

Article

The Impact of Bank Deregulations on Farm Financial Stress and Stability

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Abstract: Previous research on bank deregulation has supported the idea that interstate banking deregulation lowered the cost of credit and increased the net farm income. This analysis builds on that base by investigating whether the agricultural loan delinquency volume was also affected. Using a panel data fixed effects approach, deregulation was found to be associated with changes in the volume of delinquencies: interstate banking deregulation reduced the volume of production loan delinquencies, and de novo branching deregulation increased both production and real-estate loan delinquencies. Thus, deregulation's outcome is not clear cut: interstate banking reduced farm financial stress but de novo deregulation increased it.

Keywords: bank deregulation; agricultural loan delinquencies; farm financial stress; farm income

1. Introduction

Until the 1970s, banks in the United States were restricted on many fronts. Interstate banking regulations, for example, prevented banks from expanding operations beyond the borders of the state in which they were headquartered. This prohibition came in part from the desire of states to protect the revenue gained from chartering banks. Such revenue was guaranteed by rules requiring banks to acquire a charter before they could begin operations and by the fact that one step in the chartering process required banks to pay a fee to the chartering state. The chartering revenue only came from the initial formation of the bank and not from branching. Hence, when banks chartered in one state began to plan for expansions into other states, the states into which these banks wanted to expand started creating interstate banking regulations to prohibit such activity. Thus, the end result of interstate banking regulation was that any bank that wanted to operate in a certain state had to be chartered in that same state.

Another regulation influenced how banks operated within the state in which they received their charter. States designed these intrastate branching regulations in ways that limited the permissible scope of bank operations to one or a few localities. These restrictions effectively created localized monopolies and were driven by the desire of states to redirect some of the producer surplus from these monopolies to state treasuries [1]. Some states did this by owning the banks outright, others by holding bank shares, and still others used taxation practices to maximize their revenues [2]. Moreover, most states were engaged in this practice. In 1970, only 12 states did not have such regulations in force [3].

Over the last forty years, however, many changes to the laws governing U.S. banks have occurred, and these changes have profoundly altered the banking industry. Three reforms merit discussion. First, there is the intrastate branching deregulation, which allowed banks to enter new locations in the state where they were headquartered by acquiring existing branches of other banks. The second reform, the de novo branching deregulation, allowed banks authorized to operate in a state to open new branches in new locations in that state not only by acquiring and reflagging branches of competitors but also by

building new branches on sites of their choosing. The final reform is the interstate banking deregulation. This deregulation began primarily as a reciprocal agreement between states whose legislatures had passed such laws. By 1991, 33 states had enacted such laws [4]. Some legislatures further narrowed the scope of the rules by adding a regional component that required the acquiring bank to be headquartered in a nearby state. For example, Massachusetts limited entry to banks headquartered in Connecticut, Maine, New Hampshire, Rhode Island, or Vermont [5]. Virtually all such laws included provisions that prohibited interstate *de novo* branching. It was not until the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 that the regional restrictions and most of the more global regulations on banks acquiring branches across state lines, restrictions that had been in place since the McFadden Act of 1927, were removed [2]. Specifically, bank holding companies, provided that they had enough capital, could acquire banks in any state, and no state could pass laws to gain exemption from this rule after 30 September 1995 [6].

The effects of these deregulations have long been studied, and researchers have tackled the issue in many ways. Kroszner and Strahan, for example, examined the timing of deregulation reforms using a hazard model and found that deregulation occurred in predictable ways depending on the concentration of power of relevant interest groups in each state. When large banks had more influence than small banks, deregulation occurred earlier for the state and when small banks had greater influence, deregulation occurred later in the state [2]. Kareken [7] focused on how the deregulation of banks might increase the riskiness of bank portfolios, which could inflict harm on taxpayers through the requirement that the FDIC insure creditors. Huang [8] used a regression discontinuity approach focusing on differences in economic performance on spatially proximate locales separated by a state border and found some support for stronger growth occurring in the places that have deregulated. Strahan [3] also concluded that there have been tangible economic benefits from deregulation. Francis, Hasan, and Wang [9] looked at deregulation's impact on non-financial firms and found, using a difference-in-differences approach, a negative correlation with the amount of liquid assets these companies held, a result that suggests deregulation gives such firms better access to financial resources.

Others focused on whether or not deregulation increased competition and gave borrowers access to cheaper credit. Beck, Levine, and Levkov [10] found that intrastate branching deregulation increased incomes for those in the bottom half of the income distribution by disrupting monopolistic practices that allowed banks to extract higher rents. Jayaratne and Strahan [11] found that intrastate branching deregulation, and to a lesser degree interstate banking deregulation, resulted in lower loan rates for borrowers, as it allowed more efficient and lower cost banks to expand.

While this topic has been studied at great length for the general economy, little effort has been made to determine the overall effect of bank deregulations on the U.S. agricultural sector and whether deregulation helped alleviate the negative consequences from agricultural downturns. To our knowledge, only Kandilov and Kandilov [12] have tried to fill in this gap in the agricultural literature, showing that interstate banking deregulation lowered agricultural credit costs and led to positive increases in both gross sales and net income.

Given the scale of the changes and the consequential effects that have been found for the general economy, the effect of bank deregulations on farm financial stress needs to be clearly grasped, especially as Dinterman, Katchova, and Harris [13] found that farms are now facing increasing debt, decreasing income and stagnant land values. Worse still, these trends are expected to continue, putting the long-term viability of many small farm operations at risk.

