.000	-0.000	0.006
	(0.81)	(-0.08)	(-0.32)	(0.01)	(-0.07)	(0.81)
Droughts*post 2012		0.014	0.016	-0.035	0.018	0.001
		(1.08)	(1.33)	(-1.04)	(0.78)	(0.09)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.729	0.729	0.701	0.819	0.684	0.759
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	0.003	0.001	-0.000	-0.005	-0.001	0.006
	(0.94)	(0.22)	(-0.02)	(-0.32)	(-0.22)	(1.32)
Droughts*post 2012		0.013	0.015	-0.030	0.018	0.001
		(1.01)	(1.21)	(-1.06)	(0.80)	(0.11)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.729	0.729	0.701	0.819	0.684	0.759
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	0.011*	0.005	0.009	-0.032	0.012	-0.000
	(1.74)	(0.59)	(1.21)	(-1.25)	(1.19)	(-0.01)
Designated		0.016	0.0107	-0.031	-0.008	-0.037
		(0.24)	(0.16)	(-0.14)	(-0.09)	(-0.41)
Drought*Designated		0.009	0.003	0.051	-0.014	0.030**
		(0.75)	(0.23)	(1.63)	(-0.96)	(2.13)
Observations	52,817	52,817	46,805	5,929	22,384	30,251
R^2	0.820	0.820	0.792	0.873	0.790	0.827

Table A3: Loans secured by real estate

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans secured by real estate in percent of loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown, and *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	0.007	-0.020	-0.012	0.070	-0.029	0.029
	(0.34)	(-0.88)	(-0.56)	(1.24)	(-0.98)	(1.11)
Droughts*post 2012		0.070	0.062	-0.066	0.058	0.001
		(1.60)	(1.42)	(-1.04)	(0.98)	(0.02)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.819	0.819	0.821	0.883	0.828	0.853
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	0.026*	0.021	0.029*	-0.003	0.015	0.039***
	(1.84)	(1.42)	(1.90)	(-0.09)	(0.77)	(2.67)
Droughts*post 2012		0.030	0.019	0.005	0.015	-0.013
		(0.77)	(0.51)	(0.11)	(0.29)	(-0.51)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.819	0.819	0.821	0.883	0.828	0.853
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.036***	-0.020	-0.019	0.010	0.023	-0.052***
	(-4.14)	(-1.48)	(-1.36)	(0.29)	(1.09)	(-3.17)
Designated		0.094	0.123	0.042	0.315**	-0.082
		(1.10)	(1.32)	(0.20)	(2.17)	(-0.83)
Drought*Designated		-0.025	-0.025	-0.061*	-0.056**	0.0002
		(-1.60)	(-1.53)	(-1.72)	(-2.41)	(0.01)
Observations	52,817	52,817	46,805	5,929	22,384	30,251
R^2	0.940	0.940	0.941	0.943	0.948	0.936

Table A1: Summary statistics

Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Panel A: CRA dataset						
Amount $<$100k	The total amount of small farm loans originated, with loan amount with less than $100,000, as a percentage of bank assets	119,294	0.04	0.21	0	13.19
Amount $>$100k $<$250k	The total amount of small farm loans originated, with loan amount in the range of $100000-$250000, as a percentage of bank assets	119,294	0.04	0.18	0	9.08
Amount $>$250k$<$1m	The total amount of small farm loans originated, with loan amount in the range of $250000-1 million, as a percentage of bank assets	119,294	0.03	0.16	0	8.16
Amount firms revenue $<$1m	The total amount of loans originated to small businesses, with gross annual revenues $<$ $1 million, as a percentage of banks assets	119,294	0.10	0.44	0	22.10
Droughts_{3-4}	Number of weeks (divided by 100) within the growing season for which the drought index is at least level D3	119,294	0.03	0.06	0	0.27
Droughts_{2-4}	Number of weeks (divided by 100) within the growing season for which the drought index is at least level D2	119,294	0.01	0.04	0	0.27

Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Panel B: Call Reports dataset						
Total loans	Total loans as a percentage of total assets	136,453	63.75	15.93	0.01	91.40
Agriculture loans	Loans to finance agricultural production and other loans to farmers as a percentage of total loans	136,453	7.26	12.33	0	55.91
Industry loans	Commercial and industrial loans to U.S. address as a percentage of total loans	136,453	3.46	7.99	0	53.87
Individual loans	Loans to individuals for household, family and other personal expenditures as a percentage of total loans	136,453	2.62	5.26	0	33.02
Real estate loans	Loans secured by real estate as a percentage of total loans	136,453	58.62	25.49	0.91	99.66
Loans, RE, farmland	Loans secured by farmland as a percentage of total loans	136,453	6.97	9.28	0	39.56
Loans, RE, 1-4 residential	Loans secured secured by 1–4 family residential properties as a percentage of total loans	136,453	29.04	19.65	0	92.34
Loans, RE, multi-residential	Loans secured by by multifamily (5 or more) residential properties as a percentage of total loans	136,453	2.39	3.63	0	21.17
Loans, RE, non-farm	Loans secured by nonfarm nonresidential property as a percentage of total loans	136,453	15.58	17.27	0	65.74
NPL, RE, farmland, non-accrual	Loans secured by real estate (in domestic offices): for which the secured by farmland - nonaccrual, as percent of total loans	136,453	0.05	0.18	0	1.29
Droughts_{3-4}	Number of weeks within the growing season for which the drought index is at least level D3	136,453	1.11	3.91	0	27
Droughts_{2-4}	Number of weeks within the growing season for which the drought index is at least level D2	136,453	2.60	5.97	0	27

Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Panel C: *SoD dataset*						
Deposit growth	Annual growth rate of branch deposits	1,672,750	11.44	35.95	-100	248.15
Droughts_{3-4}	Number of weeks within the growing season for which the drought index is at least level D3	1,672,750	1.17	4.46	0	27
Droughts_{2-4}	Number of weeks within the growing season for which the drought index is at least level D2	1,672,750	2.63	6.44	0	27
Panel D: Rate Watch dataset						
MM25K	Money market deposit account with minimum balance $25,000	131,804	0.73	0.78	0	5.40
12MCD10K	Certificates of deposit with an account size $10,000 for a tenor of 12 month	138,303	1.52	1.32	0	6.60
INTCK0K	Interest-bearing checking account with minimum balance $0	132,855	0.27	0.34	0.001	10.47
Construction loans 175K	Construction loans of less than $170,000	14,025	5.95	1.39	0	11.98
Droughts_{3-4}	Number of weeks within the growing season for which the drought index is at least level D3	131,804	1.08	3.91	0	27
Droughts_{2-4}	Number of weeks within the growing season for which the drought index is at least level D2	131,804	2.55	6.01	0	27

Table A2: Commercial and industrial loans to U.S. address

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans secured by real estate in percent of loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown, and *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
Droughts_{3-4}	0.005	-0.000	-0.002	0.000	-0.000	0.006
	(0.81)	(-0.08)	(-0.32)	(0.01)	(-0.07)	(0.81)
Droughts*post 2012		0.014	0.016	-0.035	0.018	0.001
		(1.08)	(1.33)	(-1.04)	(0.78)	(0.09)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.729	0.729	0.701	0.819	0.684	0.759
Panel B Drought index at least of level D2						
Droughts_{2-4}	0.003	0.001	-0.000	-0.005	-0.001	0.006
	(0.94)	(0.22)	(-0.02)	(-0.32)	(-0.22)	(1.32)
Droughts*post 2012		0.013	0.015	-0.030	0.018	0.001
		(1.01)	(1.21)	(-1.06)	(0.80)	(0.11)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.729	0.729	0.701	0.819	0.684	0.759
Panel C Drought index at least of level D2, post-2012						
Droughts_{2-4}	0.011*	0.005	0.009	-0.032	0.012	-0.000
	(1.74)	(0.59)	(1.21)	(-1.25)	(1.19)	(-0.01)
Designated		0.016	0.0107	-0.031	-0.008	-0.037
		(0.24)	(0.16)	(-0.14)	(-0.09)	(-0.41)
Drought*Designated		0.009	0.003	0.051	-0.014	0.030**
		(0.75)	(0.23)	(1.63)	(-0.96)	(2.13)
Observations	52,817	52,817	46,805	5,929	22,384	30,251
R^2	0.820	0.820	0.792	0.873	0.790	0.827

Table A3: Loans secured by real estate

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable are loans secured by real estate in percent of loans reported in the call reports. Single state banks (multi) are banks that operate in one (more than one) state. Single county banks (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown, and *,**, *** denote significance at the 10, 5 and 1% level, respectively.

