Commodity Price Shocks and Financial Stability: Evidence from the 1920s*

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PRELIMINARY: PLEASE DO NOT QUOTE OR DISTRIBUTE

Abstract

U.S. bank failures between 1921 and 1929 are conventionally attributed to asset-side losses resulting from banks' exposure to bad agricultural debts. Exploiting a new annual database on farm real estate transfers at the county-level, we provide evidence for a complementary funding channel to bank exits. We find that deposit withdrawals from banks are highly correlated with bank suspensions, even after directly controlling for the asset-side impact of farm distress. Building on a simple theoretical framework, we empirically link deposit withdrawals to the agricultural income shock following 1920, farmers' expectations about future returns, and their decision to default on mortgage loans.

JEL Codes: G21, N12, N22, Q14

Keywords: agricultural crisis, bank failures, deposit withdrawals, farming, illiquidity, insolvency, mortgage loan, strategic default

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1 Introduction

Between 1921 and 1929, a protracted wave of bank failures hit the United States. 5,712 banks suspended operations and the number of active banks fell from 28,885 in 1920 to 23,712 in 1929 (Alston et al., 1994). The available evidence suggests that these bank failures had dire consequences. Banking distress in the 1920s reduced access to credit in small rural communities (Alston et al., 1994), led to a persistent collapse in land prices over the next few decades (Rajan and Ramcharan, 2015; Jaremski and Wheelock, 2020), and may have laid the foundation for regional banking panics during the Great Depression (Friedman and Schwartz, 1963).

Most existing studies attribute the high number of bank suspensions during the 1920s to weak asset-side fundamentals (Wheelock, 1992; Alston et al., 1994; Rajan and Ramcharan, 2015; Jaremski and Wheelock, 2020). According to this interpretation, the commodity price bust after 1920 eroded the value of farm debt that U.S. banks had accumulated during the agricultural boom to assist farmland expansion in the wake of World War I. Losses from defaulted loans and on repossessed collateral are thought to have wiped out bank equity, leading to widespread insolvency.

The well-documented rise in farm foreclosures during the 1920s lends empirical support to the insolvency story (Alston, 1983). Yet, this narrative also presents a puzzle. Between 1910 and 1930, commercial banks only held about 15% of all outstanding farm-mortgage debt. The lion's share of agricultural mortgage loans was granted by non-banks, most notably individuals and life insurance companies (Horton et al., 1942). In addition, farm mortgages represented a modest share of bank balance sheets. Real estate loans amounted to 7.3% of commercial banks' total assets in 1919 (Board of Governors of the Federal Reserve System, 1959).[1] Figure 1 documents that the weighted mean of the share of real estate loans in state-chartered banks' and national banks' total loan portfolios amounted to 11.4% and 0.9% respectively in 1919.[2] These numbers raise the question whether the fall in asset values alone can plausibly account for the widespread bank closures during the 1920s.

In this paper, we introduce a new, complementary channel to explain bank exits during the 1920s. We argue that the loss of local funding in the form of bank deposits was a crucial driver of rural bank suspensions between 1921 and 1929. The erosion of stable funding came in several waves. First, the commodity price collapse at the beginning of the 1920s represented a substantial income shock for farmers. Unable to sell products for enough to liquidate their debts, many farmers drew down bank deposits to pay off loans from merchants and factors in the cities, and to meet their expenses. Second, as price recovery remained a long time coming, each planting season confronted farmers with the hard decision between strategic default on outstanding mortgages and continued investment in their property. A larger initial income shock left farmers with few resources and lower equity values, increasing the probability of default in the presence of binding credit constraints. To the extent that agricultural households expected the decline in commodity prices to be persistent, lower future expected returns

[1] Since these numbers include mortgage on farmland, residential property and other land, they likely represent an upper bound estimate.

[2] Keehn and Smiley (1977, p.475) suggest that national banks found ways to participate "in mortgage lending indirectly but which did not show up in the usual banking statistics." Hence, national banks' true exposure to mortgage loans may have been somewhat higher than shown in official statistics.

also increased their propensity to default. Upon default, farmers had little choice but to withdraw their remaining savings, either to smooth consumption until they had found a new local job and/or to permanently move out of rural America. This cascade of events did not only expose local banks to losses due to farm foreclosures, but it also deprived them of otherwise stable funding. Given that the overwhelming majority of rural banks were not members of the Federal Reserve System, many could not easily replace deposits in the short-run by borrowing from the discount window of their regional Federal Reserve Bank.

To evidence this mechanism linking the commodity price shock to bank exits, we proceed in several steps. First, we present a simple theoretical framework that models the farmer's decision to engage in strategic default as a function of the initial income shock and their expectations about future returns. We use this framework to discipline our narrative and to translate it into testable predictions about the drivers of mortgage defaults, deposit withdrawals and bank failures.

Second, we leverage a novel, hand-collected panel data set of farm real estate transfers for a sample of 485 U.S. counties between 1900 and 1935 published in a 1939 report by the Bureau of Agricultural Economics at the United States Department of Agriculture. These data enable us to separate the county-level effect of the farm income shock into two components: the impact of the price shock on local involuntary transfers of farm real estate due to foreclosure, bankruptcy and assignment to creditors; and the impact of the bust on deposit withdrawals from local banks. These two components capture both the traditional asset-side channel to bank failures and our complementary hypothesis on the role of stable funding. We show econometrically that agricultural distress as proxied by the fall in crop prices after 1920 is a highly statistically and economically significant predictor of the rise in involuntary farm transfers *and* deposit withdrawals. These results are unlikely to be driven by policy or agricultural differences across counties, as we control for a range of time-varying county and state characteristics such as the rise in investment during the 1910s boom period or deposit insurance.

Third, we draw on these "two prongs of agricultural distress" to investigate the drivers of bank suspensions. We run horse race regressions to explain county-level bank suspension rates using involuntary transfers alongside deposit withdrawals as our main two covariates of interest. We find that deposit withdrawals from banks are highly correlated with U.S. bank distress during the 1920s, even after directly controlling for the asset-side impact of farm foreclosures. This result holds for both state-chartered and national banks, although the link between deposit withdrawals and suspensions is substantially larger for state-chartered banks. Farm foreclosures are also associated with bank suspensions, but the relevant coefficient estimate is economically smaller and less statistically significant than for deposit withdrawals. Hence, our results suggest that the asset-side induced insolvency channel alone does not capture the full story behind the large-scale bank exits during the 1920s.

Finally, we draw on several quantitative and qualitative sources to elucidate the economic mechanism at play and to support our econometric results. Most importantly, we hand-collect novel data on monthly futures prices for major crops during the 1920s. We use these futures price series to construct annual proxies for farmers' expectations about future returns at the county level. We add this measure of expectations to our panel data set and show that it is negatively correlated with foreclosures and deposit withdrawals, as predicted by our simple theoretical framework. Furthermore, contemporaries emphasized that deposit outflows in agricultural counties were significantly higher than in non-agricultural counties and that banks in agricultural counties sharply increased their borrowings from the Federal Reserve Banks relative to non-agricultural counties (Joint Commission of Agricultural Inquiry, 1922a,b; Wallace, 1956). These aggregate developments provide additional suggestive evidence that the funding channel was particularly salient for bank suspensions during this time period. We close by summarizing the descriptive reasons for bank failures given in official supervisory reports, highlighting that withdrawals drove a considerable share of bank suspensions during the 1920s.

Our paper advances several literatures. First, we contribute to the literature on the causes of bank distress during the 1920s. Building on previous work that typically attributes bank failures to fundamental weaknesses growing out of the agricultural bust (Wheelock, 1992; Alston et al., 1994; Rajan and Ramcharan, 2015; Jaremski and Wheelock, 2020), we also provide evidence for a funding channel to the mass exits of banks. Existing studies cannot distinguish between the insolvency and stable funding channel to bank closures during the 1920s because they lack a dis-aggregated measure for involuntary transfers of farm real estate. Perhaps as a corollary, the fundamental shock to farmers' incomes is generally equated with a shock to banks' asset values. While we ground our analysis in the same price bust as previous papers, we show that this shock did not only affect the asset side of bank balance sheets but likely also impacted banking sector stability via substantial deposit withdrawals. This finding resonates with recent research showing that Federal Reserve policy interventions in 1920–21 reduced failures mainly because they induced banks to accumulate higher liquidity buffers (Rieder, 2024).

We argue that the agricultural commodity price collapse and its reverberations were the main driving force of large scale deposit withdrawals. Drawing on bank-level data, we show that our empirical results on the agricultural determinants of deposit withdrawals are robust to 1) the exclusion of states experiencing local banking panics during the 1920s and to 2) the inclusion state-year fixed effects. Thus, although withdrawals may have subsequently served as a coordination device or a fundamental signal sparking bank runs (Diamond and Dybvig, 1983; Gorton, 1988; Davison and Ramirez, 2014), panics due to mere rumors as in a "contagion of fear" are unlikely to have constituted the main root cause of high suspension rates in the 1920s. Overall, our findings echo an earlier debate on the causes of U.S. bank failures during the Great Depression (Temin, 1976; Wicker, 1980; White, 1984; Calomiris and Mason, 1997, 2003; Postel-Vinay, 2016; Messer, 2023; Marodin et al., 2024). During this later episode, illiquidity and insolvency also both played important roles (Richardson, 2007).

Second, our novel panel dataset on county-level farm real estate transfers allows us to complement previous work on the drivers of agricultural distress in the 1920s. Earlier contributions rely on cross-sectional data to investigate the drivers of U.S. state-level farm foreclosure rates (Alston, 1983, 1984). More recent studies of this period take the analysis to the county-level to better control for unobserved heterogeneity across states (Rajan and Ramcharan, 2015; Jaremski and Wheelock, 2020). Yet, so far, this shift to lower levels of aggregation comes at a cost because the lack of direct measures requires scholars to resort to proxy variables for farm distress (e.g., land or crop prices). Our new county-level data enable us to employ a fixed effects estimator to better disentangle the fundamental causes of farm distress from other economic, social or legal differences across states *without* losing precision in terms of our outcomes of interest. Moreover, our data cover the period from 1900 to 1935, whereas gaps in data availability limited previous studies of state foreclosure rates to the period after 1925. Since the farm price bust occurred at the very beginning of the 1920s, capturing developments during the years before 1926 are arguably important to fathom the full extent of the agricultural crisis at the time. Also, since our dataset contains both voluntary *and* involuntary transfers of farm real estate, we can closely track the boom and the bust cycle based on actual farmland transactions.

Third, previous contributions highlight the crucial role of commodity price expectations for the slide into and the recovery from the Great Depression (Hamilton, 1992; Eggertsson, 2008; Hausman et al., 2019). We show that expectations regarding future crop prices also seem to have influenced the backstory of the Great Depression by shaping consequential economic decisions during the 1920s. We collect monthly futures price series for major crops between 1919 and 1930. Our results suggest that farmers' expectations about future agricultural returns constitute an important predictor of their decisions to engage in strategic default on outstanding mortgage debt in the aftermath of the price collapse in 1920. This finding paints a – perhaps surprisingly – sophisticated picture of rural economic agents that mirrors behavioral patterns found in modern models of strategic default (Foote et al., 2010; Campbell and Cocco, 2015).

The remainder of this paper is organized as follows. Section 2 provides the historical background for our study. Section 3 presents our simple theoretical framework. Section 4 discusses our novel hand-collected database on farm real estate transfers. Section 5 contains the main empirical analysis. Section 6 discusses our econometric results and the underlying mechanism in the light of additional quantitative and qualitative evidence. Section 7 concludes.

2 Historical Background

Longer-than-expected hostilities during World War I and, after 1917, the Soviet Revolution, caused a significant disruption in the supply of farming produce from Europe and Russia. Simultaneously, a decline in local production created excess demand for agricultural imports in these regions. As a corollary, agricultural sectors elsewhere experienced a positive external demand shock. With production fixed in the short-run, agricultural commodity prices soared. Figure 2 plots the average value of eleven crop prices in the United States. A sudden rise in commodity prices after 1915 is apparent.

In reaction to booming prices, U.S. farmers sought to expand their production capacities. Farmland values per acre increased by more than 50% between 1910 and 1920, as did land prices more generally (Rajan and Ramcharan, 2015; Jaremski and Wheelock, 2020). Improved acreage effectively doubled over the same time period (Wheelock, 1992), involving the cultivation of inferior or "marginal" land of lower quality (Alston, 1983), often at the cost of a considerable mortgage debt burden. Mortgage indebtedness increased by an average of 83% across U.S. states over the 1910s (Jaremski and Wheelock, 2020).

Our new data on transfers of farm real estate, explained in detail in Section 4, document the evolution of the market for farmland during the boom period. Figure 3a plots the time trend for the number of *voluntary* transfers per 1,000 farms, normalized to the base year of 1915 to ease interpretation. Voluntary transactions rose substantially after 1915, exactly when commodity prices started their ascent.

In the U.S., the agricultural boom during the late 1910s was further fueled by an inadequate macroeconomic policy response. Only founded in 1913, the Federal Reserve System succumbed to "fiscal dominance" after the Unites States' entry into World War I. The Treasury enforced the prevailing low-rate environment at the time to ensure favorable conditions for floating war bonds and maintaining their prices (Hilt and Rahn, 2020). Hence, instead of intervening countercyclically, the Federal Reserve System kept interest rates unchanged at levels below market rates during the height of the boom years and instituted preferential treatment for refinancing demands using war bonds as collateral.

When monetary policy eventually received green light to initiate a tightening cycle in December 1919, rates in the System were raised substantially from 4.75% to 6% (in some districts even to 7%) in only five months. At this point, however, the Federal Reserve's reaction was likely too late to quench the negative consequences of the boom, and too much, given economic developments elsewhere. European agricultural production had came back online more quickly than expected following armistice, triggering a reduction in demand for U.S. agricultural produce and a collapse in farm commodity prices. For example, by June 1921, the prices of oats and corn had fallen by 65% and 72% respectively relative to 12 months before. The evolution of the crop price index in Figure 2 illustrates the generalized nature of the agricultural price collapse after 1919. The effect of the monetary contraction of 1919–1920 thus came on top of an incipient agricultural depression.[3] While the price bust directly affected the U.S. agricultural sector, tighter monetary policy likely amplified the sharp downturn of 1920–21 by subduing demand in other sectors of the economy.

Plummeting prices generated a substantial income shock for U.S. farmers. Struggling to sell products at sufficiently high prices, many farmers could not liquidate their seasonal short-term bank loans. They also became increasingly unable to service the mortgages they had taken up to expand production during the boom years. Farm owners had amassed loans based on the – with hindsight mistaken – assumption that present or future increases in income and land values would render their debt sustainable (Horton et al., 1942). Yet, fixed mortgage payments in combination with falling nominal earnings contributed to a rising debt burden after 1920. Moreover, farmland values fell with the price bust as earnings expectations were revised. Lower land values cut into farmers' equity, making it also more difficult for them to obtain new loans to smooth consumption (Alston, 1983).

[3]This unfortunate timing prompted Friedman and Schwartz (1963, p.231) to conclude that "Federal Reserve policy was a further and not unimportant factor contributing to the severity of the moment".

Whenever farmers defaulted on their mortgage loans, creditors exercised the right to redeem their property by repossessing the land that had served as collateral. The mass foreclosures of farm real estate that ensued during the 1920s are well documented (e.g. Alston, 1983). Between 1921 and 1940, foreclosures averaged at 17.5 per thousand farms, with an average of 96,000 farm foreclosures each year. For comparison, foreclosure rates had never exceeded 3.2 per thousand farms in any year before the interwar period (Alston, 1983). Drawing on our novel data, Figure 3b shows that distressed transfers of farm real estate first started to rise in 1922. This increase followed two years after commodity prices had begun falling and one year after voluntary transactions had first dropped below their 1915 level. The lag between the price bust and eventual property foreclosures likely stemmed from a combination of loan characteristics, initial lender forbearance and credit policies. Agricultural mortgage debt typically took the form of short-term loans with a balloon payment (Jaremski and Fishback, 2018; Jaremski and Wheelock, 2020). According to Horton et al. (1942, Table 74), the average maturity of farm mortgage loans recorded by banks between 1917–1921 ranged from 1.4 years in the South to 5 years in New England. Assuming that a considerable share of mortgages was written around the peak of the boom years in 1919, default rates on these loans would only increase with a delay of several years after the initial income shock. Furthermore, redemption periods, i.e. the fixed time span after default during which borrowers could reclaim title to the property by honoring their obligations, differed across states, but usually lasted between 12–24 months and thus deferred foreclosure by an equal amount of time (Postel-Vinay, 2017). As Figure 3b displays the flow of foreclosures each year, it suggests that distress levels remained high throughout the 1920s, before modestly rising further during the Great Depression.

Foreclosure rates during the 1920s exhibited substantial heterogeneity across states (Alston, 1983). Most importantly, defaults on farm mortgages varied across major crops and farm produce, with regions specializing in corn, cotton, wheat and livestock among the most affected by the price collapse. Figure A3 in the Appendix suggests that differential crop exposure only explains a portion of the regional variation in distressed transfers of farm real estate in the interwar period. While the impact of the fall in agricultural prices did differ across regions (Panel a), it can only imperfectly account for the heterogeneity in in distressed transfers (Panel b). Hence, other regional differences must have also have impacted foreclosure rate. Indeed, Alston (1983) shows that foreclosures were positively correlated with the absolute number of farms and farm indebtedness. Moreover, proximity to urban centers was associated with lower foreclosure rates, as farmers close to cities benefited from higher demand, more stable outlets and lower mortgage rates. In our econometric analyses, we always test for the robustness of our results to the inclusion of region-year fixed effects.