During agricultural downturns, debt to asset ratios often deteriorate to the point where debts will exceed assets. This greatly increases farmers' vulnerability and threatens the sustainability of their farms. In such downturns, farmers "need bank credit the most in order to continue their operations" [14]. Yet, in such times of insolvency, creditors are often "unwilling to advance additional credit" and are instead focused on recovering what they can from farmers. Many creditors do this through bankruptcy proceedings [15]. Some will seek complete liquidation of the farm's assets. The farmer cooperative Farmland Industries, for example, was forced to sell its operations to a competitor after declaring

bankruptcy in 2007 [16]. A less drastic alternative is reorganization, but even that comes with onerous requirements to sell “some assets to reduce debt” or implement other major “changes to increase the [farm’s] efficiency and profitability” [17].

Thus, as farm financial difficulties have grave consequences, our goal is to clarify whether these banking deregulations aided farmers and reduced their financial stress. Doing so contributes to the literature by advancing and intertwining the previous research on the impact of bank deregulations with the research on farm financial stress. Jolly, Paulsen, Johnson, Baum, and Prescott [15] state that the level of this stress can be indirectly measured by examining things like land-value trends, foreclosures, and loan delinquencies. The measure of farm financial stress used in this paper is the volume of agricultural loan delinquencies. There are two major types of agricultural loans: production loans and real estate (RE) loans. Production loans are loans whose funds are used to finance farm operations by purchasing seeds, fertilizer, equipment, etc. RE loans are loans that are used to finance farmland purchases. In this study, whenever delinquencies of either type of loan existed, that was taken as evidence of farm financial stress, as it meant that certain borrowers were unable to fully service their debt.

Our focus is on identifying whether the volume of both agricultural production loan and agricultural RE loan delinquencies decreased after the interstate banking deregulation came into effect, as such a result would accord well with the idea that this deregulation led to the availability of cheaper credit. Another contribution of this work is that the effect of intrastate branching and the *de novo* branching deregulation was also examined. No study to our knowledge has chosen to focus specifically on *de novo* deregulation’s impact on farm financial stress. Most have focused only on the impact of intrastate branching deregulation. Our decision to look at both was merited by the fact that 21 of the 46 states in the study have substantial variation in their implementation dates for *de novo* and intrastate branching deregulations.

Our hypothesis is that deregulation leads to reductions in the volume of delinquencies. This is first because of how credit-cost reductions have been shown to be the result of more efficient banks entering the market [18] and because of the lower cost loan offerings post-deregulation [11]. Anticipation of deregulation alone could not have enabled these lower cost loans to be offered, as regulation specifically prevented such entry. Additionally, for those banks already operating within the locale who might have anticipated other banks’ entry, there would have been little incentive or ability to cut costs before deregulation. This is because monopolistic banks pre-deregulation would have had little incentive to voluntarily forego higher rents until deregulation became a reality and low efficiency banks would have been unable to reduce borrower credit costs. Only post-deregulation, when these bank branches were acquired by high efficiency banks, would profits have risen and in tandem credit costs decreased [3].

Our results reveal that interstate banking deregulation did in fact reduce the volume of production loan delinquencies. This accords with results from India where policies that reduced credit costs were shown to increase farm incomes [19] and highlights the opportunities that exist for policymakers around the globe to mitigate the negative consequences of agricultural downturns by using available tools, such as control of the interest rate for the Farm Loans Program of the United States Department of Agriculture-Farm Service Agency (USDA-FSA). The fact that *de novo* branching deregulation worked in the opposite direction though, increasing the volume of production and real-estate loan delinquencies, demonstrates that caution must be exercised to ensure that reductions in farm financial stress are actually obtained. All in all, deregulation’s outcome is not clear cut: interstate banking reduced farm financial stress but *de novo* deregulation increased it.

2. Materials and Methods

The data in this study come from several sources. Information on total agricultural loan volume and agricultural loan delinquency volume was obtained through the FDIC’s Consolidated Reports of Condition and Income (Call Reports). One limitation of the Call Reports is that there is no information regarding the total number of borrowers or the number of borrowers that are delinquent in repaying

their loans. This meant that there was no way to report changes in the number of borrowers or the average size of either all loans or delinquent loans.

Data for 46 states were used in the study. Alaska and Hawaii were excluded, due to the differences resulting from their geographical remoteness. South Dakota and Delaware were left out of the study, due to the differences in their tax laws, usury ceilings, and the resulting concentration of credit-card banks that Sherman [20] details.

Data cover the period from 1983 to 2001 for all banks where agricultural loans make up more than 5% of their total loan volume, as banks with a lower threshold were not required to report delinquencies. Our decision on the year to start our analysis was mainly driven by the availability of data in the Call Reports and our decision to stop at 2001 was due to the fact that interstate banking and intrastate branching deregulations were in full effect across the United States by 1995 and because six years of additional data was believed adequate to account for the possibility that the effects of deregulation might not be immediate. Additionally, only four states had not implemented *de novo* branching deregulation by 2001 and that condition has not changed to this date. Thus, for production loan delinquencies, 47,957 county-year (874 state-year) observations were used, covering the years 1983 to 2001 and for real estate loan delinquencies, there were 24,974 county-year (460 state-year) observations, covering the years 1992 to 2001.