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A Drought index at least of level D3						
$Droughts_{3-4}$	0.007	-0.020	-0.012	0.070	-0.029	0.029
	(0.34)	(-0.88)	(-0.56)	(1.24)	(-0.98)	(1.11)
Droughts*post 2012		0.070	0.062	-0.066	0.058	0.001
		(1.60)	(1.42)	(-1.04)	(0.98)	(0.02)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.819	0.819	0.821	0.883	0.828	0.853
Panel B Drought index at least of level D2						
$Droughts_{2-4}$	0.026*	0.021	0.029*	-0.003	0.015	0.039***
	(1.84)	(1.42)	(1.90)	(-0.09)	(0.77)	(2.67)
Droughts*post 2012		0.030	0.019	0.005	0.015	-0.013
		(0.77)	(0.51)	(0.11)	(0.29)	(-0.51)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.819	0.819	0.821	0.883	0.828	0.853
Panel C Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	-0.036***	-0.020	-0.019	0.010	0.023	-0.052***
	(-4.14)	(-1.48)	(-1.36)	(0.29)	(1.09)	(-3.17)
Designated		0.094	0.123	0.042	0.315**	-0.082
		(1.10)	(1.32)	(0.20)	(2.17)	(-0.83)
Drought*Designated		-0.025	-0.025	-0.061*	-0.056**	0.0002
		(-1.60)	(-1.53)	(-1.72)	(-2.41)	(0.01)
Observations	52,817	52,817	46,805	5,929	22,384	30,251
R^2	0.940	0.940	0.941	0.943	0.948	0.936

Online Appendix

As dry as a bone: how do banks cope with droughts?

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CRA Data

Adams, Brevoort and Driscoll (2021): We use a dataset where each observation provides a bank's lending activity in a county in a single year ("bank-county-year" data). This dataset includes all counties regardless of whether the bank made loans there. These zero-loan county observation are included to reduce sample selection bias that comes from only examining the counties to which loans are made (if permanent they do not have to be included…). Since every bank could, hypothetically, lend to every county in the U.S., the fact that they do not lend in particular counties provides useful information about the importance of distance.

Total small business lending, shown in Figure 1, increased substantially during the first half of our sample period, peaking at over $320 billion in 2007. During the ensuing recession, lending fell sharply and remains below pre-recession levels. Large and small loans both exhibit the same general pattern with two notable exceptions. The first is the effect of the 2005 changes in CRA reporting thresholds (in principle the time dummy show take care of this…; as a robustness check, re-define the threshold; exclude the ones that drop, i.e. that are below the 2005 threshold; one could argue that this should be the base sample). While large-loan volumes dropped sharply in 2005, small-loan volumes continued to increase, suggesting that the small lenders exempted from CRA reporting were more heavily involved in large-loan lending.

The second notable difference is that small-loan volumes grew more rapidly than large loans over the entire sample, increasing small loans as a share of lending. This growth is particularly remarkable given that the CRA's $100,000 threshold does not adjust for inflation. As discussed above, according to the Consumer Price Index, prices in 2017 were 56% higher than in 1996. This means that the equivalent of a $65,000 loan in 1996, which would then have been safely below the threshold, would not be considered a small loan in 2017 (the threshold changes in economic terms, not in absolute terms…).

Our figure OF1 is more or less similar to Figure 1 of Adams, Brevoort and Driscoll (2021).

Figure OF1: Small Business Lending Trends

This figure replicates trends in small business lending as described in Adams, Brevoort, and Driscoll (2021). Total small business lending is shown, indicating significant changes over the sample period.