Ultimately, the agricultural boom and bust cycle also affected lenders. The existing literature directly links the agricultural collapse to eroding bank asset values and widespread bank suspensions after 1920 (Wheelock, 1992; Alston et al., 1994; Rajan and Ramcharan, 2015; Postel-Vinay, 2017; Jaremski and Wheelock, 2020). While suspensions occurred among both state-chartered and national bank banks, the former experienced substantially higher failure rates – a fact usually ascribed to their predominantly rural locations and several regulatory differences. The National Banking Act contained restrictive provisions on loans secured by real estate. National banks could only grant farm mortgages if they were not located in central reserve cities. Also, the mortgaged land needed to be unencumbered and the mortgage could not exceed a loan-to-value ratio of 50%. Furthermore, on aggregate, mortgage loans could not exceed 25% of a national bank's capital and surplus or one third of its time deposits. After 1916, the maximum maturity for mortgage loans from national banks was even reduced from five years to one year. Despite their regular complaints and documented attempts by national banks to engage in regulatory arbitrage (Keehn and Smiley, 1977), the vast majority of farm mortgages on commercial bank balance sheets that eventually turned sour thus came from state-chartered banks (c.f. also Figure 1 above). Finally, Wheelock (1992) also points to another consequential regulatory difference to explain higher bank failure rates among state-chartered institutions: in several states, these banks benefited from deposit insurance schemes which appear to have led to riskier lending practices during the boom years.

Despite its prominent place in the literature, the direct link between the agricultural depression and bank distress during the 1920s remains somewhat tenuous, in particular when it comes to the precise mechanisms at play. Defaults on farm mortgages and associated losses on bank assets do not constitute a wholly convincing channel for at least two reasons. First, farm loans primarily came from non-bank sources at the time, with the U.S. commercial banking sector only holding about 15% of outstanding mortgage debt in 1919 (Horton et al., 1942). Second, upon borrower default, lenders repossessed the mortgaged land. While farmland prices fell substantially after 1920, the available evidence suggests that loan-to-value ratios were generally low, usually only amounting to 50% (Postel-Vinay, 2017). Hence, loan arrangements should have provided a substantial safety buffer even in the case of borrower default.

3 Theoretical Framework

3.1 Intuition and Set-up

In this paper, we argue that the agricultural price collapse and the concomitant shock to farmers' income affected bank balance sheets not only due to asset-side losses, but also via large-scale deposit withdrawals. The intuition underlying our argument is as follows.

In response to sharply falling incomes, farmers drew down bank deposits to smooth consumption and pay off or service outstanding debts. Since falling land values had reduced their equity, farmers could not easily obtain external bridge financing and needed to liquidate their savings instead. Following the shock, farmers needed to repeatedly make a strategic decision on whether to default on their outstanding mortgage or to continue investing in agricultural production. We think of this decision as a function of two major factors: the size of the initial income shock, which left farmers with fewer resources to capitalize on future investments for agricultural production and farmers' expectations about future returns to production. Where farmers took the decision to default, they had little choice but to withdraw a substantial part of their savings to smooth consumption until they had found a new local job and/or to permanently move out of rural America. Where farmers opted against default, they withdrew the necessary funds to smooth consumption and finance investment.

In the course of this process, rural banks permanently lost otherwise stable funding to an extent that made their continued operation nonviable. Two additional features of this setting help rationalizing the observed outcomes discussed in the previous section. First, the funding channel to bank exit could explain why a number of national banks failed during the 1920s even though their exposure to real estate loans was very small. Second, our narrative suggests that the relatively higher exit rate of state-chartered banks may have not only derived from their exposure to the farm mortgage market. In contrast to national banks, most state-chartered banks did not become members of the Federal Reserve System. Hence, many state-chartered banks did not benefit from the access to the discount window of their regional Federal Reserve Bank that could have eased a transition to other funding resources, at least in the short-run.[4]

We now discipline this narrative in a simple model with two periods, $t \in \{1, 2\}$. A continuum of farmers enter period 1 owning a plot of land that they have an outstanding mortgage on with a stock of savings. Farmers choose either to service their mortgage and invest in their farm to obtain production in period 2, or to default on their mortgage and consume out of savings. The only source of uncertainty in the model is productivity of land in period 2, which we use to capture stylistically farmers' expectations of price recovery. The productivity of land takes one of two states. With probability α, productivity is good, G, and with probability $1-\alpha$ productivity is bad B. The initial endowment that farmers have entering period 1 is denoted by s_0. This initial endowment is the sum of total of income and initial savings. Hence, lower values of s_0 proxy for larger declines in commodity prices, which we will show are also an important predictor of the decision to default. In what follows, we first outline the farmer's problem under the decision to repay and under default, before discussing the decision to default.

3.2 Decision Problems under Repayment and Default

Under repayment, denoted by R, farmers maximize utility over consumption in period c_2 subject to period 1 and 2 budget constraints and nonnegativity constraints:

$$\begin{gathered}
V^R = E_t\left[\ln c_2^R\right] + \Gamma \\
i_1^R + s_1^R + m_1 = s_0^R \\
m_2 + c_2^R = s_1^R + (\alpha A^G + (1-\alpha)A^B)i_1^\gamma \\
i_1^R \geq 0, s_1^R \geq 0, c_2^R \geq 0
\end{gathered} \tag{R}$$

Γ denotes the flow utility of housing services that the farmer receives by repaying their mortgage. In period 1, farmers make an investment decision and assign initial savings on investment i_1, their mortgage m_1, and

[4] Anderson et al. (2018) show that state-chartered banks partly circumvented this restriction by borrowing via their correspondent national banks. Moreover, for a short period between summer 1921 and summer 1923, the Federal Reserve System temporarily enabled member banks to act as "agents of non-member banks in rediscounting paper with Federal Reserve Banks" (Federal Reserve Board, 1924, p.50). Yet, overall, state-chartered banks' access to discount window finance still remained curtailed relative to member banks during the period relevant to this study.

new deposits s_1. In period 2, the farmer receives income from their investment with returns to scale parameter $\gamma > 0$. The productivity of investment is given by A^i for $i \in \{G, B\}$ with $A^G > A^B$. These farm returns plus savings are spent on the mortgage payment m_2 and consumption.

Under default, denoted by D, farmers do not receive benefits from housing (i.e., $\Gamma = 0$). They also do not pay down their mortgage, and instead lose access to the potential investment returns of their farm. Their decision problem is given by:

$$\begin{aligned} V^D &= E_t\left[\ln c_1^D\right] \\ s_1^D + c_1^D &= s_0^D \\ s_1^D &\geq 0 \end{aligned} \tag{D}$$

There is no uncertainty when the farmer decides to default, as the farmer no longer owns their farm. We make the assumption that, under default, the farmer only cares about consumption in period 1. The solution to this problem is given by:

$$c_1^D = s_0^D, \quad s_1^D = 0$$

3.3 Default Decision

The farmer's decision to default can be represented by:

$$\mathbf{1}\left(V^D > V^R\right)$$

Under default, $V^D \equiv \ln s_0^D$ always. Under repayment, the marginal return of savings, $(1 + r)$, must be equal to the marginal return on investment. The marginal return on investment depends on expectations of its marginal return, which is given by $E[A^i]$. Under repayment, farmers invest up until the point where $\gamma E[A^i] i_1^{\gamma-1} = 1 + r$.

In the top-left panel of Figure 4, we plot the value functions of repayment and default over the range of values for α. Low values of α suggest that the probability of the realized state being B is relatively high, and as such we see that farmers prefer to go into default. In fact, the returns are so low, that in the repayment state farmers do not wish to invest. Hence, the difference between the two lines represents the cost of the mortgage. However, as α rises, we see eventually the farmer choose to engage in investment and hence the value function begins to increase. Eventually, the probability of the good state is sufficiently high that the farmer prefers to repay.

In the bottom-left panel, we plot the change in deposits, $s_1 - s_0$. When the farmer chooses to go into default, they withdraw all their savings in period 1. When they prefer to repay, they elect to withdraw a portion of their savings, depending on the return to capital relative to the interest rate, in order to invest.

Next, we investigate the model's predictions for various initial savings, which we take to proxy for the size of the initial commodity price shock. In the top-right panel of Figure 4, we plot the value functions of repayment and default over the range of values for s_0. Low values of s_0 suggest that farmers have little wealth, possibly due to the low realization of commodity prices. With a small amount of wealth, farmers elect default as repaying the mortgage is not worth the cost. However, as s_0 rises, we eventually see the farmer choose to opt for repayment. In the bottom-right panel, we plot the change in deposits, $s_1 - s_0$ against the initial amount of savings. When the farmer chooses to go into default, they withdraw all their savings in period 1, hence savings is a downward sloping function of s_0. When they prefer to repay, they elect to withdraw only a portion of their savings, depending on the return to capital relative to the interest rate, in order to invest.

3.4 Discussion of Assumptions

We pause for a moment to discuss a few of the assumptions in our framework. First, consider the assumption that under repayment, farmers only receive utility from consumption in period 2. The focus in our simple framework is on the expectations channel, meaning that consumption in period 2 should be thought of as consumption once price expectations are realized. So long as this future period is included, including consumption in period 1 should only quantitatively weaken the role of expectations as then farmers would always withdraw some of their initial savings, leaving less with which to invest in their firm. We also do not assume the farmer receives income in period 1, which would work in the opposite direction. Either way, our focus with this model is to qualitatively show how expectations may affect the foreclosure decision, and we make these assumptions for simplicity.

Second, consider the assumption that under foreclosure, farmers only receive utility from consumption in period 1. This assumption requires more explanation. The assumption is intended to induce withdrawals by farmers to match the idea that, upon default, farmers withdraw their savings, either to smooth consumption while not having a job or because of out-migration. Historically, out-migration was a prominent adjustment mechanism of farmers if they expected persistently low returns (Hornbeck, 2012; Hornbeck and Naidu, 2014). Presumably, households that decided to give up on their farm, would close accounts at their local banks and withdraw their savings before moving out of rural America in search for opportunities elsewhere.

Third, consider our assumption of diminishing returns to scale in investing in the farm. With this assumption, and a positive rate of interest, farmers will only withdraw funding up to the point where the marginal return on capital is equal to the interest rate on savings. With constant returns to scale, the "bang-bang" solution would result in farmers either withdrawing all funds to invest in their farm or defaulting. Hence, in this simplified model under the above assumptions, the withdrawal decision would be uncorrelated with the foreclosure decision as all farmers would withdraw everything in period 1. We will instead show that our model matches the empirically relevant case when lower price expectations predicts larger withdrawals.

Finally, note that we consider α to be the subjective probability of price changes rather than the true probability of price changes. We make this assumption because we want to focus on the role of expectations in determining the foreclosure decision. In this sense, our calculation of the value function takes into account the consumption that is assumed to occur under these subjective expectations, rather than realized consumption.

3.5 Predictions and Hypotheses

Based on our narrative and the simple theoretical framework above, we formulate four empirically testable (*ceteris paribus*) predictions on the relationship between initial income shock, expectations, deposit withdrawals and strategic default.

Income shock, deposit withdrawals and strategic default.

1. The size of the initial income shock should be positively correlated with defaults[5] as the bar for sufficiently positive returns on investment becomes higher when remaining resources are low.[6]

2. The size of the initial income shock should also be positively correlated with deposit withdrawals (i.e. higher income losses lead to higher withdrawals). However, because at high levels of savings farmers will also choose to withdraw to invest in their farm, we expect this correlation to be weaker than the correlation between the initial income shock and defaults.

Expectations, deposit withdrawals and strategic default.

3. Expectations about future returns should be negatively correlated with defaults. Since different U.S. states observed different legal redemption periods (c.f. Section 2), the negative correlation might either hold contemporaneously or with a lag (or both).

4. According to our model, expectations about future returns should also be *weakly* negatively correlated with withdrawals because, on average, withdrawals are expected to be higher under default than under re-investment. Yet, since withdrawals occur under both low and high return expectations, we expect this correlation to be weaker and noisier than the correlation between expectations and default.

These predictions suggest an important role for deposit withdrawals in the aftermath of the agricultural price bust in 1920. According to our framework, deposit withdrawals *always* occur as a proximate consequence of the initial shock and farmers' expectations about future returns, no matter the state of the world (i.e. default or not). By extension, we thus hypothesize that the erosion of local stable funding constitutes an important predictor of rural bank closures during the 1920s, beyond and independent of potential asset-side losses. We test predictions 1 and 2, plus our hypothesis on deposit withdrawals as a driver of bank distress in Section 5 below. In Section 6, we test predictions 3 and 4 to further elucidate the mechanisms at hand.

[5]Note that we do not have data on farmers' decision to default in a given year: we only measure distressed transfers once they enter the county's deeds registry.

[6]Note that the income shock may in itself cause default if it is large enough to render repayment impossible. In this case, future expected returns become irrelevant.

4 Data

4.1 Farm Transfers

We digitize annual data on the number and acreage of farm transfers for 485 counties from 1900–1935. This data was published in a 1939 report by the Bureau of Agricultural Economics at the United States Department of Agriculture. The report was commissioned through a Works Progress Administration (WPA) project and conducted between 1936 and 1937.[7] We use the publicly available report to digitize the data. Since the report itself only includes a very brief data description, we supplement the data using archival materials from the National Archives.[8] The National Archives provide valuable insights into the methodology and sampling techniques used by the BEA as detailed in this section.

The publicly available report documents both voluntary and involuntary transfers of farm real estate for a selection of 485 counties across the United States. We focus on involuntary transfers that are likely to affect bank balance sheets. The report divides transfers into voluntary and involuntary transfers, with further subdivision based on the method of transfer. As we are interested in the effect of agricultural distress on banking distress, our benchmark specification focuses on involuntary transfers due to *foreclosure*, *bankruptcy*, and *assignment to creditor*. In our view, these transfers all were related to instances where the farmer could not repay debts. Other involuntary transfers include *sales for tax purposes*, *administrative sales*, *inheritance*, and an "other" category. While some of these categories may be related to agricultural distress, they are unlikely to directly affect local banks. More details are available in the Appendix.

The final report includes an unbalanced sample of counties from as early as 1900 to as late as 1935. Start dates vary based on the availability of data and when the county was incorporated. Figure 5 plots a map of counties in the United States. Counties in dark gray are included in the sample of the WPA report. Visually, the geographic dispersion of our data set is apparent, even within states. Geographic representativeness is important for our study, as it ensures we have variation of crop production across counties, potentially even within the same state or regulatory division.

We use information from archival sources to verify the data and better understand how they were constructed. The first important aspect was how to define a "farm" for the purpose of the project. According to memos from the archives, farms were broadly defined as properties used "principally for agricultural purposes," but additional criteria were also used. For example, small firms of less than three acres and farms located within the bounds of a city were considered non-farm properties and thus excluded (NAID 876996, Box 4, Folder 5).

The second important point was how the report decided on the 485 counties for which it presented the data. The central supervisors devised a list of approximately 1,000 counties for which data should be collected on farm transfers. State WPA agencies pared the list down by about half by based on (1) coverage, (2) records

[7]The project also investigated farm mortgages and farm tax payments, although here we focus only on farm transfers.

[8]The precise reference is as follows: National Archives, Record Group 83: Records of the Bureau of Agricultural Economics, "Records Relating to a Study of Farm Mortgage and Land Transfer, 1936–1938" (NAID: 876996). The records in question contain 13 boxes. We refer to the box and folder numbers as we cite from specific documents below.

condition, (3), data quality, and (4) representativeness of farm mortgage debt. Geographic completeness was a major concern of the study's managers. Chairman Donald Jackson, writing to Supervisor Nathaniel Back on September 28, 1936, stated that "it is our feeling that tax data for 33 or 34 counties in Kansas constitute an adequate sample if they are fairly well distributed over the state" (Letter dated September 28, 1936, NAID 876996, Box 1, Folder 1). Additional data from states were often requested. For example, in a letter dated October 20, 1936, Chairman Jackson, noted to Supervisor Nathaniel Back that in certain cases the data were not representative. Referring to South Dakota, the Chairman wrote that " [...] we would consider the sample adequate if tax data are obtained for the 3 western counties in which the project is operating. The 14 counties you sent us are all in the eastern half of the state" (Letter dated October 20, 1936, NAID 876996, Box 1, Folder 1).

Finally, the third important aspect was the accuracy of the data. We know from the publicly available report that the project relied on official county records of farm transfers. Our archival evidence also shows the extent to which the BEA workers verified transactions. BEA workers attempted to piece together the entire transactions history for each property, rather than rely simply on, say, country records regarding sales. A report covering an early "field trip" to Charlton, Iowa to test the process found that, for ten farms, it took a team of four people working six hours to compile the complete schedule, noting that the process should be quicker as teams obtained practice (Letter dated September 2, 1936, NAID 876996, Box 2, Folder 2). Schedules were also verified by central teams. In a letter dated February 25, 1937, Supervisor Back writes "effective today every 20th schedule is being spot-checked by this department" (Letter dated February 25, 1937, NAID 876996, Box 4, Folder 6). This verification process led to specific circumstances where further details were requested. For example, in a letter dated March 24, 1937, Supervisor Back writes "a number of schedules from counties in Louisiana [...] indicate that a Building and Loan association acquired title to a piece of property from an individual and on the same day transferred title on the same property to the same individual. We are at a loss to understand the nature of this transaction" (Letter dated March 24, 1937, NAID 876996, Box 1, Folder 1). Compiling these data was not easy work, and the BEA had to compete with other WPA programs around the country for labor. Internal reports suggest that some counties had difficulties hiring the budgeted manpower because of the combination of "paying low rates and at the same time requiring personnel with special skills" (Letter dated April 17, 1936, NAID 876996, Box 3, Folder 5). Beyond taking care to acquire the correct lineage for each farm, the BEA also compared series, including taxes per acre, with official sources. For example, the Assistant Agricultural Economist Gerhard Isaac, writing to Supervisor Nathaniel Back in 1936, noted that "The [Stevens county, Washington] 1908 tax per acre is much too large. At 1903 there is a sudden drop over 40 percent [...]. The records should be checked at this point [...]" (Ibid.).