In the Call Reports, the information for some banks is presented as if all transactions occurred at their headquarters and none through their branch offices. This required us to also use the FDIC's Summary of Deposit Reports (SOD Reports), which contains branch level deposit figures. Using this information, we were able to calculate the percentage of each bank's total deposits held by each branch. With these deposit share values in hand, we next estimated branch loan and delinquency volumes, using the assumption that the ratio of loans/delinquencies to branch deposits would be constant across all branches, an approach that has been used and validated by Morris, Wilkinson, and Hogue [21] using a variety of different data sets.

As the SOD Reports only go back to 1994, a further step was required for the years from 1983 to 1993. For those years, spatial identifiers for bank branches and head offices were used in connection with information on states' banking deregulation timelines [2,22,23]. Working backward, out-of-state branches were dropped for the years before interstate banking deregulation and then branch deposit shares for the remaining branches were recalculated.

Next, delinquency volume was determined by summing the total value of loans whose repayments were: 30 to 89 days late, more than 90 days late, and in nonaccrual status. An alternative formulation for delinquencies added in the volume that had been charged off and subtracted out the volume that had been recovered. When tested, this approach, while nonstandard, yielded same-signed regression results of only marginally different magnitude.

Agricultural land values were obtained from the United States Department of Agriculture's National Agricultural Statistics Service (USDA-NASS) June Area survey and agricultural prices were obtained from the USDA-NASS' Annual Price Survey. The cost of borrowing was proxied by examining the one- and ten-year Treasury rates recorded in Federal Reserve Economic Data (FRED) and Bureau of Labor Statistics (BLS) data were used to obtain state unemployment rates across the United States. Data from the Bureau of Economic Analysis (BEA) provided values for annual, county-level, agricultural sales and production expenditures. State-level data on production expenditures and total factor productivity from the United States Department of Agriculture's Economic Research Service (USDA-ERS) were also incorporated into the study. Conversions were made to adjust from nominal to real values.

Macroeconomic conditions were controlled for by using variables such as one- and ten-year Treasury rates to proxy for the interest rates that would be expected for the short term, production loans and the longer term, real estate loans. Conditions in each locale were approximated using variables such as the state unemployment rate and the per capita income of each county. For per capita income, a one-year lag variable was created and used. This was done to eliminate endogeneity concerns

stemming from Jayaratne and Strahan's result that causally tied intrastate branching deregulation to increases in income [24]. Table 1 provides a summary of the state-level data.

Table 1. Summary statistics, state-level.

Variables	Units	Mean	St. Dev	Min.	Median	Max.
Agricultural Production Loans	(thousands of 1982 dollars)	581,120	724,929	725	325,097	4,397,498
Agricultural RE Loans	(thousands of 1982 dollars)	261,656	295,386	527	139,770	1,630,947
Ag Production Loan Delinquencies ¹	(thousands of 1982 dollars)	16,235	29,886	−361	6080	302,525
Ag RE Loan Delinquencies ²	(thousands of 1982 dollars)	5700	6188	−4	3667	39,807
Interstate Banking Deregulation		0.6	0.49	0	1	1
Intrastate Branching Deregulation		0.71	0.45	0	1	1
De novo Branching Deregulation		0.51	0.5	0	1	1
One-Year Treasury Rate	(in percent)	7.37	2.83	3.43	6.29	14.78
Ten-Year Treasury Rate	(in percent)	8.33	2.4	5.02	7.77	13.92
State Unemployment Rate	(in percent)	6.08	2.08	2.3	5.78	17.79
Total Farm Revenue	(thousands of 1982 dollars)	2,706,875	2,754,642	23,952	2,016,926	15,412,699
Mean Farm Product Sales Price	(1982 dollars)	135	13	100	138	157
Total Production Expenses	(thousands of 1982 dollars)	2,600,144	2,498,339	27,809	1,984,277	13,461,160
Income Per Capita	(thousands of 1982 dollars)	11.47	2.37	6.66	11.22	21.45
Land Value per Acre	(thousands of 1982 dollars)	1.04	0.86	0.1	0.81	4.66

Note: In total, there were 1196 observations from the 46 sampled states over the time period covered from 1976 to 2001. ¹ For production loan delinquencies, there are 874 observations. ² For RE-secured loan delinquencies, there are 460 observations.

Agricultural delinquencies have long been considered to be positively correlated with factors like the farm debt-to-asset ratio and the interest rate [25] and negatively correlated with ones like income [26]. This paper, which examines the effect of the three banking deregulations on agricultural loan delinquencies, adopts a panel data fixed-effects approach akin to that used by Jayaratne and Strahan [24] and Kandilov and Kandilov [12]. Its form is detailed in Equation (1). The model was estimated at the state level and at the county level. The panel contains 19 years of data from 1983 to 2001 for 46 states. The decision to use a fixed-effects model was made after considering alternatives, including using random effects: Hausman test results, and the other metrics that were examined at both the county and state level, consistently and definitively supported the fixed effects choice.

$$\ln \text{Delinquencies}_{it} = \beta_0 + \beta_1 * \text{Deregs}_{it} + \beta_2 * \text{MacroConditions}_t + \beta_3 * \text{LocationCharacteristics}_{it} + \beta_4 * \text{FarmIncome}_{it} + \beta_5 * \text{FE} + \varepsilon_{it} \quad (1)$$

At both levels, the dependent variable, $\ln \text{Delinquencies}_{it}$, represents the natural log of the volume of agricultural loan (either production or RE) delinquencies with i used to index the location, which references the state or the county, and t for the year. The decision to examine the magnitude of the effects using a log-level model was made primarily because of the vast differences in scale among counties. Additionally, support for this approach comes from its use in previous research, most recently by Kandilov and Kandilov [12]. As to the dependent variable's logarithmic transformation, it was completed first by adding one dollar to the value of all observations to work around the problem that would otherwise have arisen, given that more than seven thousand of the observations had delinquency values of zero. Then, after running the regression, the coefficients on the dummy variables were adjusted to prevent the problem of bias in semilogarithmic models that Halvorsen and Palmquist [27] detail.