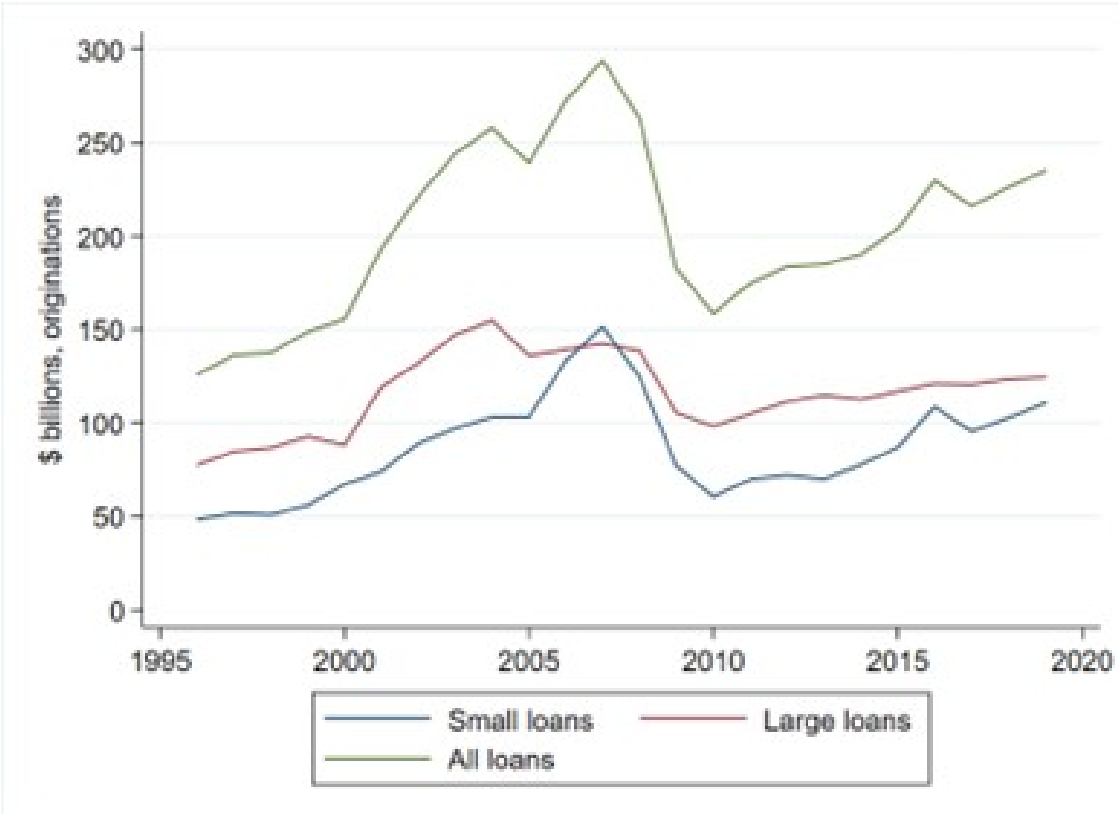
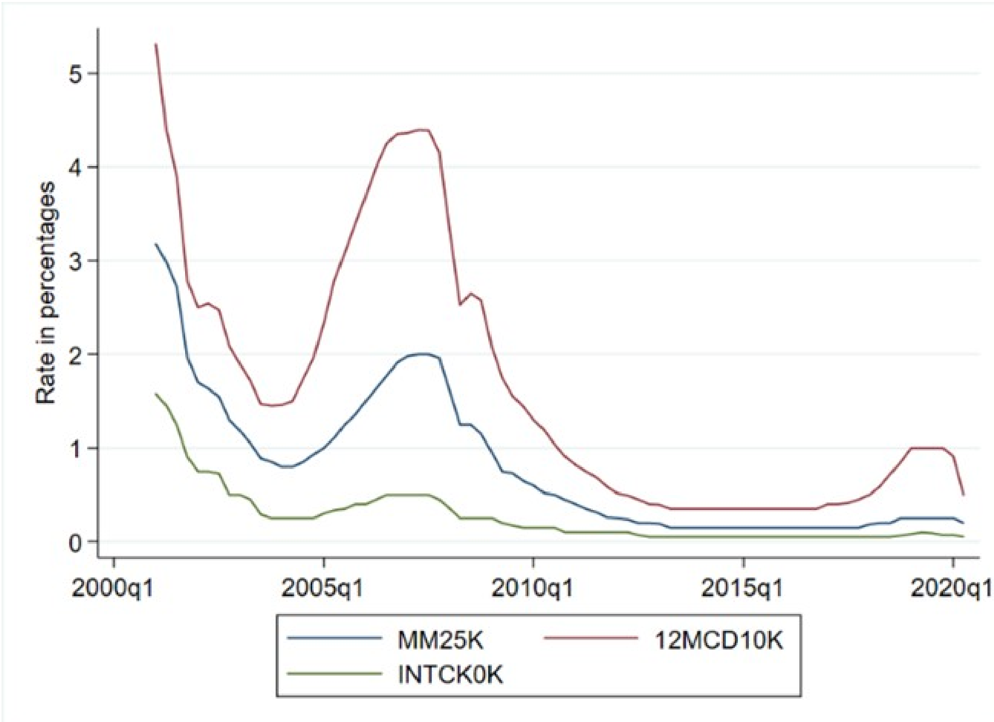