4.2 Other Data and Summary Statistics

Our measure of agricultural distress is a crop index which we construct based on previous work by Jaremski and Wheelock (2020). This index compares agricultural values to their pre-boom averages between 1908-1914, taken as given the crop mix prior to the boom period. Specifically, for county i in period t, the index is calculated as follows:

$$CropIndex_{i,t} = \frac{\sum_{c=1}^{11} Q_{c,i,1910} P_{c,t}}{\sum_{c=1}^{11} Q_{c,i,1910} P_{c,avg}}$$

where c is one of 11 crops that we include in our sample.[9] We also collect data on agricultural production, farm finances, banking, and regulatory policies from a variety of other sources, including the agricultural census, as described in Table A1 in the Appendix.

Our sample period runs from 1910-1929 for regressions including only agricultural variables, and 1920-1929 for regressions that include banking data (except when noted) for data availability reasons. Our sample of counties is unbalanced over these time periods, depending mainly on the year in which foreclosure data become available. We stop our sample in 1929 as our focus is on the rise in bank failures during the 1920s, and the rise in bank failures during the Great Depression is explored at length in a voluminous literature (e.g. Friedman and Schwartz, 1963; Temin, 1976; Wicker, 1980; White, 1984; Calomiris and Mason, 2003; Mitchener, 2005; Richardson, 2007). In addition, ending the sample in 1929 allows us to ignore issues related to farm moratoria and other policy interventions which were passed across the country in the 1930s (Alston, 1984).

Table 1 displays summary statistics for the counties in our sample. Panel A focuses on covariates that vary over time. Over our sample period, the average level of the log crop index was almost two-thirds log points below its value in the early 1910s, which highlights the depth and duration of the agricultural depression across counties. The bank suspension rate was on average 2.3% of banks across counties in our sample, with state banks accounting for most of the suspended banks. In Panel B, we show time-invariant variables.

We explore how representative our sample of counties is to evaluate potential problems of selection bias. Table 2 compares counties in our sample to other agricultural counties, where we define agricultural counties as counties with at least 250 farms and at least 15,000 acres of improved farmland (Jaremski and Wheelock, 2020). As shown in Table 2, the counties in our sample are similar to counties that are not included along most dimensions, such as policy values in terms of the redemption period of foreclosure and financial variables including the share of farms mortgaged. There are some significant differences, including the boom period change in improved farmland being higher for counties *outside* of our sample, while the debt-to-value ratio is higher for counties *within* our sample. To be sure, we include each of these controls in a time-varying way across the regression specifications in this paper.

Finally, we also collect novel futures price data for major agricultural crops in the United States. We source these data from the *Annual Report of the Trade and Commerce of Chicago* (1929) and the *Yearbook of the National Association of Cotton Manufacturers* (19211931) at a monthly frequency for the period between 1919 and 1930. We describe our futures price data in more detail in Section 6 below.

[9]These crops are corn, wheat, oats, barley, rye, buckwheat, flax seed, cotton, tobacco, Irish potatoes, and sweet potatoes.

5 Empirical Analysis

5.1 The Effect of the Income Shock on Foreclosures and Deposit Withdrawals

We hypothesize that the negative agricultural price shock after 1920 had two effects on bank balance sheets: a solvency effect due to the (depreciated value of) foreclosed properties and a loss-of-funding effect due to farmers' deposit withdrawals. Our goal in this subsection is to demonstrate that the plausibly exogenous commodity price shock after 1920 triggered both effects. We begin by using our novel data to investigate whether the agricultural shock had an effect on farm foreclosures. Our benchmark specification at the county-year level is given by Equation 1:

$$FD_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{i,t-1} + \Upsilon X_{i,t} + \varepsilon_{i,t} \tag{1}$$

$FD_{i,t}$ denotes the sum of foreclosures, bankruptcies and assignments to creditor (henceforth: total foreclosures) per 1,000 farms for county i in year t and $\ln CropIndex_{i,t}$ is the log-level of the crop index for county i in year t. Our baseline includes county and time fixed effects, denoted by α_i and δ_t respectively, but we also experiment with using Federal Reserve district $\times$ year fixed effects. We cluster standard errors at the county level.

We include various controls to account for composition differences in farming development across counties. We interact continuous measures taken from the agricultural census with time fixed effects. Following earlier studies (Alston, 1983; Rajan and Ramcharan, 2015; Jaremski and Wheelock, 2020), we use all of the following continuous measures: the percentage change in improved land from 1910-1920, the share of tenant farmers in 1920, the percentage change in mortgage debt values from 1910-1920, the state-level redemption period, and the debt-to-value ratio in 1920. We also include a control for state deposit insurance, which has been found to be an important indicator of banking distress (Wheelock, 1992). Our main coefficient of interest is β, which represents the effect of changes in the level of the log crop index relative to the pre-war period on farm foreclosures. We predict $\beta < 0$, suggesting that lower levels of log crop prices imply higher foreclosure rates in the following year.[10]

Column (1) of Table 3 presents the results from estimating Equation (1).[11] A decline in the log crop index by one log point is associated with a statistically significant rise in the number of farm foreclosures of approximately 5.7 foreclosures per 1,000 farms. The coefficient is economically significant at the 1% level. Recall that the crop index fell around 1.5 log points from peak values across regions during the bust, and the number of foreclosures per 1,000 farms rose by approximately 10 on average across the United States during the 1920s.

To highlight how our novel foreclosure data tie into previous contributions, we also examine the importance of the banking system in explaining the relationship between the crop index and farming distress. Given the focus of

[10] We use the lagged value of the crop index. When we include the contemporaneous value, the estimated coefficient on the contemporaneous value is smaller in magnitude and becomes insignificant after the inclusion of district $\times$ year fixed effects. This suggests a delayed effect of changes in crop prices affecting foreclosures, potentially due to the fact that foreclosures take time to process.

[11] Results are robust, and in fact stronger, when only using 1917 data after 1917.

previous work, we are particularly interested in whether the credit system played a role in shaping the effect of the agricultural shock on farm foreclosures. For this purpose, we augment Equation (1) by including an interaction of the crop index with a time-invariant, county-specific measure of finance in the county $Z_{i,1920}$:

$$FD_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{i,t-1} + \gamma \ln CropIndex_{i,t-1} \times Z_{i,1920} + \Upsilon X_{it} + \varepsilon_{it} \tag{2}$$

We use two measures of $Z_{i,1920}$. First, we use the percentage of farms mortgaged in the county in 1920. The percentage of farms mortgaged is independent of the source of credit, and so is only focused on whether higher dependence on external finance across counties is associated with a stronger effect of changes in the log crop index on farm foreclosures. Column (2) of Table 3 shows the results when including this interaction term. The interaction term is statistically significant and implies that a county with 100% of farms mortgaged is likely to see the number of farm foreclosures per 1,000 farms rise by 7 more than a county with no farms mortgaged for each log point decline in the crop index. In addition, the direct effect is now smaller in magnitude, suggesting that counties with no farms mortgaged have a much smaller number of foreclosures. This finding is comforting, as by definition foreclosures require some mortgage debt.

Second, in Column (3) of Table 3, we use the number of commercial banks per 1,000 county inhabitants in 1920. Farmers did not only borrow from banks, and so this specification is a test of whether the presence of banks was an important source of heterogeneity of foreclosure rates across counties. Again, we find a statistically significant effect whereby for each additional bank per 1,000 people, a county is likely to see approximately 6 more farm foreclosures for each log point decline in the crop index.[12] The direct effect, while smaller in magnitude relative to column (1), remains statistically significant.

The location of banks and the availability of credit throughout the 1920s may have depended on monetary policy, which differed across Federal Reserve districts. In Columns 4–6 of Table 3, we include Fed District × Year fixed effects instead of simply Year fixed effects. The point estimates are similar across the columns on the interaction terms, suggesting that banks and credit availability remain important even after accounting for differences in Federal Reserve policy. The direct effect for both interaction terms falls in economic and statistical significance, suggesting that regional differences played an important role in the estimate of the direct effect seen in Column (3).

We now move on to explore whether the sudden agricultural shock also had a direct impact on bank deposit withdrawals. To obtain the coefficient estimates displayed in Table 4, we regress the log change in deposits on farm foreclosures and the log crop index. We find a consistently positive correlation between the crop price index and the log deposit change in deposits. To interpret this result, consider e.g. the coefficient estimate in Column (4). The estimate implies that every log point decline in the crop index increases deposit outflows by 8 percentage points, which is both economically and statistically significant. Interestingly, the results became

[12] In unreported results, the estimates are qualitatively unchanged if we focus on the number of state banks or the number of national banks per 1,000 people instead. The point estimates are slightly higher for national banks, but the number of national banks per 1,000 people is also lower as there were simply fewer national banks.

stronger when we include Fed District × Year fixed effects, suggesting that districts with less supportive liquidity policy may have experienced larger declines in the log crop index, a point we return to below.

We view the results in this subsection as implying that changes in farming income as proxied by crop prices played an important role in explaining agricultural distress across counties. Previous work has emphasized how changes in farm income led to higher rates of bank entry throughout the 1910s (Jaremski and Wheelock, 2020) and subsequently contributed to a credit boom during that time period (Rajan and Ramcharan, 2015). Our results show that the subsequent agricultural bust directly affected farmers' balance sheets. Importantly, the results in Tables 3 and 4 suggest that our proxies for insolvency (farm foreclosures) and funding losses (deposit withdrawals) represented two separate channels through which the agricultural price shock affected bank balance sheets.

5.2 Farm Distress and Bank Closures

In this subsection, we investigate whether the solvency and funding impact of the price bust both contributed to bank closures over the 1920s. Contemporaries believed the agricultural depression played a role in rising bank failures. Previous work using cross-sectional, state-level data has indeed found that farm foreclosures play a role in predicting bank failures, especially in rural areas (Alston et al., 1994). In addition, bank failures during the 1920s period have been found to be closely associated with the boom period in agriculture (Jaremski and Wheelock, 2020). We estimate the following regression:

$$Y_{i,t} = \alpha_i + \delta_t + \beta FD_{i,t} + \eta \Delta \ln Dep_{i,t} + \Upsilon X_{i,t} + \varepsilon_{i,t} \tag{3}$$

where $Y_{i,t}$ is the share of suspended banks, $FD_{i,t}$ denotes farm foreclosures, and $\Delta \ln Dep_{i,t}$ denotes the log change in total deposits in county i at time t. The coefficients of interest are β, i.e. the association between farm foreclosures and the bank suspension rate, and η, i.e. the correlation between the log change in deposits and the bank suspension rate. We hypothesize that $\beta > 0$ and $\eta > 0$ so that higher levels of farm foreclosures and liquidity demands are associated with higher rates of bank suspensions.

Our inclusion of both farm foreclosures and the log change in deposits allows us to disentangle the drivers of bank suspensions in the 1920s. Specifically, we ask whether banks that failed in the 1920s did so because they were insolvent, as the value of assets including farm mortgage lending had dropped below the value of liabilities, or because they faced heavy funding losses, as farmers withdrew savings to buffer the income shock, move away upon default or re-invest. One may be concerned that the log change in deposits is endogenous with respect to foreclosure distress. We argue that this is not the case. As shown in Table 4, the log change in deposits is driven by changes in crop prices and not by changes in farm foreclosures. This suggests that the agricultural price shock worked *separately* through foreclosure distress and liquidity needs.

Column (1) of Table 5 shows the effect of distressed transfers on *all* banks in a county including county and year fixed effects. The coefficient estimate implies that for an increase of 10 distressed transfers per 1,000 farms, the bank suspension rate would rise by approximately 0.50 percentage points and the effect is highly statistically significant. Including Fed District × year fixed effects in Column (2) results in a similarly estimated effect. In the appendix, we show that including *all* involuntary transactions such as changes due to tax purposes lowers this coefficient estimate, suggesting that the effect stems mainly from transfers related to bank finances. The effect of the log change in deposits, shown in the second row, is also highly significant and economically meaningful. The coefficient estimates suggest that a decline in deposits of one log point raises the suspension rate by 0.20 percentage points.

The total effects in Columns (1) and (2) mask significant heterogeneity across state-chartered and national banks. In the remaining columns of Table 5, we thus investigate suspension rates by bank type. Our method of defining state and national bank suspensions relative to total banks in a county implies that the coefficient estimates in the two separate regressions sum to the overall effect. So, for example, the coefficient estimates in Column (3), for state banks, and Column (5), for national banks, should sum to the effect in Column (1). This decomposition is particularly useful to highlight which mechanisms are more relevant for different types of banks. It ensures ease of interpretation across specification, as the estimated coefficient will always refer to the effect of a change in, say, foreclosures on the number of suspended banks of a certain type relative to all banks. The downside is that there are significantly more state banks in the sample.[13]

Columns (3) and (5) replicate the specification without Fed District × Year fixed effects for state and national banks, respectively. We find that a rise in distressed transfers has a statistically and economically significant effect on national bank suspensions. An increase in foreclosures of 10 per 1,000 farms raises the suspension rate by approximately 0.20 percentage points for national banks, and is robust to the inclusion of district × time fixed effects. However, farm foreclosures do not have a significant effect on the state suspension rate when including District × Year fixed effects, with the effect of an increase in foreclosures of 10 per 1,000 farms raising the suspension rate approximately by a statistically insignificant 0.30 percentage points. Taken together, changes in distressed transfers appear to have a significant effect only on national bank suspensions.

In contrast, columns (3) and (5) show that liquidity plays a role, especially for state bank suspensions. The coefficient estimate for state bank suspensions is economically large and statistically significant, accounting for approximately three-quarters of the effect from Column (1). This is commensurate with the share of state banks across the country. In Column (5), we see that the log change in deposits also plays a role in explaining the suspension rate for national banks.

Our results may appear puzzling at first glance, as previous contributions find that the boom period predicts variation in suspension rates across state banks, rather than national banks (e.g. Jaremski and Wheelock, 2020). Yet, we argue that our new data allow us to better differentiate among the drivers of bank suspension. On the

[13] Assuming that the true effect of, say, foreclosures were the same for both national banks and state banks, we should expect the coefficient for state bank suspensions to be scaled up by the multiple of state banks relative to national banks. In 1921, approximately two-thirds of banks were state banks (predominantly nonmember banks), i.e. there were roughly twice as many state banks as national banks.

one hand, some banks suspended because the value of their assets dropped precipitously as farmers could not repay. On the other hand, farmers' liquidity needs rendered rural banks nonviable due to the permanent loss of stable funding.

Our results above suggest that the loss of funding played a role in explaining bank suspension rates, especially for state banks. To further investigate this role, we now present further suggestive evidence on the workings of this channel. To do so, we augment Equation 3 by interacting the log change in deposits with a measure of liquidity supply.

$$Y_{i,t} = \alpha_i + \delta_t + \beta FD_{i,t} + \eta \Delta \ln Dep_{i,t} + \gamma \left(\Delta \ln Dep_{i,t} \times Z_{s(i),t} \right) + \Upsilon X_{i,t} + \varepsilon_{i,t}$$

Our measure of the liquidity supply, $Z_{s(i),t}$, is the share of deposits at Federal Reserve member banks at the state level. State banks were not required to be members of the Federal Reserve System. However, joining the System allowed them to access to their local Federal Reserve Bank's discount window, which could have helped alleviate negative liquidity shocks.

Table 6 summarizes the results. In Column (1), we show that a higher share of member bank deposits reduces the effect of the liquidity channel across all bank suspensions. Recall that the coefficients for the regressions focusing on state and national banks should sum to the overall effect. We can compare Columns (2) and (3), which replicate Column (1) for state and national banks, respectively, to show that this liquidity channel was stronger for state banks, as expected. Specifically, if all banks in a region were members of the Federal Reserve System, the negative effect of a liquidity shock would be almost completely eliminated, as shown in Column (2). All national banks were required to be members of the Federal Reserve System. Hence, it is not surprising that in Column (3) we find no effect of the share of deposits at member banks on national bank suspension rates.

6 Robustness and Mechanism

6.1 Bank-level Evidence

In this subsection, we use bank-level data to implement two robustness tests. First, we check whether "non-fundamental" banking panics could have been the main cause of banks' funding losses. Second, we verify that our results on the determinants of bank suspensions continue to hold at the bank level, after controlling for a range of time-varying bank characteristics.

We draw on bank-level balance sheet data for 20 states covering the period 1919-1925.[14] Our bank-level data include both national banks and state-chartered banks. We obtain failure events for each bank by inferring failure dates (i.e. year of failure) based on when a bank last reported a balance sheet. For example, if a given

[14]The states included are Alabama, Arkansas, California, Colorado, Georgia, Idaho, Illinois, Iowa, Louisiana, Maryland, Michigan, New Jersey, New York, North Carolina, Ohio, Oregon, South Dakota, Washington, West Virginia, and Wisconsin.

bank published its last balance sheet in 1923, we infer that this bank closed in 1924. Although this strategy of identifying exits does not allow us to distinguish between outright failures and other forms of bank closures (for example, mergers), it provides a simple upper-bound approximation of bank failures happening during periods of agricultural distress in the first half of the 1920s.