Deregs_{it} represents a set of dummy variables for the interstate banking, intrastate branching, and de novo branching deregulations that take the value of 1 after the respective deregulation comes into effect. The set of β_1 coefficients thus represent the effect of the three bank deregulations on agricultural loan delinquencies. These coefficients should be negative if the deregulations are helping to reduce farm stress by lowering delinquencies. As was mentioned before, the coefficient on interstate banking deregulation is of particular interest, as this is the one that has been causally tied with decreases in the cost of agricultural credit.

The impact of macroconditions, which do not vary by location, on delinquencies are captured by the β_2 coefficients. The most important of these was U.S. Treasury rates, as Briggeman [28] described it as one of the key components of farm stress. Therefore, it was included in all models.

LocationCharacteristics_{it} covers the set of variables that control for the conditions in the location (state or county). Two such state-level variables are unemployment rate and land values. These were included in all models, as Dinterman, Katchova, and Harris [13] found unemployment rates to be positively correlated with farm bankruptcies and agricultural land values to be negatively correlated. State-level minimum wage and total factor productivity and county-level per capita income and population density variables were also used. The β_4 coefficients reveal the effect of the average financial condition of farms in the county or state. Variables used here included those reflecting county-level total farm sales, livestock sales, crop sales and production expenses. More detailed state-level data for expense categories were also used in various robustness checks, as this data enabled the examination of the impact of changes in cost for expenses such as feed and capital. Their inclusion, however, did not affect the outcomes for the main variables of interest in any significant manner.

Location and year fixed effects were captured by the β_5 coefficients. At both the state and county level, the basic design controlled for these fixed effects. This approach was chosen, as adding in county or state fixed effects allows the time-invariant, unobserved features of the locations under study to be differenced out. Adding year fixed effects further refines the model, as shocks to the total economy can be removed. Region-by-year fixed effects were also used for the four main U.S. Census regions (Northeast, Midwest, South, and West), as their inclusion helps to account for shocks that are of limited scope and also for any exogenous heterogeneity in regional economic development that could have impacted the financial health of differing regions' farms. Thus, the features of this panel data set enable the construction of a model that allows for isolation of the impact of the banking deregulations within each location (county or state). The unidentified noise in the model is represented by ε_{it} .

When the model was estimated at the county-level, potential problems with serial correlation needed to be addressed. This issue arose due to the existence of many state-level independent variables being used in tandem with county-level dependent variables. Bertrand, Duflo, and Mullainathan [29] describe in detail how such situations result in understated standard errors. Tests for serial correlation confirmed this to be an issue. To address the problem, the approach followed by Kandilov and Kandilov [12] of clustering by state while computing robust heteroskedastic standard errors was adopted here as well. After examining the data using the model described in Equation (1), several robustness checks were also undertaken using county-level data, including an analysis where the main and interactive effects of the deregulations were examined.

3. Results

To understand whether these bank deregulations resulted in a reduction of delinquencies, answers to several questions were sought. The first question was how loan volume, in real dollars, has changed. Results for the period from 1976 to 2001 are displayed in Figure 1. Real estate loan volume, after a small dip in the early years of the farm crisis, grew slowly but consistently over time. Production loan volume, conversely, was roughly ten billion 1982 dollars more over the first half of the timeframe than over the second half. This could be suggestive of a higher volume of loans before the farm crisis of the 1980s and a new, lower normal afterward. As to the relative magnitude of the two types of loans, in 1976, real estate loan volume was just one-third of production loan volume, but by 2001, the ratio of real estate to production loans surpassed 75%. However, in no year did the volume of real estate loans surpass that of production loans. When considering the total volume of agricultural loans over time, the result is a graph that is lower by five to ten billion real dollars in the late 80s/early 90s but appears largely stable over time. As these results indicate significant changes in the volume and composition of loans over time, loan volume was always included as a control to capture its effect on the volume of agricultural delinquencies.