Figure OF2: Median deposit and loan rates

(a) Deposits

This figure shows the median rates for deposits over the sample period. The rates are calculated based on bank-specific deposit data, aggregated to provide an industry median.



(b) Loans - Construction Loan @ 175K

This figure illustrates the median interest rates for construction loans @ 175K. The data covers the 2001-2020 period, showing trends across different bank types.

Table OA1: The impact of droughts on rates of construction loans 175K

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is the interest rate on construction loans @ 175K. “Single state banks” (multi) are banks that operate in one (more than one) state. “Single county banks” (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A: Drought index at least of level D3						
$Droughts_{3-4}$	0.003	0.003	-0.004	0.012	-0.015	0.006
	(1.02)	(0.71)	(-0.93)	(1.61)	(-1.38)	(1.35)
Droughts*post 2012		0.002	0.008	-0.010	0.031*	-0.001
		(0.26)	(1.03)	(-0.53)	(1.90)	(-0.19)
Observations	14,019	14,019	8,920	4,004	2,476	10,516
R^2	0.848	0.848	0.854	0.862	0.877	0.846
Panel B: Drought index at least of level D2						
$Droughts_{2-4}$	0.000	-0.001	-0.005	0.001	-0.004	0.000
	(0.01)	(-0.38)	(-1.31)	(0.24)	(-0.53)	(0.03)
Droughts*post 2012		0.004	0.011*	-0.001	0.025*	-0.001
		(0.91)	(1.72)	(-0.11)	(1.81)	(-0.10)
Observations	14,019	14,019	8,920	4,004	2,476	10,516
R^2	0.848	0.848	0.854	0.862	0.877	0.846
Panel C: Drought index at least of level D2, post-2012						
$Droughts_{2-4}$	0.003	0.007	0.019	-0.002	0.049***	-0.010
	(0.65)	(0.61)	(1.48)	(-0.05)	(2.82)	(-0.61)
Designated		0.122**	0.150**	-0.0178	-0.080	0.100*
		(2.31)	(2.39)	(-0.16)	(-0.51)	(1.75)
Drought*Designated		-0.008	-0.017	0.003	-0.041**	0.007
		(-0.69)	(-1.23)	(0.08)	(-2.17)	(0.40)
Observations	3,951	3,951	2,606	776	639	2,801
R^2	0.852	0.852	0.862	0.876	0.907	0.849

Table OA2: The impact of droughts on the interest rate of money market accounts (MM25K)

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is the interest rate on construction loans @ 175K. "Single state banks" (multi) are banks that operate in one (more than one) state. "Single county banks" (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level