Above, we show that deposit withdrawals were tightly associated with bank suspension rates at the county level. In our theoretical framework and empirical sections, we trace deposit withdrawals to the agricultural commodity price collapse and its reverberations. Yet, local banking panics represent a potential alternative explanation for banks' heavy deposit losses during the 1920s. These local panics may have erupted for reasons unrelated to agricultural distress, e.g. due to rumors or a "contagion of fear" (Marodin et al., 2024), as observed later during the Great Depression (Calomiris and Mason, 2003; Richardson, 2007). According to Davison and Ramirez (2014), three local banking panics occurred during the first half of the 1920s: the first broke out in Minnesota around 26 November 1923; the second happened in South Dakota (dated between 11 January and 25 January 1924); and the third hit New Mexico on the days following 28 January 1924.

To test whether these local banking panics spuriously drove the association between agricultural distress and deposit withdrawals, we estimate the fixed effects panel regression model in Equation 4 at the bank-level. The model regresses the bank-level log change in deposits on bank-level fixed effects (α_i), year or state-year fixed effects (δ_t), the county-level contemporaneous crop index (natural logarithm) and and vector of time-varying bank-level control variables (X). The control vector includes the loan to deposits ratio, the return on equity, the equity ratio, the share of deposits in total assets, the ratio of liquid assets to total assets and the natural logarithm of total assets.

$$\Delta \ln Dep_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{c,t} + \Upsilon X_{i,t} + \varepsilon_{i,t} \tag{4}$$

Table 7 summarizes the results for several empirical specifications of Equation 4. All coefficients represent the marginal effects of a one standard deviation increase in the crop price index. We first show that the tight connection between local agricultural conditions and deposit withdrawals documented in Table 4 is robust to the inclusion of bank and year fixed effects (Column (1)). A one standard deviation increase in the log crop price index is associated with a 9.4 percentage point (0.09 log points) increase in the log change of deposits. In other words, banks located in counties with comparatively better agricultural conditions experienced significantly less deposit withdrawals. This link also remains highly statistically and economically significant after we drop all banks located in South Dakota from our sample (Column (2); Minnesotan and New Mexican banks are not covered by our bank-level sample). Column (3) replicates the specification in Column 1 after replacing year fixed effects with state-year fixed effects. We use state-year fixed effects to flexibly control for potential regional panics that may have not been detected by Davison and Ramirez (2014). In Columns (4) and (5), we add time-varying bank-level controls, in contemporary form and lagged by one year, respectively. Controlling for flexible time trends across states and time-varying control variables, we are able explain between 50% and 60% of the bank-level variation in the log change of deposits. Overall, our results suggest that "non-fundamental" regional banking panics did not spuriously drive the empirical link between local agricultural conditions and bank-level deposit withdrawals.

To take our analysis of failure dynamics to the bank level, we first draw on the non-parametric Nelson-Aalen estimator of the cumulative hazard function ($\hat{H}$) to convey an overview of failure dynamics of banks located in counties in and outside our WPA foreclosure sample. In Equation 5, F represents the number of bank failures at time t and N is the total number of banks at risk at t. Figure 6 summarizes the results. Panel A shows that about 20% of the total banking population at risk exits between 1919 and 1925. Panel B evidences that banks located in counties featured in our WPA sample exhibit statistically identical failure dynamics when compared to banks located in the remaining counties. The Cox regression-based test for the equality of survivor functions displayed in Panel B cannot reject the null hypothesis of equality (χ^2-statistic of 0.03 and p-value of 0.86).

$$\hat{H}(t) = \sum_{t_j \leq t} \frac{F_j}{N_j} \tag{5}$$

Next, we analyze the bank-level drivers of bank exits in a parametric survival regression framework. In Equation 6, $\log L$ represents the log-likelihood function, Υ is a vector of coefficients corresponding to the vector of control variables X, γ is the shape parameter of the log-logistic distribution, δ represents a dummy variable indicating bank failure, h is the hazard function, t marks the time to failure (or censoring if no failure occurs until the end of 1925), and S stands for the survival function. X contains a list of lagged time-varying bank-level and time-invariant county-level control variables.[15]

$$\log L(\Upsilon, \gamma) = \sum_{i=1}^{n} [\delta_i \log h(t_i|X_{i,t-1}) + \log S(t_i|X_{i,t-1})]\,^{16} \tag{6}$$

Table 8 summarizes the estimation results. All estimated coefficients are displayed in time ratio form (exponentiated coefficients) and are directly comparable because the underlying covariates are standardized. Consistent with our county-level results, Column (1) provides evidence that a one standard deviation increase in the log change in deposits increased the median time to bank exit by 9% (statistically significant at the 1% level). We also find that a standard deviation increase in distressed transfers of farm real estate accelerated the median time to bank exit by 9% (Column (2); statistically significant at the 5% level). Note that the estimation sample falls substantially from Column (1) to Column (2) because county-level information on transfers of farm real

[15] X contains the following time-varying bank-level variables: total assets (natural logarithm), bank age (as of 1925) and the equity ratio. X also includes a dummy for bank type (national vs. state-chartered banks) state-level redemption periods in months, county-level percentage changes in improved acreage and mortgage debt values between 1910 and 1920, the share of owner-occupied farms, and the debt-to-value ratio (both measured at the county-level in 1920).

[16] The full notations for the survival and hazard functions are $S(t) = \frac{1}{1+(\frac{t}{\lambda})^{\gamma}}$ and $h(t|X_{i,t-1}) = \frac{\gamma/\lambda_i (t/\lambda_i)^{\gamma-1}}{1+(t/\lambda_i)^{\gamma}}$, where $\lambda_i = \exp(X_{i,t-1}\Upsilon')$.

estate is only available for counties in our WPA sample. In Columns (3) and (4), we run a horse race between the log change of deposits and distressed transfers of real estate, before and after stratifying the baseline hazard by state. In both cases, we find that deposit withdrawals are significant predictors of the time to bank exit, whereas distressed transfers are not. In sum, these bank-level results are consistent with the findings reported in Table 5 and confirm the relative importance of the liquidity channel to bank distress during the 1920s.

6.2 The Role of Commodity Price Expectations

This subsection provides additional empirical evidence on the economic mechanisms driving farmers' default and withdrawal decisions during the 1920s. Holding the size of the initial income shock constant, prediction 3 of our framework suggests that farmers decide whether to engage in strategic default based on expected future price developments. That is, if returns are expected to remain persistently low with a high enough probability, the farmer defaults. To test the prediction that commodity price expectations were an important determinant of defaults/foreclosures, we require historical data that capture variations in farmers' expectations of returns on investment during the 1920s. Ideally, we would observe medium-term or longer-term future price expectations at the beginning of each planting season for the universe of crops cultivated by U.S. farmers.

Agricultural commodity price expectations as reflected in futures contract prices provide a suitable proxy for our purpose. Historical futures prices for U.S. agricultural commodities are available for the 1920s at high-frequency intervals (monthly and even daily), but only for a limited number of major crops (corn, cotton, oats, and wheat). Moreover, the longest available forward horizons of futures contracts never exceed 11 months during the 1920s. We collect monthly futures prices for all available delivery dates in a given year (May, July, September and December) for the four crops from the *Annual Report of the Trade and Commerce of Chicago* (1929) and the *Yearbook of the National Association of Cotton Manufacturers* (1921–1931).

In a first step, we combine these futures price series with the respective monthly spot price data sourced from the *NBER Macrohistory Database* to inspect broad trends over time. The spot price prevailing at the beginning of the delivery horizon (i.e. when the futures contract is initiated) represents the anchor relative to which futures prices (i.e. price expectations) evolve over different delivery horizons. For example, we connect the spot price for corn at the beginning of May 1920 to the futures price for delivery at the end of May, July, September and December 1920. In this way, we obtain a series of expected prices for 1 month, 3 months, 5 months and 8 months ahead, as of May 1920. We implement this step for all months and delivery horizons. We plot the resulting line charts for all four crops, months and horizons in Panels A, B, C and D of Figure 7.

Given the annual frequency of our foreclosure and bank data, our goal is to construct a series of price expectations that reflects farmers' information about the sequence of their future returns in each year. Thus, in a second step, we focus on our expected price series for end-of-year (December) delivery dates. For the December delivery date in year t, the longest horizon with consistent data for all crops and years stems from July in t (6 months ahead). Yet, some crops (e.g. cotton) and the later years in our sample feature futures price data for longer horizons (i.e. horizons starting in months before July, e.g. June, May, April and sometimes even January). To approximate long-term expectations in the best possible way, we always pick the longest available forward horizon for each crop in each year. At the very least, our data on expectations of prices in December of year t as of early/late spring in the same year capture expectations during planting season about the upcoming harvest in year t.[17]

Panels A, B, C and D in Figure 8 provide information on the sign and size of price expectations for the longest available forward horizon for each crop until the end of each year (December delivery). To obtain the sign and size of price expectations, we subtract spot prices prevailing at the initiation of the respective futures contract from the expected end-of-year futures price. Figure 8 suggests that expectations were often negative (albeit *ex post* still too optimistic) in the first years following the price bust. Price expectations subsequently remained relatively stable (but at low levels) until the mid-1920s. The partial (spot) price recovery between 1924 and 1926 induced a short period of modestly rising expectations for some crops. In the remaining years until 1930, but also more generally, price expectations varied across crops and years. While our data only imperfectly reflect medium- to longer-term expectations, the observed variation across time and crops may still be useful to capture parts of the strategic default considerations of farmers.

To exploit our data on price expectations for December in each year within our econometric set-up, we construct a weighted average of expectations at the county level. For this purpose, we weight price expectations for each of our four crops using revenue shares from the 1920 Agricultural Census.

$$EXPEC_{i,t} = \sum_{c} \frac{P_{c1920}Q_{c1920}}{\sum_{c'} P_{c'1920}Q_{c'1920}} EXPEC_{c,t}, \quad c \in \{\text{Corn, Cotton, Oats, Wheat}\}$$

where c denotes individual crops. Variation in county-level expectations across counties comes from the sales distribution of these four crops.

Armed with a measure of county-level commodity price expectations, we now investigate how these expectations shaped patterns of foreclosures, withdrawals, and bank suspension rates. We estimate the following regression specification:

$$Y_{it} = \alpha_i + \delta_t + \beta EXPEC_{i,t} + \Upsilon X_{i,t} + \varepsilon_{i,t} \tag{7}$$

$Y_{i,t}$ denotes foreclosures, log changes in deposits, or bank suspension rates. We include the same controls as in our estimation of Equation (1) in $X_{i,t}$. In addition, we include the lagged level of the crop index to account for the fact that the effects of expectations are likely more important when prices are more depressed. We also include the log difference between the highest and lowest price futures in the month in which expectations are set to account for initial volatility in expectations. Standard errors are clustered at the county level. The main parameter of interest is β, which represents the marginal effect of the the forecasted change in prices on the

[17] According to the U.S. Department of Agriculture, the harvest season runs: for corn from August to December, for cotton from September to December, for oats from May to October, and for wheat from July to October. Planting season for all of these crops is roughly April to July, although for fall oats they are planted the previous year.

outcome of interest.[18]

We face two challenges when estimating Equation 7. First, as mentioned above, our measure of future price expectations could be somewhat short relative to the time horizon of strategic default decisions. Specifically, we only have short-term price expectations at a maximum horizon of 11 months ahead. Our measure may understate expected movements if farmers consider low-frequency changes in demand to take years to affect prices. Given that mortgage loan maturities differed across regions and were typically extended at horizons between one to five years (c.f. Section 2), it is possible that our expectations are thus shorter than those farmers would typically use to take strategic default decisions. We expect our estimates of coefficient β to be downward biased due to this issue.

Second, recall that we only have futures prices for four crops. In other words, for a significant share of counties, we do not have full information on expected price changes relative to all sources of farmers' income. This missing data problem would likely bias results towards zero, especially if we consider it as a classical measurement error. To address this shortcoming of our data, we take two approaches to estimating Equation 7. First, we focus on those counties for which the four crops make up at least 80% of revenues in the 1920 census. Second, we estimate Equation 7 using weighted least squares, using the revenue shares of the four crops with price expectations as weights. As we will show, the two methods produce similar results.

Figure 9 presents the estimated coefficient and 95% confidence intervals from estimating Equation 7 six different times: once for each outcome (foreclosures per 1,000 farms, log changes in deposits, and bank suspension rates) by model type (restricted by shares of the four crops for which we have expectations data or using weighted least squares). The first two rows show that expectations of price recovery are indeed negatively correlated with foreclosures: the larger the expected price recovery, the smaller the county-level foreclosure rate.[19]

In the next two rows, we present estimated effects of expectations on the log change in deposits. Prediction 4 of our framework suggests that counties with smaller expected changes in prices (i.e. less positive expectations) should see larger deposit withdrawals. While farmers also tap into savings if they decide to re-invest, their withdrawals are expected to be larger under default. Our evidence shows that log changes in deposits are indeed weakly positively correlated with expectations. Finally, the last two rows present the direct effect of expectations on bank failures. These results can be interpreted as a reduced form-type regression. We do not find any evidence that expectations had a direct effect on bank suspension rates. These zero results are not particularly surprising: Section 5 shows that most of the action regarding suspension rates comes from deposit withdrawals and expectations only constitute a noisy predictor of withdrawals.

Overall, the results presented in this subsection are consistent with the predictions of our theoretical framework. Expectations about future returns to investment in farming are negatively correlated with farm foreclosures and

[18] We focus on the contemporaneous value of expectations as the lagged values are in all cases smaller in magnitude and insignificant. Their inclusion slightly widens the standard errors of the estimated coefficient on the contemporaneous effect of price expectations.

[19] The foreclosure models of Foote et al. (2010) also predict that homeowners should be less likely to default on mortgages when income is expected to recover.

deposit withdrawal throughout the 1920s.

6.3 Distinguishing between fundamentals and fire sale dynamics

In this subsection, we provide additional evidence to test whether fire sale dynamics played a role in exacerbating bank suspensions. We have argued that the agricultural crisis depressed farmers' expectations of price recovery. Low farmer sentiment about the future economic situation led to bank suspensions during a wave of deposit withdrawals as farmers sought liquidity due in part to loan defaults. This fundamental explanation of bank suspensions highlights the strategic decision faced by farmers in the wake of price collapses to give up their farms as the situation worsened.

However, an alternative explanation for bank suspensions during this period is that through farm foreclosures and other loan defaults, agricultural distress reduced local financial intermediation capacity. Specifically, if farmers were unable or unwilling to repay debts, banks may have been forced to seize collateral. If farmers were the "best" users of farmland, collateral values may have dropped as asset demand fell. Depressed asset valuations could have led to a weakening of balance sheets for banks, as highlighted by Rajan and Ramcharan (2016) in their study of this period. This financial distress in turn could have triggered an increase in bank suspensions amidst a general slowdown in economic activity (Allen and Gale, 2005; Bernanke, 1983).

To disentangle fundamentals from fire sales as drivers of bank suspensions, we adopt a similar identification strategy as Rajan and Ramcharan (2016). As foreclosure laws were determined by states, the cost of foreclosure varied across the country. For example, in eighteen states across the country during this period, lenders were permitted to have power of sale clauses in mortgage contracts that allowed foreclosure without resorting to courts. More generally, power of sale states had lower overall costs of foreclosure (Bridewell, 1938; Rajan and Ramcharan, 2016).

Under the hypothesis that depressed agricultural fundamentals were a key driver, we would not expect the effect of foreclosure and withdrawals on bank suspension rates to vary depending on the associated legal environment. In Table 9, we directly test this hypothesis. Columns (1) and (2) show that for two different proxies of foreclosure costs, the dollar cost as estimated by Bridewell (1938) and a dummy for a power of sale state, higher costs are associated with a lower observed number of foreclosures per 1,000 farms in the next year. However, as shown in Columns (3) and (4), we find that these differences do not matter for predicting bank suspension rates. The direct effect of foreclosure and deposit withdrawals are of similar magnitude to Table 5, while the interactions are much smaller in magnitude and statistically insignificant.

Before concluding this section, we note that our results do not contradict the findings in Rajan and Ramcharan (2016). They find that across states, higher foreclosure costs limited the effects of agricultural distress on local financial intermediation capacity. It is entirely possible, and even probable, that distress at local banks played an important role in propagating the agricultural depression of the 1920s through various channels including fire sales. Our results point to a solvency-based explanation as the initial shock. However, over time the lack of local financial intermediation capacity may have played a larger role.

6.4 Narrative Evidence

The minutes and the final report of the congressional Joint Commission of Agricultural Inquiry (1922a,b) provide first-hand descriptive and qualitative insights supporting our econometric evidence for a potential illiquidity channel to bank distress. The commission's report classified counties as agricultural, semi-agricultural and non-agricultural to demonstrate that deposit withdrawals from banks located in the first group of counties far exceeded those from banks situated in the remaining two. Data from the report, as summarized by Wallace (1956), show that banks in agricultural counties lost 11% of all deposits in the short period between May 4, 1920 and April 29, 1921 alone. The corresponding numbers in semi-agricultural counties and non-agricultural counties amount to −5.2% and −4.4%, respectively. The final report of the Joint Commission of Agricultural Inquiry (1922a, p.102) explicitly states that "farmers in agricultural districts being unable to sell their products for enough to liquidate their bank loans, or in many cases to sell them at all, drew down their deposits to pay debts to merchants and factors and others who in turn paid wholesalers or manufacturers in the cities". In sum, the report suggests that deposit outflows were directly linked to the local impact of the agricultural price collapse and constituted an important part of farmers' response to the income shock, at least at the beginning of the 1920s.