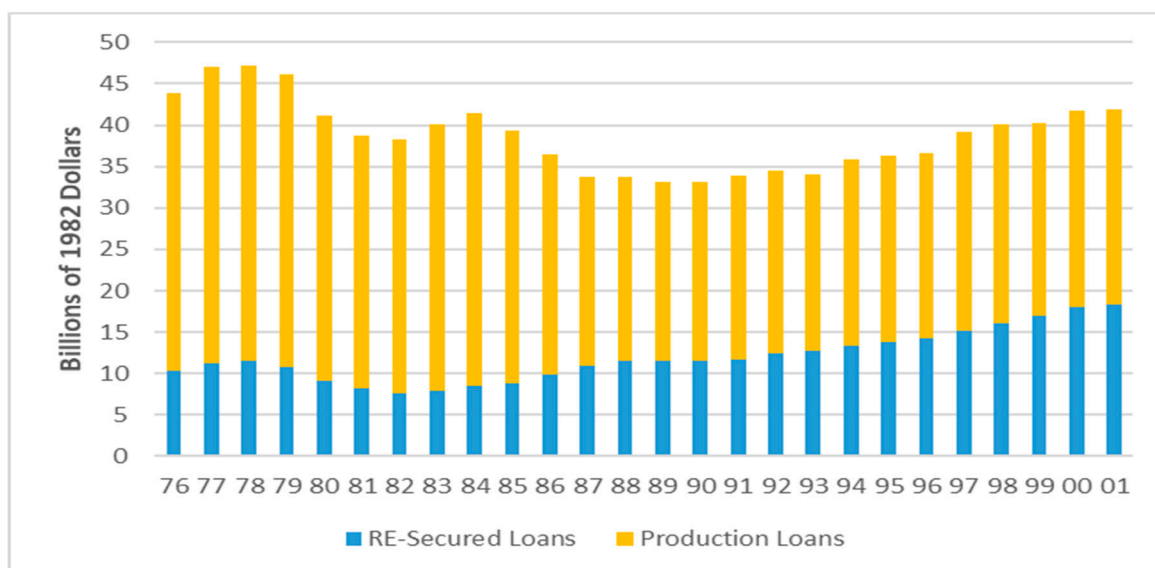


Figure 1. Total loan volume by type and by year, billions of \$1982, 1976–2001.

Before examining delinquencies, the impact of the deregulations on the volume of agricultural loans was ascertained. It was expected that interstate banking deregulation would increase the total volume of loans, as it should have enabled farmers to secure more loans and to also take out a larger volume of loans, given the cheaper credit finding of previous research. The other two deregulations were also examined to determine whether or not they impacted the volume of delinquencies, and if so, the direction of the relationship.

The results of this regression, which are presented in Table 2, show that interstate banking deregulation was strongly tied to increases in the volume of production loans, just over 9%, and to the volume of real estate loans, around 8%. Conversely, de novo branching deregulation reduced the volume of real estate loans by 8.5%, but had no impact on production loans. Intrastate branching deregulation had no effect on either type of loan.

Table 2. Factors influencing agricultural loan volume (%), county-level data, 1983–2001.

Variables	(1)	(2)	(3)
	Production Loans	RE Loans	Total Ag Loans
Interstate Banking Deregulation	0.092 *	0.083 *	−0.027
Intrastate Branching Deregulation	0.072 *	0.105	−0.090 **
De novo Branching Deregulation	0.028	−0.085 *	0.061 *
State Unemployment Rate	0.01928	0.09761 ***	−0.02164
Farmland Value Per Acre ⁺	0.16255	−0.06578	0.29148 ***
Per Capita Income ⁺	0.05836 ***	0.04010 ***	0.06527 ***
Lagged Farm Profit	0.000002 ***	0.000003 **	0.000001 **
One-Year Treasury Rate	−0.02884		−0.07677 **
Ten-Year Treasury Rate		−0.13488 ***	−0.02852
R-squared	0.062	0.316	0.669

Note: Asterisks denote *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. Model used 46 states, 2702 counties and a total of 66,254 observations. The superscript⁺ represents variables scaled in thousands of \$1982. County, year, and U.S. Census Region-by-year fixed effects were employed.

When total agricultural loan volume, the sum of the previous two types, was considered, the coefficient on interstate banking deregulation was not significant while de novo branching deregulation increased the volume of loans by more than 6% and intrastate branching deregulation decreased them by 9%.

Turning to delinquencies, the impact of the three deregulations on agricultural production loan delinquencies was examined first at the state level, using four specifications that introduce step-wise the macroeconomic and farm-specific control variables that the literature has highlighted as highly relevant. Results are presented in Table 3.

Table 3. Factors impacting delinquent agricultural production loan volume (%), state-level data, 1983–2001.

Variables	Agricultural Production Loan Delinquencies			
	(1)	(2)	(3)	(4)
Interstate Banking Deregulation	−0.224 **	−0.164 *	−0.161 *	−0.159 *
Intrastate Branching Deregulation	−0.111	−0.046	−0.04	−0.037
De novo Branching Deregulation	−0.073	−0.047	−0.051	−0.059
Production Loan Volume	0.000002 ***	0.000002 ***	0.000002 ***	0.000002 ***
Total Farm Sales ⁺	0.0000001	0.0000002	0.0000002	0.0000002
Sales Price	−0.016	0.037	0.045	0.031
Total Production Expenses ⁺	−0.0000007 ***	−0.0000008 ***	−0.0000008 ***	−0.0000008 ***
Unemployment Rate		0.101 ***	0.102 ***	0.099 ***
One-Year Treasury Rate		0.02	0.048	0.002
Farmland Value Per Acre ⁺		0.04	0.012	−0.004
Total Factor Productivity ¹			0.027	0.054
State and Year FE				−0.884 **
Region-by-Year FE	Yes	Yes	Yes	Yes
R-squared	0.497	0.514	0.514	0.52

Note: Asterisks denote *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. Model used 46 states and a total of 874 observations. The superscript⁺ represents variables that are scaled in thousands of 1982 dollars. ¹ Total factor productivity is measured at the state level and sets 1982 Alabama = 1.0, as the reference point.

As should be expected, there was a positive relationship between the volume of production loans and the volume of delinquencies, with each extra 1000 dollars in outstanding loans resulting in a marginal increase in delinquencies. Results also consistently showed interstate banking deregulation having a significant effect. On average, interstate banking deregulation reduced the volume of agricultural production loan delinquencies in a state by around 16%. De novo and intrastate branching, however, yielded no significant effect. Of the other control variables, the coefficients for production expenses, state unemployment rate, and total factor productivity were significant.