	Whole sample		Single	Multi	Single	Multi
			state banks		county banks	
Panel A: Drought index at least of level D3						
Droughts_{3-4}	0.001***	0.002***	0.003***	-0.000	0.003**	0.001
	(3.01)	(3.11)	(3.92)	(-0.22)	(2.53)	(1.28)
Droughts*post 2012		-0.002**	-0.003***	-0.000	-0.002*	-0.001
		(-2.52)	(-2.86)	(-0.14)	(-1.67)	(-1.10)
Observations	131,826	131,826	90,773	30,756	38,712	82,660
R^2	0.806	0.806	0.812	0.813	0.816	0.808
Panel B: Drought index at least of level D2						
Droughts_{2-4}	0.000	0.001	0.001**	-0.002	0.001	0.000
	(0.94)	(1.07)	(2.43)	(-1.46)	(1.40)	(0.37)
Droughts*post 2012		-0.001	-0.001*	0.001	-0.001	-0.000
		(-0.99)	(-1.96)	(1.07)	(-1.02)	(-0.33)
Observations	131,826	131,826	90,773	30,756	38,712	82,660
R^2	0.806	0.806	0.812	0.813	0.816	0.808
Panel C: Drought index at least of level D2, post-2012						
Droughts_{2-4}	-0.000	-0.000	-0.000	-0.000	0.0001	-0.001**
	(-0.98)	(-1.22)	(-1.22)	(-0.24)	(0.17)	(-1.98)
Designated		0.000	-0.000	0.006	-0.001	0.002
		(0.33)	(-0.21)	(1.28)	(-0.18)	(0.61)
Drought*Designated		0.000	0.000	0.000	-0.000	0.001*
		(0.81)	(0.67)	(0.31)	(-0.50)	(1.71)
Observations	56,411	56,411	37,018	12,634	15,524	34,025
R^2	0.726	0.726	0.723	0.711	0.756	0.715

Table OA3: Loans to depository institutions

The estimation period is 2001-20. The estimations are done with the fixed effects estimator including bank- and year-fixed effects. The dependent variable is the interest rate on construction loans @ 175K. "Single state banks" (multi) are banks that operate in one (more than one) state. "Single county banks" (multi) are banks that operate in one (more than one) county. Standard errors are clustered by county. In brackets t-statistics are shown. *,**, *** denote significance at the 10, 5 and 1% level

	Whole sample		Single	Multi	Single	Multi
		interaction	state banks		county banks	
Drought index at least of level D3						
$Droughts_{3-4,season}$	0.00002	-0.00002	0.00004	-0.002	-0.00002	-0.00005
	(0.14)	(-0.17)	(0.26)	(-1.33)	(-0.16)	(-0.17)
Droughts*post 2012		0.0001	0.0001	0.0007	0.0003	-0.00007
		(0.40)	(0.52)	(0.19)	(1.21)	(-0.11)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.608	0.608	0.613	0.637	0.676	0.592
Drought index at least of level D2						
$Droughts_{2-4,season}$	0.0002*	0.0002*	0.0002**	-0.0006	0.00008	0.0003
	(1.71)	(1.81)	(2.27)	(-0.49)	(0.64)	(1.64)
Droughts*post 2012		-0.0001	-0.0001	-0.00104	0.0002	-0.0004
		(-0.29)	(-0.21)	(-0.27)	(1.01)	(-0.68)
Observations	136,453	136,453	125,790	10,538	67,307	68,688
R^2	0.608	0.608	0.613	0.636	0.676	0.592
Drought index at least of level D2, post-2012						
$Droughts_{2-4,season}$	0.00008	0.0005	0.0002**	0.0025	0.0001	0.0009
	(0.54)	(1.31)	(2.21)	(0.78)	(0.85)	(1.22)
Designated		0.00006	-0.001	0.0175	-0.003	0.0025
		(0.04)	(-1.18)	(1.31)	(-1.50)	(0.97)
Drought*Designated		-0.0006	-0.00002	-0.0056	0.0002	-0.0013
		(-1.30)	(-0.14)	(-1.48)	(1.15)	(-1.54)
Observations	52,817	52,817	46,805	5,929	22,384	30,251
R^2	0.732	0.732	0.800	0.663	0.800	0.699