Between May 1920 and April 1921, banks in agricultural counties also sharply increased their borrowings from the Federal Reserve Banks (by 57%) and from their correspondents (by 66%) (Joint Commission of Agricultural Inquiry, 1922a, p.102). Their peers in semi-agricultural and non-agricultural counties both reduced borrowings from the Federal Reserve System (by -0.2% and -28.5%, respectively) and raised external financing from correspondents only modestly (by 19% and 0.6%) relative to agricultural counties. These comparative statistics convey the impression that banks in agricultural districts had to go to great lengths to replace the deposit funding they had lost. Member banks located in agricultural districts borrowed heavily from their Federal Reserve Bank to pay out depositors.[20] Although correspondent finance also appears to have played a major mitigating role, the numbers suggest that state-chartered non-member banks without access to the Federal Reserve System's liquidity facilities must have struggled to meet depositors' demands. If the availability of deposit funding in agricultural counties continued to remain low or decreased further after 1921, the lack of discount window access could have significantly depressed prospects for state-chartered non-member banks and may explain their higher exit rates over the following years. The results in Table 6 above lend empirical support to this conjecture.

Our econometric evidence suggests that bank suspensions during the 1920s were often driven by large-scale deposit withdrawals. If our hypothesis of a funding channel to bank closures is correct, we would expect contemporaries to refer to withdrawals as a major source of banks' troubles during this time. The Annual Report

[20] Stigma on Federal Reserve discount window borrowing developed only later(Gorton and Metrick, 2013; Anbil, 2018).

of the Comptroller of the Currency provides descriptive reasons for all national bank suspensions that occurred in a given year. We collect these data for all national bank failures between 1920 and 1926.[21] The reports only attribute 37 out of 235 national bank suspensions (i.e. 16%) directly to asset-side losses, mentioning "depreciation of securities", "inability to realize on loans", "failure of large debtors", "crop losses" or simply "large losses" as the main cause of failure. In 54 out of 235 instances (i.e. 23% of all failures), the reports directly refer to "heavy withdrawals", "depleted reserves", "bank runs" or the "inability to meet demands" as the main reason for national bank suspensions. In addition, the Comptroller of the Currency ascribed 44 national bank suspensions between 1920 and 1926 to agricultural distress more broadly ("local financial depression from unforeseen agricultural disaster").[22] The last category does not allow us to ascertain whether local agricultural distress impacted banks' health mainly via the asset side or liabilities side. Based on our econometric results, we suspect that both sides of banks' balance sheets were affected. Overall, the descriptive evidence from the Annual Report of the Comptroller of the Currency suggests that the funding channel to bank exits did play a non-negligible role in the case of national banks. The loss of otherwise local stable funding could be one of the main reasons why national banks failed in considerable numbers in the wake of the agricultural crisis during the 1920s, even though their exposure to farm mortgage loans was very low.

7 Conclusion

Many existing contributions attribute the widespread U.S. bank failures between 1921 and 1929 to asset-side losses resulting from banks' exposure to bad agricultural debts. This paper provides evidence for a complementary funding channel to bank exits during the 1920s. We build a simple theoretical framework to link deposit withdrawals to the agricultural income shock following 1920, farmers' expectations about future returns and their decision to default on mortgages. Thanks to a new annual database on farm real estate transfers at the county-level, we are able to empirically disentangle the impact of bad agricultural debts from the effect of funding losses on bank balance sheets. We find that deposit withdrawals from banks are highly correlated with bank suspensions – even after directly controlling for the asset-side impact of farm distress. We also collect novel futures price series for major agricultural crops to construct proxies for farmers' expectations of future returns and use these data to plausibilize the economic mechanisms driving deposit withdrawals. Overall, our results suggest that the traditional focus on asset-side losses alone does not capture the full story behind the large-scale bank exits during the 1920s.

[21] The definition of descriptive categories changed after 1926, which makes it difficult to compare the reasons for failures after that date.

[22] Other reasons for bank failures mentioned in the reports include bad management, injudicious banking, defalcation/fraud, and bank robberies.

References

Allen, F. and D. Gale (2005). From cash-in-the-market pricing to financial fragility. *Journal of the European Economic Association 3*(2-3), 535–546.

Alston, L. J. (1983). Farm foreclosures in the United States during the interwar period. *Journal of Economic History 43*(4), 885–903.

Alston, L. J. (1984). Farm foreclosure moratorium legislation: A lesson from the past. *American Economic Review 74*(3), 445–457.

Alston, L. J., W. A. Grove, and D. C. Wheelock (1994). Why Do Banks Fail? Evidence from the 1920s. *Explorations in Economic History 31*(4), 409–431.

Anbil, S. (2018). Managing stigma during a financial crisis. *Journal of Financial Economics 130*(1), 166–181.

Anderson, H., C. W. Calomiris, M. Jaremski, and G. Richardson (2018). Liquidity risk, bank networks, and the value of joining the Federal Reserve System. *Journal of Money, Credit and Banking 50*(1), 173–201.

Bernanke, B. S. (1983). Nonmonetary effects of the financial crisis in the propagation of the great depression. *American Economic Review 73*(3).

Board of Governors of the Federal Reserve System (1946). Banking and monetary statistics 1914-1941.

Board of Governors of the Federal Reserve System (1959). All Bank Statistics: United States 1896–1955. Miscellaneous publication 58-60050, Board of Governors of the Federal Reserve System.

Bridewell, D. A. (1938). The effects of defective mortgage laws on home financing. *Law and Contemporary Problems 5*(4), 545–563.

Bureau of Agricultural Economics (1939). Transfers of farm real estate: Number of properties and acreage transferred, by kind of transfer.

Calomiris, C. W. and J. R. Mason (1997). Contagion and bank failures during the Great Depression: The June 1932 Chicago banking panic. *American Economic Review 87*(5), 863–883.

Calomiris, C. W. and J. R. Mason (2003). Fundamentals, panics, and bank distress during the depression. *American Economic Review 93*(5), 1615–1647.

Campbell, J. Y. and J. F. Cocco (2015). A model of mortgage default. *Journal of Finance 70*(4), 1495–1554.

Carter, S. B., S. S. Gartner, M. R. Haines, A. L. Olmstead, R. Sutch, G. Wright, et al. (2006). *Historical statistics of the United States: millennial edition*, Volume 3. Cambridge University Press New York.

Davison, L. K. and C. D. Ramirez (2014). Local banking panics of the 1920s: Identification and determinants. *Journal of Monetary Economics 66*, 164–177.

Diamond, D. W. and P. H. Dybvig (1983). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy 91*(3), 401–419.

Eggertsson, G. B. (2008). Great expectations and the end of the depression. *American Economic Review 98*(4), 1476–1516.

Federal Deposit Insurance Corporation (1957). Annual Report of the Federal Deposit Insurance Corporation for the Year Ended December 31, 1956.

Federal Deposit Insurance Corporation (2001). Federal Deposit Insurance Corporation Data on Banks in the United States, 1920-1936.

Federal Reserve Board (1924). *Tenth annual report of the Federal Reserve Board covering operations for the year 1923*. Washington D.C.: Government Printing Office.

Foote, C., K. Gerardi, L. Goette, and P. Willen (2010). Reducing Foreclosures: No Easy Answers. In *NBER Macroeconomics Annual 2009, Volume 24*, NBER Chapters, pp. 89–138. National Bureau of Economic Research, Inc.

Friedman, M. and A. J. Schwartz (1963). *A monetary history of the United States, 1867-1960*. Studies in business cycles. Princeton: Princeton University Press.

Gorton, G. (1988). Banking panics and business cycles. *Oxford Economic Papers 40*(4), 751–781.

Gorton, G. and A. Metrick (2013). The Federal Reserve and panic prevention: the roles of financial regulation and lender of last resort. *Journal of Economic Perspectives 27*(4), 45–64.

Haines, M., P. V. Fishback, and P. Rhode (2016). United States agriculture data, 1840-2012.

Hamilton, J. D. (1992). Was the deflation during the Great Depression anticipated? Evidence from the commodity futures market. *American Economic Review 82*(1), 157–178.

Hausman, J. K., P. W. Rhode, and J. F. Wieland (2019). Recovery from the Great Depression: The farm channel in spring 1933. *American Economic Review 109*(2), 427–472.

Hilt, E. and W. Rahn (2020). Financial asset ownership and political partisanship: Liberty bonds and Republican electoral success in the 1920s. *Journal of Economic History 80*(3), 746–781.

Hornbeck, R. (2012). The enduring impact of the American Dust Bowl: Short- and long-run adjustments to environmental catastrophe. *American Economic Review 102*(4), 1477–1507.

Hornbeck, R. and S. Naidu (2014). When the levee breaks: Black migration and economic development in the American South. *American Economic Review 104*(3), 963–990.

Horton, D. C., H. C. Larsen, and N. J. Wall (1942). Farm-Mortgage Credit Facilities in the United States. Miscellaneous publication 478, U.S. Department of Agriculture, Bureau of Agricultural Economics.

Jaremski, M. and P. V. Fishback (2018). Did inequality in farm sizes lead to suppression of banking and credit in the late nineteenth century? *Journal of Economic History 78*(1), 155–195.

Jaremski, M. and D. C. Wheelock (2020). Banking on the Boom, Tripped by the Bust: Banks and the World War I Agricultural Price Shock. *Journal of Money, Credit and Banking 52*(7), 1719–1754.

Joint Commission of Agricultural Inquiry (1922a). *Report of the Joint Commission of Agricultural Inquiry.* Part II: Credit. Washington D.C.: Government Printing Office.

Joint Commission of Agricultural Inquiry (1922b). *Transcript of Hearings before the Joint Commission of Agricultural Inquiry*, Volume 2 of *Sixty-Seventh Congress, First Session under Senate Resolution 4*. Washington D.C.: Government Printing Office.

Keehn, R. H. and G. Smiley (1977). Mortgage lending by national banks. *Business History Review 51*(4), 474–491.

Marodin, F. A., K. J. Mitchener, and G. Richardson (2024). Contagion of fear: Panics, money, and the Great Depression. *Explorations in Economic History 93*, 1–.

Messer, T. (2023). Financial failure and depositor quality: Evidence from building and loan associations in California. *Journal of Economic History 83*(1), 87–130.

Mitchener, K. J. (2005). Bank supervision, regulation, and instability during the Great Depression. *Journal of Economic History 65*(1), 152–185.

Postel-Vinay, N. (2016). What caused Chicago bank failures in the Great Depression? A look at the 1920s. *Journal of Economic History 76*(2), 478–519.

Postel-Vinay, N. (2017). Debt dilution in 1920s America: lighting the fuse of a mortgage crisis. *Economic History Review 70*(2), 559–585.

Rajan, R. and R. Ramcharan (2015). The anatomy of a credit crisis: The boom and bust in farm land prices in the United States in the 1920s. *American Economic Review 105*(4), 1439–1477.

Rajan, R. and R. Ramcharan (2016). Local financial capacity and asset values: Evidence from bank failures. *Journal of Financial Economics 120*, 229–251.

Richardson, G. (2007). Categories and causes of bank distress during the Great Depression, 1929-1933: the illiquidity versus insolvency debate revisited. *Explorations in Economic History 2007*(44), 588–607.

Rieder, K. (2024). The comparative effects of financial stability policies. *CEPR Discussion Paper 16490*, 1–71.

Temin, P. (1976). *Did Monetary Forces Cause the Great Depression?* W. W. Norton & Company.

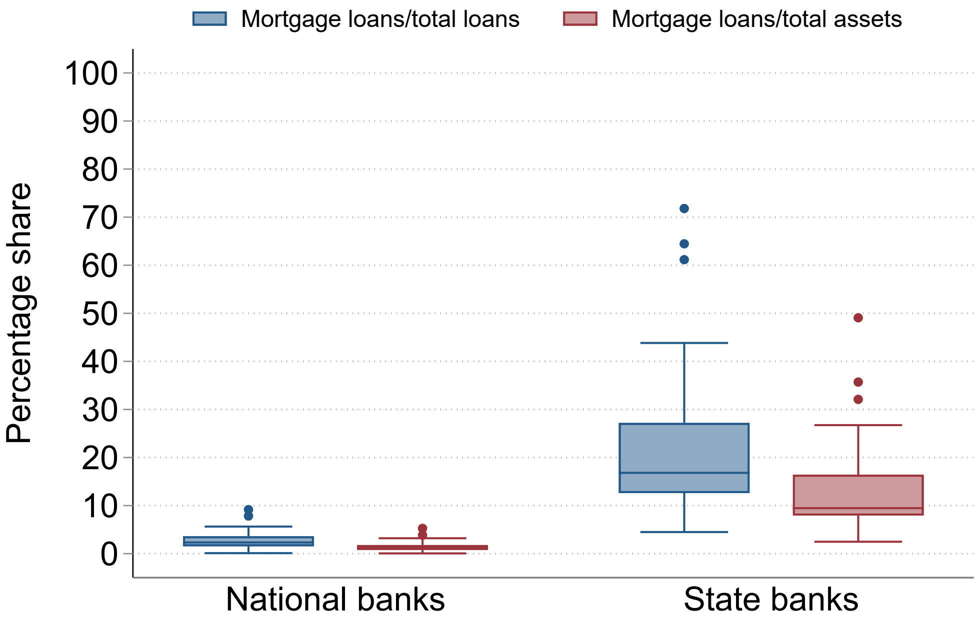
Wallace, R. F. (1956). The use of the progressive discount rate by the Federal Reserve System. *Journal of Political Economy 64*(1), 59–68.

Wheelock, D. C. (1992). Regulation and Bank Failures: New Evidence from the Agricultural Collapse of the 1920s. *Journal of Economic History 52*(4), 806–825.

White, E. N. (1984). A reinterpretation of the banking crisis of 1930. *Journal of Economic History 44*(1), 119–138.

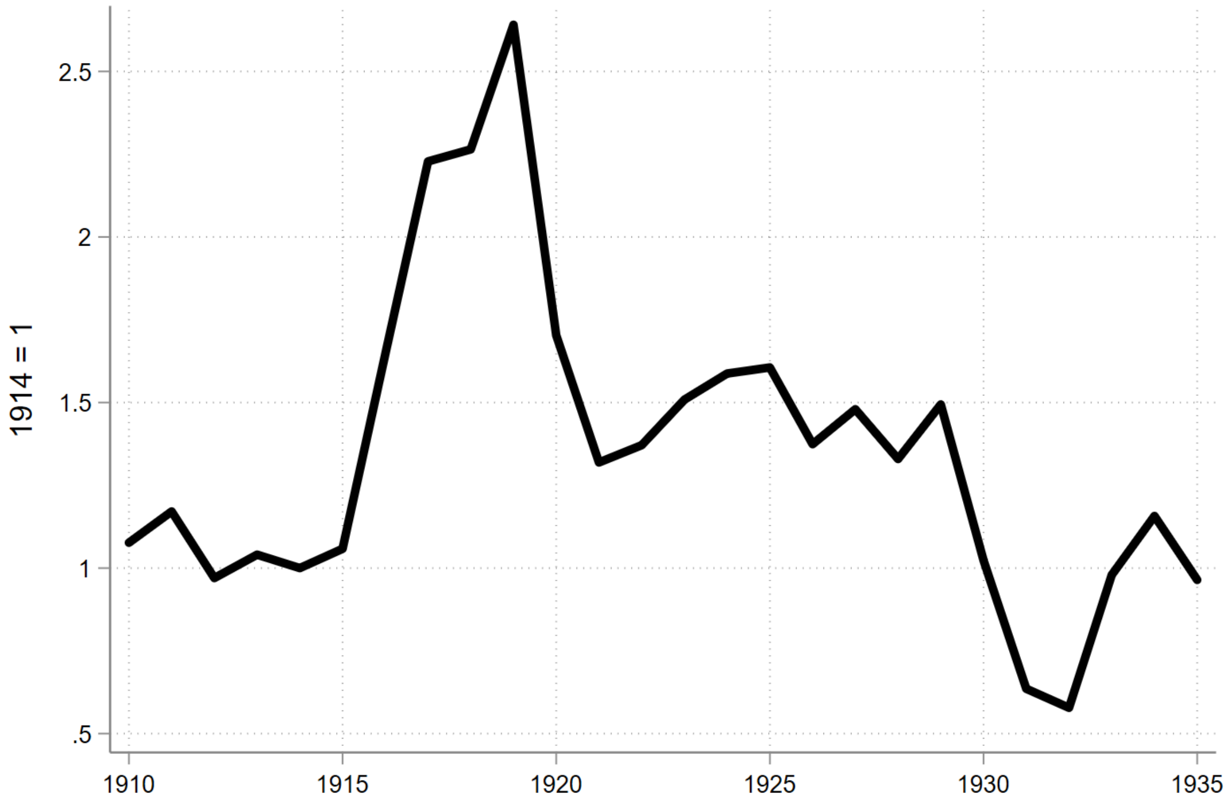
Wicker, E. (1980). A reconsideration of the causes of the banking panic of 1930. *Journal of Economic History 40*(3), 571–583.