When the agricultural production loan delinquency models were reexamined at the county level, the results, presented in Table 4, show that the coefficients on interstate banking and de novo branching are significant. Interstate banking deregulation reduces delinquencies by roughly 2% and de novo branching deregulation increases delinquencies by almost 4%. In addition, in all models in Table 4, the coefficient on the loan volume is significant and positive. Livestock and crop sales prices also have significant coefficients in all columns, with a one dollar increase in sales price reducing delinquencies by around a quarter and a tenth of a percent, respectively. Lastly, a one point increase in a state's total factor productivity is linked with nearly a 6% decrease in delinquencies and the farm crisis is shown to have increased delinquencies by 12%.

For analysis of real estate loan delinquencies, data was only available, as mentioned above, for the period from 1992 to 2001. This meant that the effect of interstate banking deregulation could not be analyzed, as only one state in the study deregulated after 1992 and thus only 0.2% of the observations would have provided the pre-deregulation baseline. A similar problem existed for intrastate branching: only two states deregulated after 1992. The situation for de novo branching was far less problematic, as thirteen states still had not deregulated by 1992. This gave roughly 7000 county-year observations as a base against which to test the effect of deregulation.

Table 4. Factors impacting delinquent agricultural production loan volume (%), county-level data, 1983–2001.

Variables	Agricultural Production Loan Delinquencies			
	(1)	(2)	(3)	(4)
Interstate Banking Deregulation	−0.022 **	−0.021 **	−0.021 **	−0.021 **
Intrastate Branching Deregulation	0.028	0.028	0.028	0.027
De novo Branching Deregulation	0.038 ***	0.037 ***	0.038 ***	0.037 ***
Production Loan Volume ⁺	0.000005 ***	0.000005 ***	0.000005 ***	0.000005 ***
Total Livestock Sales ⁺	0.0000003	0.0000003	0.0000003	0.0000003
Livestock Sales Price	−0.007 ***	−0.003 ***	−0.003 ***	−0.003 ***
Total Crop Sales ⁺	−0.000001	−0.000001	−0.000001	−0.000001
Crop Sales Price	−0.001 *	−0.001 ***	−0.001 **	−0.001 **
Total Production Expenses ⁺	0.00001	0.00001	0.00001	0.00001
State Unemployment Rate		0.004	0.004	0.004
One-Year Treasury Rate		−0.01	−0.01	−0.01
Farmland Value Per Acre ⁺			−0.026	−0.028
Per Capita Income ⁺				−0.002
Total Factor Productivity ¹				−0.057 **
Farm Crisis Dummy	0.120 ***			
County FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes
Region-by-Year FE	Yes	Yes	Yes	Yes
R-squared	0.343	0.343	0.343	0.343

Note: Asterisks denote *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. The superscript + represents variables that are scaled in thousands of 1982 dollars. ¹ Total factor productivity is measured at the state level and sets 1982 Alabama = 1.0, as the reference point.

For all these reasons, only the effect of de novo branching deregulation was examined when considering real estate loan delinquencies. One benefit of examining de novo branching deregulation only from 1992 to 2001 is that it enabled testing of the previously identified positive effect of this deregulation on delinquencies outside of the 80s farm crisis window: the benefit being that if a positive effect appeared here, it clearly could not be dismissed as a model misspecification problem where the farm crisis' impact was being improperly attributed to de novo branching deregulation. The state-level regression for real estate loan delinquencies is shown in Table 5.

The relationship between the volume of real estate loans and the volume of real estate loan delinquencies is again significant but only marginally impactful. More importantly, de novo branching here as well is seen as a significant factor in delinquencies. On average, after having implemented this deregulation, states would have 25% more real estate loan delinquencies. The county-level regression, which is presented in Table 6, produced similarly signed results. De novo branching deregulation again increased delinquencies, by roughly 4.5% per county.

Table 5. Impact of de novo branching deregulation on delinquent agricultural real estate loan volume (%), state-level data, 1992–2001.

Variables	Farmland-Secured (RE) Loan Delinquencies			
	(1)	(2)	(3)	(4)
De novo Branching Deregulation	0.315	0.297	0.264 *	0.246 *
RE Loan Volume	0.000003 ***	0.000003 ***	0.000003 ***	0.000003 ***
Total Farm Sales ⁺	0.0000001	0.0000001	0.0000001	0.0000001
Sales Price	−0.029	0.096 **	0.041	0.04
Total Production Expenses ⁺	0.0000003	0.0000003	0.0000002	0.0000002
Unemployment Rate		0.094	0.04	0.039
Ten-Year Treasury Rate		0.227	−0.458	−0.478
Farmland Value Per Acre ⁺			0.405	0.424
Per Capita Income ⁺			−0.479 **	−0.459 **
Total Factor Productivity ¹				−0.987
State and Year FE	Yes	Yes	Yes	Yes
R-squared	0.231	0.235	0.275	0.28

Note: Asterisks denote *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. Model used 46 states and a total of 460 observations. The superscript + represents variables that are scaled in thousands of 1982 dollars. ¹ Total factor productivity is measured at the state level and sets 1982 Alabama = 1.0, as the reference point.

Table 6. Impact of de novo branching deregulation on delinquent agricultural real estate loan volume (%), county-level data, 1992–2001.

Variables	Farmland-Secured (RE) Loan Delinquencies			
	(1)	(2)	(3)	(4)
De novo Branching Deregulation	0.047 **	0.045 **	0.043 **	0.043 **
RE Loan Volume ⁺	0.000008 ***	0.000008 ***	0.000008 ***	0.000008 ***
Total Farm Sales ⁺	−0.000001 *	−0.000001 *	−0.000001 *	−0.000001 *
Sales Price	−0.005 *	−0.003	−0.003	−0.004
Total Production Expenses ⁺	0.000001	0.000001	0.000001	0.000001
Unemployment Rate		0.017	0.018	0.018
Ten-Year Treasury Rate		−0.016	−0.031	−0.043
Farmland Value Per Acre ⁺			−0.083	−0.071
Per Capita Income ⁺				−0.010 ***
Total Factor Productivity ¹				0.066
County and Year FE	Yes	Yes	Yes	Yes
Region-by-Year FE	Yes	Yes	Yes	Yes
R-squared	0.182	0.183	0.183	0.184

Note: Asterisks denote *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. The superscript⁺ represents variables that are scaled in thousands of 1982 dollars. ¹ Total factor productivity is measured at the state level and sets 1982 Alabama = 1.0, as the reference point.

The above results largely demonstrate consistency in the impact of the deregulations across both loan type and level, but to ensure that there were no misspecification issues or other problems, several robustness checks were undertaken. The first of these robustness checks, whose results are detailed in Table 7, involved examining both types of loan delinquencies, but only for the top 25 agricultural states, as these states account for roughly 85 percent of the agricultural production in the United States. States were chosen based on data from the USDA-ERS. Results for the production loan delinquencies yielded the expected split-valence result, with interstate banking deregulation decreasing delinquencies by about 3.5%, intrastate branching deregulation decreasing them another 3%, and de novo branching deregulation increasing delinquencies by more than 5%. For real estate loan delinquencies, de novo branching deregulation continued to demonstrate a positive correlation, increasing them by more than 5% per county.

Table 7. Factors impacting volume of agricultural loan delinquencies (%) for top 25 agricultural states in US by value, county-level data.

Variables	Production-Loan Delinquencies		RE-Loan Delinquencies	
	(1983–2001)		(1992–2001)	
	(1)	(2)	(3)	(4)
Interstate Banking Deregulation	−0.036 ***	−0.036 ***		
Intrastate Branching Deregulation	0.031 ***	0.033 ***		
De novo Branching Deregulation	0.054 ***	0.054 ***	0.055 ***	0.057 ***
Production Loan Volume ⁺	0.000006 ***	0.000006 ***		
RE Loan Volume ⁺			0.00001 ***	0.00001 ***
Total Farm Sales ⁺	−0.000001 ***	−0.000001 ***	−0.000001	−0.000001 ***
Sales Price	0.003	0.003	0.011 **	0.011 **
Total Production Expenses ⁺	0.000002 ***	0.000002 ***	0.000002 ***	0.000002 ***
State Unemployment Rate	0.001	0.002	0.029 ***	0.031 ***
One-Year Treasury Rate	0.007 *	0.009 **		
Ten-Year Treasury Rate			−0.040 *	−0.026
Farmland Value Per Acre ⁺		−0.02		0.044
Per Capita Income ⁺		0.005 ***		0.014 ***
State and Year FE	Yes	Yes	Yes	Yes
Observations	36,212	36,211	18,858	18,858
R-squared	0.386	0.389	0.369	0.378
Number of Counties	25	25	25	25

Note: Asterisks denote *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.10$. The superscript⁺ represents variables scaled in thousands of 1982 dollars.

In this model, many other coefficients were also significant. For example, a 1000 dollar increase in the volume of loans again marginally increased delinquencies. Additionally, a one-thousand dollar increase in farm sales was linked to a decrease in both production and real estate loan delinquencies.

Also, a one point increase in the unemployment rate increased real estate loan delinquencies by roughly 3%. Three other variables had coefficients that were significant: per capita income, production expenses, and the Treasury rate.

The next check involved examining the various deregulations while considering two possibilities: (1) that the impact of the control variables might not be the same at all levels and (2) that together the impact of the deregulations might either be greatly amplified or potentially muted. These regression results are displayed in Table 8.

First, in columns (1) and (2), interstate banking deregulation is shown to decrease agricultural production loan delinquencies by just over 2% and de novo branching deregulation is tied to an increase of roughly 3.5%. Of the other coefficients that are significant, only sales price and farmland value are of any magnitude, decreasing delinquencies by 2.5% and 16.5% respectively. In columns (3) and (4), de novo branching deregulation is tied to an increase of roughly 7% and intrastate branching deregulation when de novo branching deregulation is not in effect also increases delinquencies by roughly the same amount. As for interstate banking deregulation, when intrastate branching deregulation is also in effect, it is shown to decrease agricultural production loan delinquencies by nearly 6.5%. Finally, the impact of having all three deregulations in effect was an increase in delinquencies of 4.6% per county.

Table 8. Factors impacting volume of production loan delinquencies (%), using quadratic and interacted variables, 1983–2001, county-level data.