Figure 1: Real estate loan shares on bank balance sheets



This figure shows the importance of real estate loans relative to total loans and total assets respectively for state banks and national banks as of 1919. Boxes represent interquartile ranges, with horizontal lines denoting medians. Whiskers denote adjacent values. Points are outliers beyond these adjacent values. **Source**: Board of Governors of the Federal Reserve System (1959)

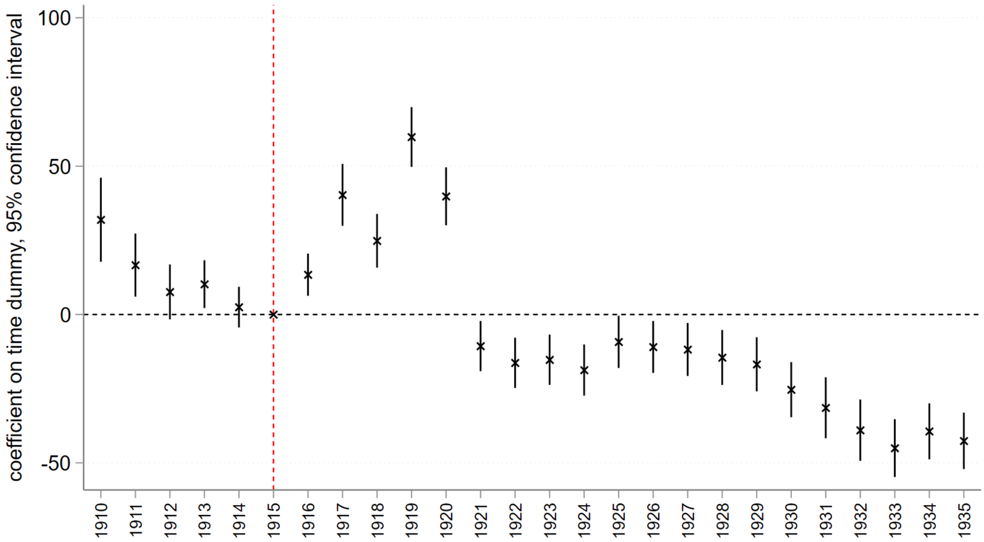
Figure 2: Average Crop Prices



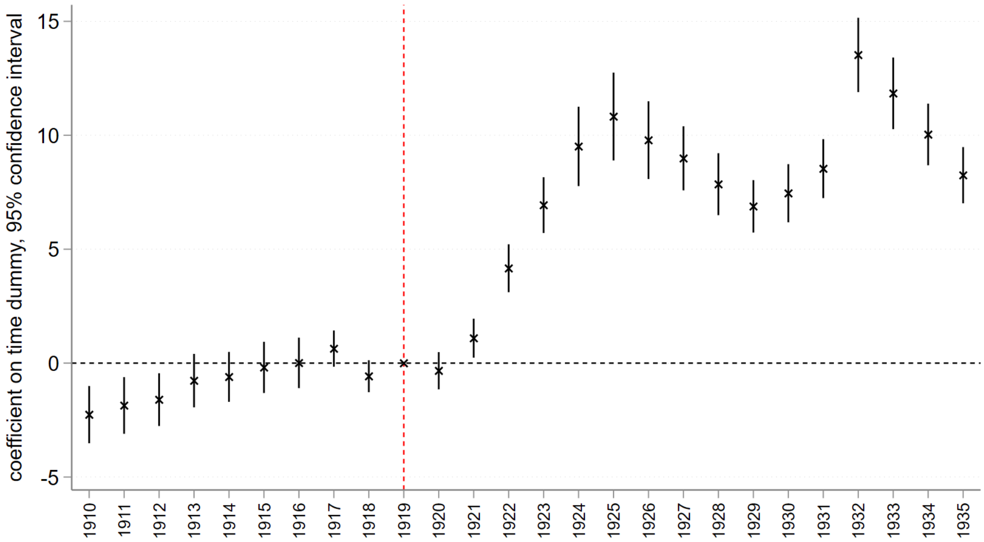
This figure plots the unweighted average of the prices of eleven crops, normalized to 1914. The crops include corn, wheat, oats, barley, rye, buckwheat, flaxseed, cotton, tobacco, Irish potatoes, and sweet potatoes. **Source:** Carter et al. (2006)

Figure 3: Farm Transfers in the Interwar Period

(a) Voluntary Farm Transfers (1915 = 0)

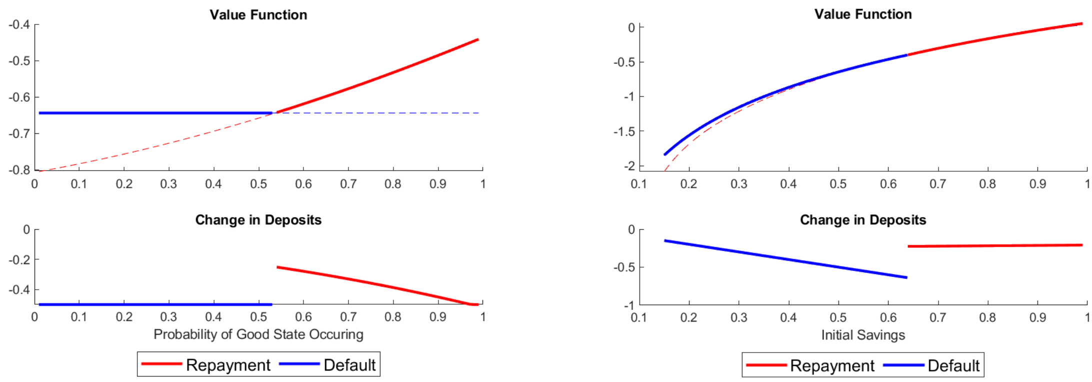


(b) Involuntary Farm Transfers (1919 = 0)



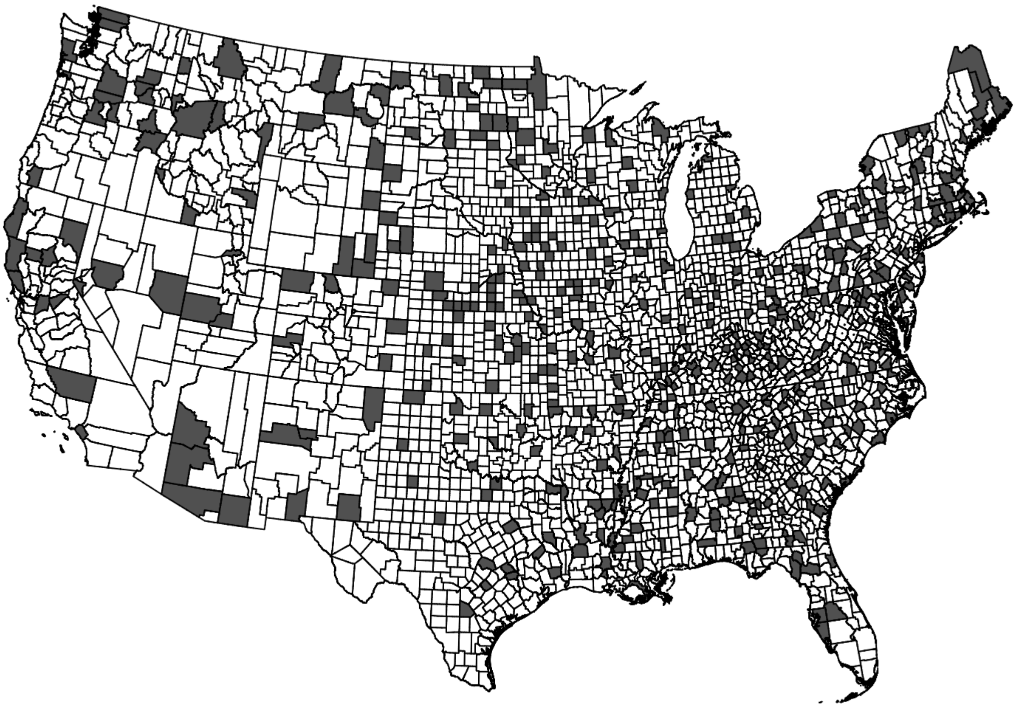
These figures plot the estimated coefficient and 95% confidence interval for the coefficient β_t in the regression $Y_{i,t} = \alpha_i + \beta_t + \varepsilon_{i,t}$, where i denotes counties and t denotes years. In the top panel, $Y_{i,t}$ is the number of voluntary transfers per 1,000 farms in 1920, and β_t is normalized relative to 1915. In the bottom panel, $Y_{i,t}$ is the number of involuntary transfers per 1,000 farms in 1920, and β_t is normalized relative to 1919. Voluntary and involuntary transfers are described in Section 4. **Source**: Authors' Calculations, Bureau of Agricultural Economics (1939)

Figure 4: Value Functions and Deposit Changes under Default and Repayment



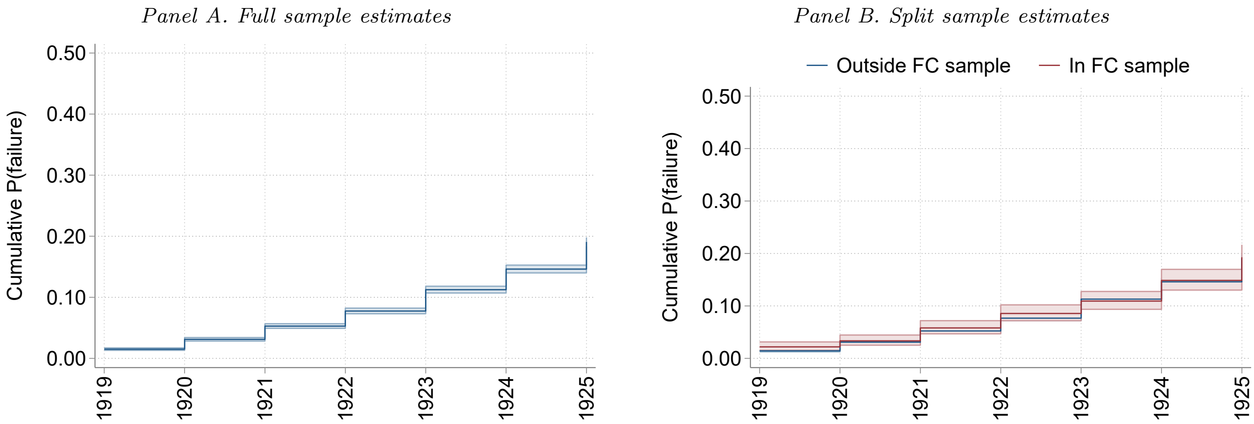
The left-side of this figure shows model simulations across different values of price expectations α. The top-left panel of this figure plots the value function under default V^D, in blue, and repayment V^R, in red, against the subjective probability of a good state occurring (α). Solid lines denote the optimal decision by a farmer conditional on the value α. The bottom-left panel denotes the change in deposits in period 1, $s_1 - s_0$, when the default decision is made. The right-side of this figure shows model simulations across different values of initial wealth s_0. The top-right panel of this figure plots the value function under default V^D, in blue, and repayment V^R, in red, against the initial amount of savings (s_0). Solid lines denote the optimal decision by a farmer conditional on the value s_0. The bottom-right panel denotes the change in deposits in period 1, $s_1 - s_0$, when the default decision is made. Benchmark parameter values include $\alpha = 0.5$, $A^G = 1.25$, $A^B = 0.75$, $s_0 = 0.5$, $r = 0.05$, $m_2 = 0.15$, and $\gamma = 0.7$.

Figure 5: Sample of Counties included in the WPA Report



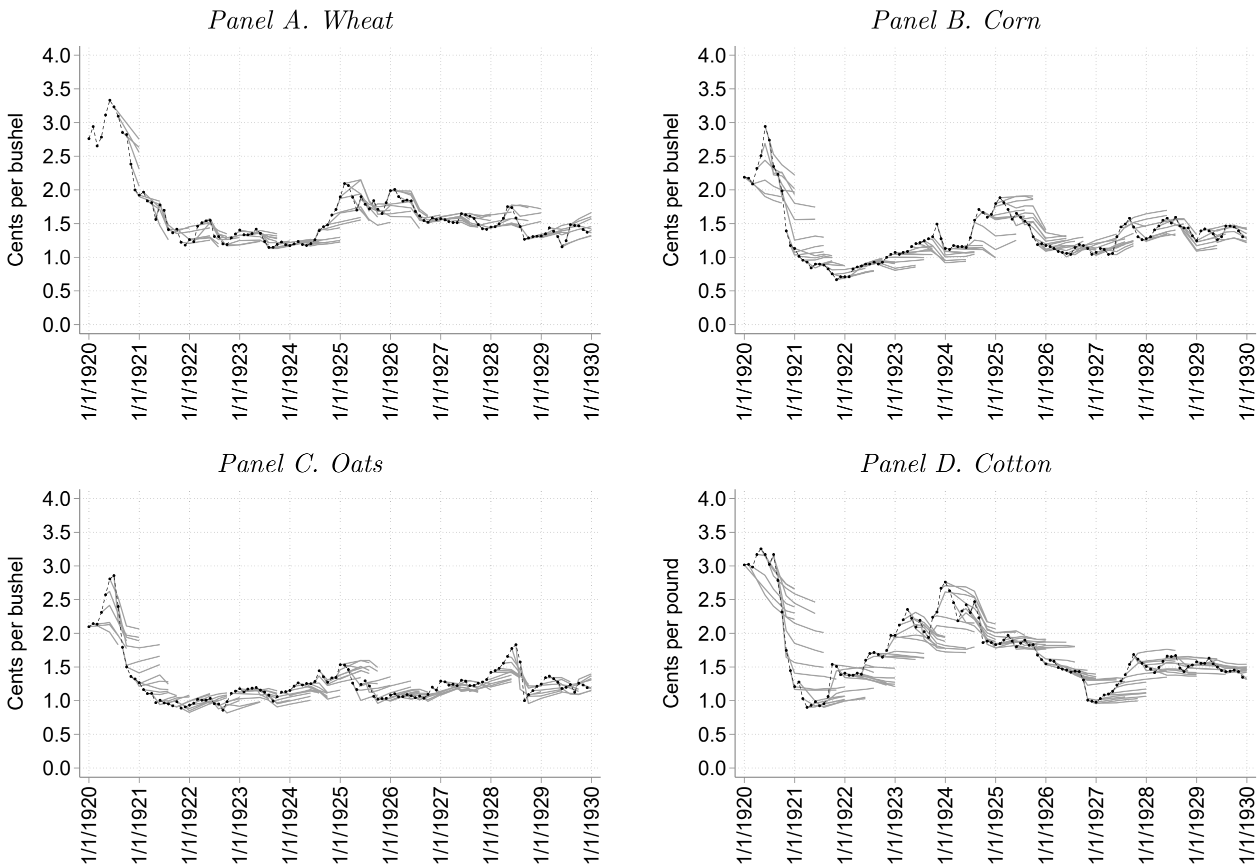
This figure shows the location of counties included in the WPA report. The counties included in the report are shaded in gray.
Source: WPA

Figure 6: Non-parametric survival estimates



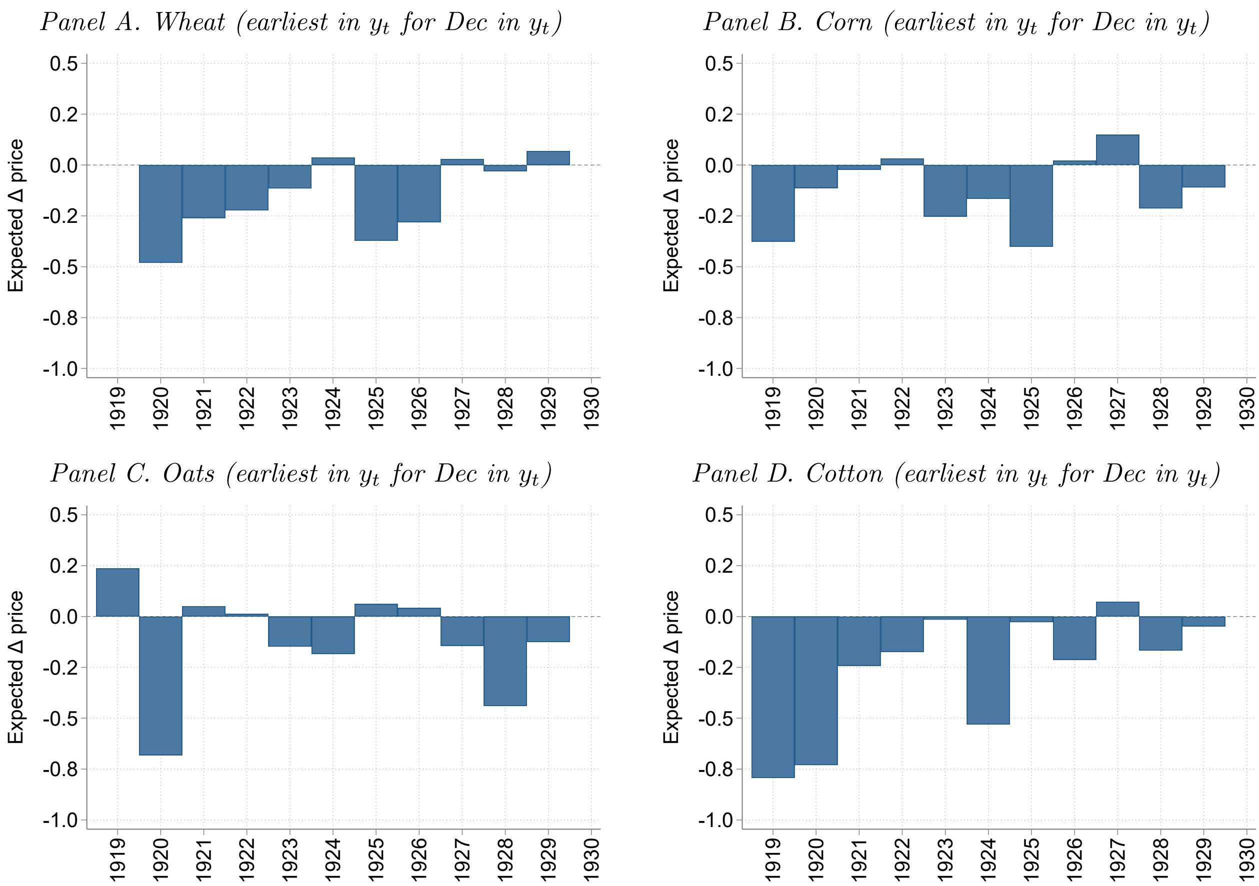
This figure plots estimates of the Nelson-Aalen cumulative hazard function (including 95% confidence intervals) for the bank-level sample. Panel A reports the results for the full bank-level sample. Panel B shows the hazard function separately for banks located in counties contained in our farm distress data base and for banks in counties outside our sample. The Cox regression-based test for the equality of survivor functions displayed in Panel B cannot reject the null hypothesis of equality (χ^2-statistic of 0.03 and p-value of 0.86). **Source**: Matthew Jaremski and Authors' Calculations.