Variables	Agricultural Production Loan Delinquencies			
	(1)	(2)	(3)	(4)
Interstate Banking Deregulation	−0.021 **	−0.024 **		
Intrastate Branching Deregulation	0.025	0.024		
De novo Branching Deregulation	0.036 ***	0.038 ***	0.072 **	0.075 **
Interstate Banking w/o De novo Branching			0.012	0.013
Intrastate Branching w/o De novo Branching			0.066 **	0.067 **
Interstate Banking w/o Intrastate Branching			−0.007	−0.008
Interstate & Intrastate Interaction			−0.064 **	−0.065 **
All 3 Deregulations' Combined Effect			0.046 **	0.046 **
Production Loan Volume ⁺	4×10^{-9} ***	4×10^{-9} ***	2×10^{-9} *	2×10^{-9} *
Production Loan Volume Squared ⁺	-3×10^{-17} ***	-3×10^{-17} ***		
Total Farm Sales ⁺	−0.0000002	−0.0000002	−0.000001	−0.000002
Total Farm Sales Squared ⁺	-2×10^{-15}	-4×10^{-15}		
Sales Price	0.017	0.025 *	−0.001 *	−0.001 **
Sales Price Squared	−0.00006	−0.00009 **		
Total Production Expenses ⁺	0.000002 ***	0.000002 ***	0.000003	0.000003
Total Production Expenses Squared ⁺	-1×10^{-12} ***	-1×10^{-12} ***		
State Unemployment Rate	0.012	0.012	0.002	0.002
State Unemployment Rate Squared	−0.0004	−0.0004		
One-Year Treasury Rate	0.012	0.002	−0.001	−0.00004
One-Year Treasury Rate Squared	−0.0002	−0.001		
Farmland Value Per Acre ⁺		−0.165 **		−0.006
Farmland Value Per Acre Squared ⁺		0.026 **		
Per Capita Income ⁺		−0.002		0.001
Per Capita Income Squared ⁺		−0.000003		
R-squared	0.254	0.256	0.207	0.207

Note: Asterisks denote *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$. All values are in percent terms (e.g., 1.0 denotes a 1 percent change). The superscript⁺ represents variables that are scaled in thousands of 1982 dollars.

From all these model formulations, two themes repeatedly recur. First, interstate banking deregulation appears to have had a strong, negative impact on agricultural loan delinquencies. While in some models intrastate branching deregulation needed to also be in effect before the impact of the interstate banking deregulation was felt, as was the case in columns (3) and (4) of Table 8, interstate banking deregulation was never shown to increase delinquencies. This is potentially the result of interstate banking deregulation engendering reduced agricultural credit costs, but that hypothesis was not specifically tested here.

The second result, which does not harmonize with the lowered cost of credit idea, is the increased volume of delinquencies resulting from de novo branching deregulation. This result does not necessarily mean that the cost of credit argument can be dismissed, but it, at minimum, suggests that there was a significant change that this deregulation brought about, and that change, whatever it was, greatly

increased farm financial stress. One possibility could be related to competition prompting issuance of loans to borrowers with less than stellar credit. Support for this can be seen from the fact that during the 1980s and 1990s, the de novo banking rate was quite high: during this time, roughly two to three percent of all banks were de novo creations [1]. Still, much further study is required to unearth the exact reasons driving this.

4. Discussion

Much research effort has been spent understanding the effect of the banking deregulations that were enacted from the 1970s to the mid-1990s and also the factors that affect farm financial stress. This article built on that previous research by examining whether or not three bank deregulations impacted the volume of agricultural production loan and real estate secured loan delinquencies.

Using a fixed effects panel approach, two of the deregulations were shown to have consistently impacted the volume of delinquencies. Interstate banking deregulation, in all tests, was found to have had a non-positive effect on the volume of delinquencies, and in most formulations, it reduced the volume of production-loan delinquencies by between 2% and 4% per county. De novo branching deregulation was also found to have had an impact, increasing production-loan delinquencies by between 4% and 7.5% per county. For real-estate-secured loans as well, de novo branching deregulation increased delinquencies, by around 4.5% per county.

These results first highlight the fact that there are major questions that future research needs to resolve concerning de novo deregulation. First and foremost, why did de novo deregulation precipitate such large increases in the volume of delinquencies? Previous research has not focused much on this particular deregulation, as it was often the last of these three deregulations to be implemented. The fact that its impact has been revealed to be so large, though, means that it needs to be carefully studied. At this point, it is unknown why this deregulation is increasing the volume of delinquencies. One possibility, that this deregulation was capturing the impact of the 80s farm crisis, was tested and rejected, as the effect persisted even outside of that timespan. Other possibilities include increased bank competition leading to riskier loans being extended or lending engendering moral hazard problems. The later was found in Iran: many farmers used funds for priorities not even tied to agricultural operations and with no eye to repayment [30]. The increased delinquencies thus could be said to reflect the issue of asymmetric information, as “lenders cannot know the borrowers’ intentions or their ability to repay a loan” [31], but to understand exactly why de novo deregulation led to such large increases in the volume of production and real estate loan delinquencies, focus should turn to identifying precisely what changes this deregulation brought about.

The second major takeaway is that interstate banking deregulation clearly reduced farm financial stress. This result is robust to a variety of alternate specifications that included the introduction of controls like county-level population density, state-level categorical production expenses, state-level minimum wage, county-level farm profit numbers, and dummy variables for the farm crisis or the Riegle-Neal Act. Given these facts, this work should be seen as showing strong support for the idea that interstate banking deregulation lowers agricultural delinquencies. Previous research, furthermore, has shown a tie between this deregulation and lower credit costs [10–12], and lower credit costs have been shown to reduce financial stress. For example, research that examined the Vietnam Bank for Social Policies found that when the bank provided loans with subsidized interest rates, poor farmers’ financial situations stabilized somewhat [32]. Taken together, these results seem to suggest that this deregulation may have worked through credit costs to lessen farm financial stress. This suggests that there might be times when policymakers would find it advantageous to use mechanisms, such as by controlling the interest rates of the USDA-FSA’s Farm Loan Program, to help foster the long-term health and stability of small farms.

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