Figure 7: Evolution of spot and futures prices (1920–1930)



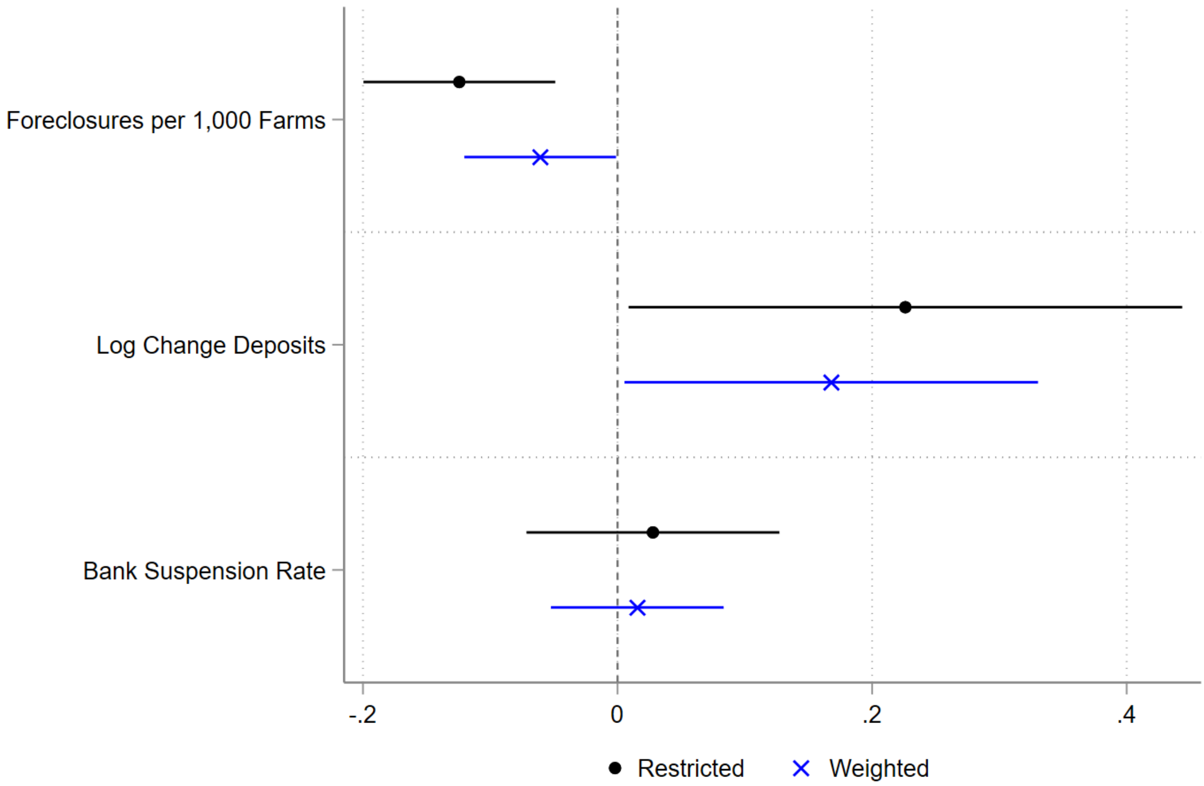
This figure shows the evolution of spot and futures prices (in cents per bushel or pound per bushel). The dark dots represent spot prices. The gray line charts plot the midpoint of the low and high of futures prices for different horizons (May, July, September/October and December delivery, where available). Prices are indexed to January 1914. Line charts are anchored by the spot price prevailing at the time when the futures contract was initiated. Trading in wheat futures contracts was suspended between 25 Aug 1917 and 15 July 1920. **Source**: Authors' Calculations, Annual Report of the Trade and Commerce of Chicago (1929), Yearbook of the National Association of Cotton Manufacturers (1921–1931) and NBER Macrohistory Database.

Figure 8: Expected crop price at year-end relative to spot price at start of futures contract (1919–1930)



This figure shows the difference between the earliest available futures price in year t for delivery in December of year t and the spot price prevailing at the initiation date of this futures contract. Negative values in the bar charts represent years in which markets expected prices to fall until the end of the year (relative to the spot price prevailing when the futures contract was initiated). Prices are indexed to January 1914. Trading in wheat futures contracts was suspended between 25 Aug 1917 and 15 July 1920. **Source**: Authors' Calculations, Annual Report of the Trade and Commerce of Chicago (1929), Yearbook of the National Association of Cotton Manufacturers (1921–1931) and NBER Macrohistory Database.

Figure 9: The Effects of Expectations on Foreclosures, Deposits, and Suspensions



This figure shows coefficient estimates for β from estimating Equation 7: $Y_{it} = \alpha_i + \delta_t + \beta EXPEC_{i,t} + \Upsilon X_{i,t} + \varepsilon_{i,t}$. $Y_{i,t}$ denotes foreclosures, log changes in deposits, or bank suspension rates. $EXPEC_{i,t}$ is our main regressor of interest, a proxy for farmers' expectations about future returns. $EXPEC_{i,t}$ is defined as the county-level weighted price expectation for four major crops ($c \in$ {Corn, Cotton, Oats, Wheat}): $\sum_c \frac{P_{c1920}Q_{c1920}}{\sum_{c'} P_{c'1920}Q_{c'1920}} EXPEC_{c,i,t}$. We weight expectations for each crop by crop revenue shares from the 1920 Agricultural Census. We include the same controls as in our estimation of Equation 1 in $X_{i,t}$. In addition, we include the lagged level of the crop index to account for the fact that the effects of expectations are likely more important when prices are more depressed. We also include the log difference between the highest and lowest price futures in the month in which expectations are set to account for initial volatility in expectations. We estimate Equation 7 in two ways: first, using a restricted estimation sample of counties where the four crops make up at least 80% of revenues in the 1920 census; second, we estimate Equation 7 using weighted least squares, drawing on the revenue shares of the four crops with price expectations as weights. Standard errors are clustered at the county level and we display 95% confidence intervals around each coefficient. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Annual Report of the Trade and Commerce of Chicago (1929), Yearbook of the National Association of Cotton Manufacturers (1921–1931) NBER Macrohistory Database, Authors' Calculations.

Table 1: Summary Statistics

Panel A: County-Time Variables

Variable	Obs	Mean	Std. Dev.
Distressed transfers per 1,000 farms in 1920	5,798	8.45	11.98
Distressed transfers per 1,000 farms in 1920	5,798	8.45	11.98
Log Crop Index	5,798	0.34	0.30
Deposit Insurance	5,798	0.18	0.39
Bank Suspension Share (p.p.)	3,513	2.33	7.51
State Bank Suspension Share (p.p.)	3,513	1.83	6.47
National Bank Suspension Share (p.p.)	3,513	0.40	2.96
National Bank Share (p.p.)	3,840	26.43	23.42

Panel B: County Time-Invariant Variables

Variable	Obs	Mean	Std. Dev.
Redemption period, in months (1925)	441	7.96	7.26
Perc. Change Improved Acreage (1910-1920)	441	1.06	0.37
Owner Share of Farms (1920)	441	0.55	0.19
Perc. Change in Mortgage Debt (1910-1920)	441	3.35	4.00
Debt to Value Ratio (1920)	441	29.94	5.74
Banks per 1,000 People (1920)	441	0.49	0.38
Percent of Farms Mortgaged (1920)	441	0.37	0.17

This table displays summary statistics (number of observations, means, and standard deviations) for the variables used in this paper. The top panel shows summary statistics for variables that vary by county and time, while the bottom panel shows summary statistics for variables that vary only across counties. **Source**: Bureau of Agricultural Economics (1939), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Haines et al. (2016), Authors' Calculations.

Table 2: Balance Table

Variable	Out Sample	In Sample	Difference
Redemption period, in months (1925)	7.619	7.959	0.340
	(7.188)	(7.264)	(0.376)
Perc. Change Improved Acreage (1910-1920)	1.145	1.061	-0.085***
	(1.302)	(0.367)	(0.032)
Owner Share of Farms (1920)	0.539	0.551	0.012
	(0.188)	(0.192)	(0.010)
Perc. Change in Mortgage Debt (1910-1920)	3.468	3.348	-0.120
	(4.627)	(3.998)	(0.213)
Debt to Value Ratio (1920)	29.130	29.941	0.812***
	(5.637)	(5.743)	(0.297)
Banks per 1,000 People (1920)	0.510	0.487	-0.022
	(0.373)	(0.381)	(0.020)
Percent of Farms Mortgaged (1920)	0.377	0.370	-0.007
	(0.170)	(0.165)	(0.009)
Observations	2,374	441	2,815

This table shows the difference in various county characteristics across those counties included in the WPA report and those agricultural counties not in the WPA report. Robust standard errors are in parentheses. **Source**: Postel-Vinay (2017), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Authors' Calculations.

Table 3: The Effect of Crop Prices on Farm Foreclosures

	Distressed transfers per 1,000 farms					
	(1)	(2)	(3)	(4)	(5)	(6)
Log Crop Index (Lag 1)	-5.732***	-2.292	-2.848***	-2.785**	0.832	0.373
	(0.997)	(1.402)	(1.062)	(1.200)	(1.823)	(1.389)
Log Crop Index (Lag 1) × Perc. Farms Mortgages (1920)		-9.019***			-9.562**	
		(3.337)			(4.195)	
Log Crop Index (Lag 1) × Banks per 1000 (1920)			-5.931***			-6.456***
			(1.826)			(2.232)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
District x Year FE	No	No	No	Yes	Yes	Yes
Observations	5,785	5,785	5,725	5,785	5,785	5,725
Adjusted R^2	0.677	0.678	0.687	0.712	0.713	0.725

This table shows results for estimating regression 1: $FD_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{i,t-1} + \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $FD_{i,t}$ are foreclosures per 1,000 farms in 1920 for county i in period t, $CropIndex_{i,t}$ is the crop index as described in the text. α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district × time fixed effects. Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Columns (2), (3), (5), and (6) estimate Equation 2: $FD_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{i,t-1} + \gamma \ln CropIndex_{i,t-1} \times Z_{i,1920} + \Upsilon X_{it} + \varepsilon_{it}$, where $Z_{i,t}$ denotes either the percentage of farms mortgaged in 1920 or the number of banks per 1,000 capita in 1920. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Authors' Calculations.

Table 4: The Agricultural Determinants of Deposit Withdrawals

	Log Change Deposits					
	(1)	(2)	(3)	(4)	(5)	(6)
Log Crop Index (Lag 0)	4.653*		4.715*	8.226**		8.246**
	(2.792)		(2.823)	(3.614)		(3.619)
Distressed transfers per 1,000 farms		-0.0208	-0.0234		-0.0265	-0.0273
		(0.0499)	(0.0503)		(0.0509)	(0.0510)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
District x Year FE	No	No	No	Yes	Yes	Yes
Observations	3,501	3,501	3,501	3,501	3,501	3,501
Adjusted R^2	0.129	0.128	0.129	0.159	0.158	0.159

This table shows results for estimating the following regression: $\Delta \ln Dep_{i,t} = \alpha_i + \delta_{(D)t} + \beta \ln CropIndex_{i,t} + \gamma FD_{i,t} + \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $\Delta \ln Dep_{i,t}$ is the log change in deposits for county i in period t, $CropIndex_{i,t}$ is the crop index as described in the text, and $FD_{i,t}$ are foreclosures per 1,000 farms in 1920, α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district $\times$ time fixed effects. Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Authors' Calculations.

Table 5: Farming Distress and Banking Distress

	All Suspensions		State Bank Suspensions		National Bank Suspensions	
	(1)	(2)	(3)	(4)	(5)	(6)
Distressed transfers per 1,000 farms	0.0540***	0.0468**	0.0328*	0.0266	0.0216**	0.0212**
	(0.0206)	(0.0207)	(0.0175)	(0.0177)	(0.0105)	(0.0107)
Log Change Deposits	-0.201***	-0.211***	-0.156***	-0.162***	-0.0437***	-0.0479***
	(0.0212)	(0.0225)	(0.0232)	(0.0247)	(0.00848)	(0.00883)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
District x Year FE	No	Yes	No	Yes	No	Yes
Observations	3,501	3,501	3,501	3,501	3,501	3,501
Adjusted R^2	0.268	0.282	0.218	0.225	0.082	0.094

This table shows results for estimating the Equation 3: $Y_{i,t} = \alpha_i + \delta_t + \beta FD_{i,t} + \eta \Delta \ln Dep_{i,t} + \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $Y_{i,t}$ is the suspension rate for all banks, national banks, or state banks as described in the text. $FD_{i,t}$ are foreclosures per 1,000 farms in 1920, and $\Delta \ln Dep_{i,t}$ is the log change in deposits for county i in period t. α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district $\times$ time fixed effects. Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Authors' Calculations.

Table 6: The Role of Liquidity Supply in Banking Distress

	All Suspensions	State Bank Suspensions	National Bank Suspensions
	(1)	(2)	(3)
Distressed transfers per 1,000 farms in 1920	0.0505**	0.0306*	0.0208**
	(0.0204)	(0.0171)	(0.0105)
Log Change Deposits	-0.360***	-0.324***	-0.0307
	(0.0739)	(0.0686)	(0.0233)
Log Change Deposits × Share Dep. at Member Banks (1919)	0.253**	0.276**	-0.0293
	(0.121)	(0.116)	(0.0450)
Controls	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes
District x Year FE	Yes	Yes	Yes
Observations	3,501	3,501	3,501
Adjusted R^2	0.287	0.233	0.094

This table shows results for estimating the Equation 3: $Y_{i,t} = \alpha_i + \delta_t + \beta FD_{i,t} + \eta \Delta \ln Dep_{i,t} + \gamma \left(\Delta \ln Dep_{i,t} \times Z_{i,t}\right) \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $Y_{i,t}$ is the suspension rate for all banks, national banks, or state banks as described in the text. $FD_{i,t}$ are foreclosures per 1,000 farms in 1920, and $\Delta \ln Dep_{i,t}$ is the log change in deposits for county i in period t. α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district × time fixed effects. $Z_{s(i),t}$ denotes the share of deposits at Federal Reserve member banks for state s. Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Board of Governors of the Federal Reserve System (1946), Authors' Calculations.

Table 7: The Agricultural Determinants of Deposit Withdrawals (Bank-level Evidence)

	Log Change Deposits				
	(1)	(2)	(3)	(4)	(5)
Crop index (log)	0.0866***	0.0883***	0.0632***	0.0498***	0.0191***
	(0.0032)	(0.0033)	(0.0051)	(0.0048)	(0.0040)
Observations	67,367	63,768	67,367	67,367	67,367
Adjusted R^2	0.2019	0.1915	0.3042	0.4776	0.5718
Year FE	Yes	Yes	No	No	No
State-year FE	No	No	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
South Dakota banks	Yes	No	Yes	Yes	Yes
Bank-level controls	No	No	No	Contemporary	Lagged

This table reports coefficient estimates for the model displayed in Equation 4: $\Delta \ln Dep_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{c,t} + \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $\Delta \ln Dep_{i,t}$ represents the log change in deposits at the bank level, $\ln CropIndex_{c,t}$ stands for the county-level log crop price index and Υ is a vector of coefficients corresponding to the vector of bank-level control variables $X_{i,t}$. All displayed coefficients represent the marginal effect of a one standard deviation increase in the crop price index. Standard errors clustered by bank in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Carter et al. (2006), Haines et al. (2016), bank-level data shared by Matthew Jaremski, Postel-Vinay (2017), Board of Governors of the Federal Reserve System (1946), Authors' Calculations.

Table 8: Farming Distress and Banking Distress (Bank-level Evidence)

	Time to failure			
	(1)	(2)	(3)	(4)
Log Change Deposits	1.0898***		1.0658*	1.0748**
	(0.0136)		(0.0394)	(0.0315)
Distressed transfers per 1,000 farms in 1920		0.9072**	0.9492	1.0267
		(0.0404)	(0.0323)	(0.0228)
Observations	67,893	8,976	7,320	7,320
Log-likelihood	-5,725.150	-806.582	-602.950	-563.664
Controls	Yes	Yes	Yes	Yes
Stratified by state	No	No	No	Yes

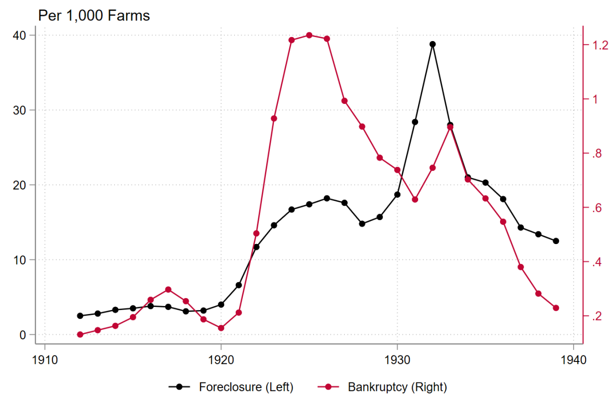
This table reports coefficient estimates for the loglogistic survival model displayed in Equation 6: $\log L(\Upsilon, \gamma) = \sum_{i=1}^{n} [\delta_i \log h(t_i|X_{i,t-1}) + \log S(t_i|X_{i,t-1})]$, where $\log L$ represents the log-likelihood function, Υ is a vector of coefficients corresponding to the vector of control variables X, γ is the shape parameter of the log-logistic distribution, δ represents a dummy variable indicating bank failure, h is the hazard function, t marks the time to failure (or censoring if no failure occurs until the end of 1925), and S stands for the survival function. X contains a list of time-varying bank-level and time-invariant county-level control variables described in the text. All displayed regression coefficients are reported in time ratio form (exponentiated coefficients) and directly comparable to each other (i.e. standardized covariates). Standard errors clustered by bank in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), bank-level data shared by Matthew Jaremski, Postel-Vinay (2017), Board of Governors of the Federal Reserve System (1946), Authors' Calculations.

Table 9: Real Fire Sales vs Fundamentals

	Distressed Transfers		All Suspensions	
	(1)	(2)	(3)	(4)
Log Crop Index (Lag 1)	-2.276	-4.366***		
	(1.464)	(1.429)		
Log Crop Index (Lag 1) × Power of Sale	-6.242***			
	(1.425)			
Log Crop Index (Lag 1) × Foreclosure Cost		1.557***		
		(0.481)		
Distressed transfers per 1,000 farms in 1920			0.0624**	0.0505**
			(0.0262)	(0.0202)
Distressed transfers per 1,000 farms in 1920 × Power of Sale			-0.0282	
			(0.0348)	
Distressed transfers per 1,000 farms in 1920 × Foreclosure Cost				0.0252
				(0.0232)
Log Change Deposits			-0.207***	-0.200***
			(0.0241)	(0.0210)
Log Change Deposits × Power of Sale			0.0139	
			(0.0390)	
Log Change Deposits × Foreclosure Cost				-0.0113
				(0.0228)
Controls	Yes	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	3501	3501	3501	3501
Adjusted R^2	0.746	0.745	0.266	0.267

This table shows coefficient estimates from estimating $Y_{it} = \alpha_i + \delta_t + \beta Z_{i,t} + \beta_2 (Z_{i,t} \times_i) + \gamma X_{i,t} + \varepsilon_{i,t}$. In the first two columns, the outcome $Y_{i,t}$ denotes foreclosures per 1,000 farms. The shock $Z_{i,t}$ denotes the lagged log crop index, and the interactions W_i include a dummy for a power of sale state and the standardized foreclosure cost, as described in the text. In the last two columns, the outcome $Y_{i,t}$ denotes the bank suspension rate. Shocks $Z_{i,t}$ include distressed transfers per 1,000 farms and the log change in deposits. The interactions W_i include a dummy for a power of sale state and the standardized foreclosure cost, as described in the text. In all regressions, other controls $X_{i,t}$ include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Bridewell (1938), Rajan and Ramcharan (2016), Board of Governors of the Federal Reserve System (1946), Authors' Calculations.

Figure A1: Farm Foreclosure Rates and Farm Bankruptcy Rates



APPENDIX FOR ONLINE PUBLICATION

A Data

Table A1 displays the variables used in this paper and their sources.

Table A1: Data Sources

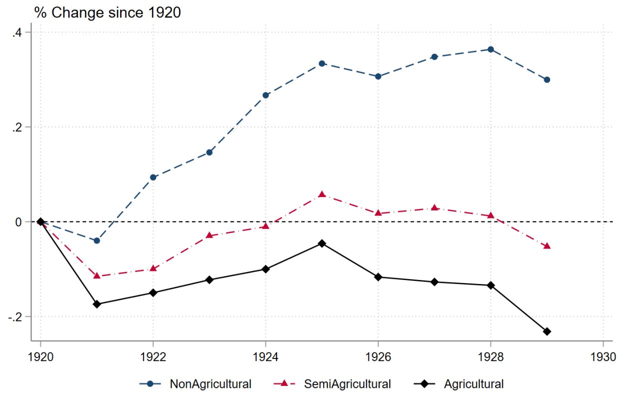
Variable	Source	Notes
County Voluntary and Involuntary Transfers	Bureau of Agricultural Economics (1939)	
National Crop Prices	Carter et al. (2006)	
County Crop Production	Haines et al. (2016)	
County Crop Index	Authors Calculations	Jaremski and Wheelock (2020)
Debt to Value Ratio	Haines et al. (2016)	
Share of Farms Mortgaged	Haines et al. (2016)	
Farm Ownership Share	Haines et al. (2016)	
Redemption Period	Postel-Vinay (2017)	Number of months
Number of Banks	Federal Deposit Insurance Corporation (2001)	Total, State, National
Number of Bank Suspensions	Federal Deposit Insurance Corporation (2001)	Total, State, national
Member Share of Bank Deposits	Board of Governors of the Federal Reserve System (1946)	State Level
Deposit Insurance	Federal Deposit Insurance Corporation (1957)	Dummy at State Level
Futures Prices (corn, oats, wheat)	Annual Report of the Trade and Commerce of Chicago (1929)	Monthly high and low prices
Futures Prices (cotton)	Yearbook of the National Association of Cotton Manufacturers (1921–1931)	Monthly high and low prices
Spot prices (corn, cotton, oats, wheat)	NBER Macrohistory Database	Monthly averages
Bank-level Balance Sheet Data	Compiled and shared with us by Matthew Jaremski	Annual data 1919–1925

B Additional Results

B.1 Bankruptcy and Foreclosure

Figure A1 plots the rates of farmers' bankruptcies and foreclosures.

Figure A2: Deposits per Capita



B.2 Deposit Changes

Figure A2 plots the rates of farmers' bankruptcies and foreclosures.

B.3 Summary Statistics

Figure A3 presents results for the crop index and distressed transfers across the five census regions.

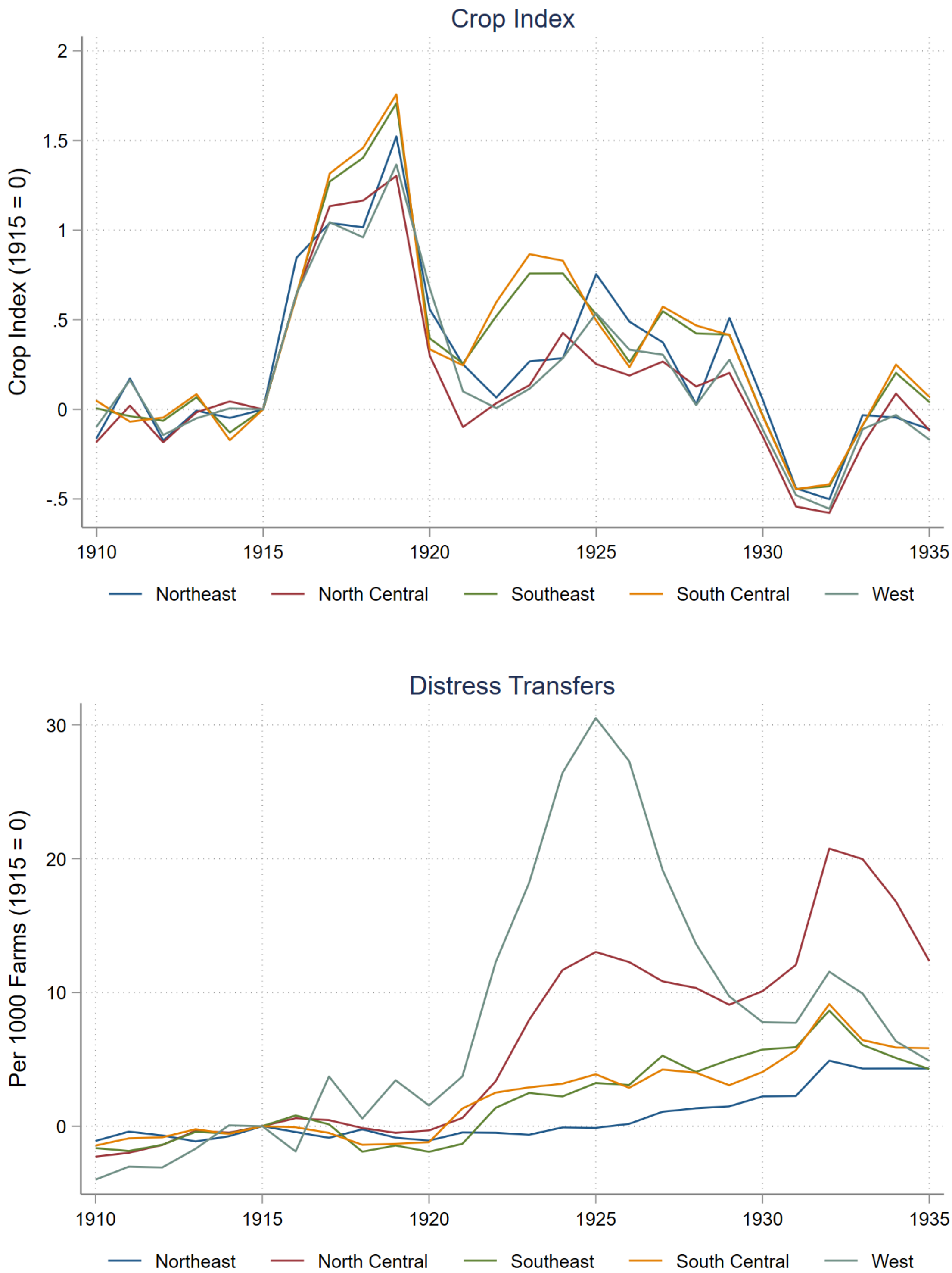
B.4 Alternative Definitions of Foreclosure

In this section, we replicate results using a broader measure of farm foreclosures by including all listed involuntary transfers. This broader measure also includes involuntaty transfers due to *sales for tax purposes*, *administrative sales*, *inheritance*, and an "other" category. The results replicating Table 3 are available in Table A2. The results replicating Table 5 are available in Table A3. The results replicating Table 6 are available in Table A4

B.5 Lags

Table A5 presents results estimating Equation 1 using both the contemporaneous value and one lag. While using just county and time fixed effects the contemporaneous value is significant and negative, it is small in magnitude than the lag when not including interaction terms, and is insignificant when including District $\times$ Year fixed effects. The contemporaneous value on the interaction terms is never significant and smaller in magnitude than the first lag.

Figure A3: Farm Distress Split by Region



This figure presents the crop index and distressed transfers across the five census regions. We plot coefficient estimates from the regression $Y_{i,t} = \alpha_i + \beta_t \gamma_{r(i)} + \varepsilon_{i,t}$, where for county i in year t the coefficients are for region $r(i)$. **Source**: Carter et al. (2006), Haines et al. (2016), Bureau of Agricultural Economics (1939), Authors' Calculations.

Table A2: The Effect of Crop Prices on Farm Foreclosures - Broad FD Definition

	Distressed transfers per 1,000 farms in 1920 (wide definition)					
	(1)	(2)	(3)	(4)	(5)	(6)
Log Crop Index (Lag 1)	-6.509***	-2.721	-3.347**	-3.843**	-0.190	-0.393
	(1.242)	(1.783)	(1.370)	(1.694)	(2.426)	(1.855)
Log Crop Index (Lag 1) × Perc. Farms Mortgages (1920)		-9.928***			-9.659**	
		(3.741)			(4.892)	
Log Crop Index (Lag 1) × Banks per 1000 (1920)			-6.407***			-7.206***
			(2.012)			(2.768)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
District x Year FE	No	No	No	Yes	Yes	Yes
Observations	5,785	5,785	5,725	5,785	5,785	5,725
Adjusted R^2	0.653	0.653	0.662	0.680	0.680	0.691

This table shows results using the broader measure of foreclosure for estimating regression 1: $FD_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{i,t-1} + \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $FD_{i,t}$ are foreclosures per 1,000 farms in 1920 for county i in period t, $CropIndex_{i,t}$ is the crop index as described in the text. α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district × time fixed effects.Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Columns (2), (3), (5), and (6) estimate Equation 2: $FD_{i,t} = \alpha_i + \delta_t + \beta \ln CropIndex_{i,t-1} + \gamma \ln CropIndex_{i,t-1} \times Z_{i,1920} + \Upsilon X_{it} + \varepsilon_{it}$, where $Z_{i,t}$ denotes either the percentage of farms mortgaged in 1920 or the number of banks per 1,000 capita in 1920. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Authors' Calculations.

Table A3: Farming Distress and Banking Distress - Broad FD Definition

	All Suspensions		State Bank Suspensions		National Bank Suspensions	
	(1)	(2)	(3)	(4)	(5)	(6)
Distressed transfers per 1,000 farms in 1920 (broad)	0.0312**	0.0260**	0.0136	0.00844	0.0181***	0.0183***
	(0.0123)	(0.0129)	(0.0120)	(0.0124)	(0.00671)	(0.00681)
Log Change Deposits	-0.202***	-0.211***	-0.156***	-0.162***	-0.0440***	-0.0482***
	(0.0213)	(0.0225)	(0.0232)	(0.0247)	(0.00853)	(0.00887)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
District x Year FE	No	Yes	No	Yes	No	Yes
Observations	3,501	3,501	3,501	3,501	3,501	3,501
Adjusted R^2	0.267	0.281	0.217	0.224	0.083	0.095

This table shows results using the broader measure of foreclosure for estimating the Equation 3: $Y_{i,t} = \alpha_i + \delta_t + \beta FD_{i,t} + \eta \Delta \ln Dep_{i,t} + \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $Y_{i,t}$ is the suspension rate for all banks, national banks, or state banks as described in the text. $FD_{i,t}$ are foreclosures per 1,000 farms in 1920, and $\Delta \ln Dep_{i,t}$ is the log change in deposits for county i in period t. α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district × time fixed effects. Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Authors' Calculations.

Table A4: The Channels of Farming Distress and Banking Distress - Broad FD Definition

	All Suspensions	State Bank Suspensions	National Bank Suspensions
	(1)	(2)	(3)
Distressed transfers per 1,000 farms in 1920 (broad)	0.0269**	0.00932	0.0182***
	(0.0128)	(0.0121)	(0.00678)
Log Change Deposits	-0.357***	-0.322***	-0.0299
	(0.0741)	(0.0686)	(0.0235)
Log Change Deposits × Share Dep. at Member Banks (1919)	0.248**	0.273**	-0.0310
	(0.122)	(0.116)	(0.0456)
Controls	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes
District x Year FE	Yes	Yes	Yes
Observations	3,501	3,501	3,501
Adjusted R^2	0.286	0.233	0.095

This table shows results using the broader measure of foreclosure for estimating the Equation 3: $Y_{i,t} = \alpha_i + \delta_t + \beta FD_{i,t} + \eta \Delta \ln Dep_{i,t} + \gamma (\Delta \ln Dep_{i,t} \times Z_{i,t}) \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $Y_{i,t}$ is the suspension rate for all banks, national banks, or state banks as described in the text. $FD_{i,t}$ are foreclosures per 1,000 farms in 1920, and $\Delta \ln Dep_{i,t}$ is the log change in deposits for county i in period t. α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district × time fixed effects. $Z_{s(i),t}$ denotes the share of deposits at Federal Reserve member banks for state s. Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Board of Governors of the Federal Reserve System (1946), Authors' Calculations.

Table A5: The Effect of Crop Prices on Farm Foreclosures - Lags

	Distressed transfers per 1,000 farms in 1920					
	(1)	(2)	(3)	(4)	(5)	(6)
Log Crop Index (Lag 0)	-2.628***	-2.214*	-3.336***	-0.317	-1.573	-2.704*
	(0.946)	(1.159)	(1.010)	(1.478)	(1.592)	(1.435)
Log Crop Index (Lag 1)	-5.261***	-2.098	-1.935*	-2.743**	1.532	1.380
	(0.936)	(1.542)	(1.085)	(1.186)	(1.864)	(1.445)
Log Crop Index (Lag 0) × Perc. Farms Mortgages (1920)		-0.580			2.945	
		(2.422)			(3.332)	
Log Crop Index (Lag 1) × Perc. Farms Mortgages (1920)		-8.419**			-11.15**	
		(3.794)			(4.520)	
Log Crop Index (Lag 0) × Banks per 1000 (1920)			2.078			3.710
			(1.641)			(2.471)
Log Crop Index (Lag 1) × Banks per 1000 (1920)			-7.049***			-8.615***
			(2.208)			(2.811)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
FIPS FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
District x Year FE	No	No	No	Yes	Yes	Yes
Observations	5,785	5,785	5,725	5785	5,785	5,725
Adjusted R^2	0.678	0.679	0.688	0.712	0.713	0.725

This table shows results for estimating regression 1: $FD_{i,t} = \alpha_i + \delta_t + \sum_{j=0}^{1} \beta_j \ln CropIndex_{i,t} + \Upsilon X_{i,t} + \varepsilon_{i,t}$, where $FD_{i,t}$ are foreclosures per 1,000 farms in 1920 for county i in period t, $CropIndex_{i,t}$ is the crop index as described in the text. α_i denotes county fixed effects and $\delta_{(D)t}$ denotes either time or district × time fixed effects.Controls, $X_{i,t}$, include a dummy for whether a state has deposit insurance, improved acreage from 1910-20 interacted with a time dummy, the share of farm owners in 1920 interacted with a time dummy, the percentage change in mortgage debt from 1910-20 interacted with a time dummy, the state's redemption period interacted with a time dummy, and the debt to value ratio in 1920 interacted with a time dummy. Columns (2), (3), (5), and (6) estimate Equation 2: $FD_{i,t} = \alpha_i + \delta_t + \sum_{j=0}^{1} \beta_j \ln CropIndex_{i,t} + \sum_{k=0}^{1} \gamma_k \ln CropIndex_{i,t} \times Z_{i,1920} + \Upsilon X_{it} + \varepsilon_{it}$, where $Z_{i,t}$ denotes either the percentage of farms mortgaged in 1920 or the number of banks per 1,000 capita in 1920. Standard errors clustered by county in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. **Source**: Bureau of Agricultural Economics (1939), Carter et al. (2006), Haines et al. (2016), Federal Deposit Insurance Corporation (2001), Postel-Vinay (2017), Authors' Calculations.