Deposit insurance, bank risk taking and failures: Evidence from the early 20th century state deposit insurance systems

Felipe Aldunate *

Pontificia Universidad Católica de Chile

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Abstract

This paper studies how deposit insurance affects the risk of the banking system. Until 1933 there was no federal deposit insurance for national banks in the United States. I use the introduction of state deposit guarantee systems in the early 20th century as a quasi-natural experiment to study its effects on banks' growth, risk taking, and failures. Using aggregate state data I find that insured banks experienced higher growth rates than uninsured banks. However, I find no effects of deposit insurance on failure rates, or risk taking proxied by leverage and illiquid assets holdings. Limited evidence on interest rates suggests that insured banks lowered the rate paid on deposits relative to uninsured banks. Using hand collected micro level data I study how individual bank characteristics and local geographic conditions shaped the effects of deposit insurance. I find higher growth rates in banks located in lower population density counties, and greater increases in the ratio of loans to total assets in banks located in counties with low house mortgage debt in the pre insurance period.

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1 Introduction

Deposit insurance is an intrinsic part of today's financial system. If a bank were to fail, its depositors count on federal deposit insurance to spare them from any financial loss, up to a limit. Thus it is usually argued that deposit insurance is a beneficial regulation, because it increases the stability of the financial system by minimizing the probability of bank runs. For example, when the U.S. government increased the federal deposit insurance limit from $100,000 to $250,000 during the recent financial crisis, the FDIC chairman stated: *"This temporary increase in deposit insurance coverage should go far to help consumers maintain confidence in the banking system [...] And clearly the public's confidence is key to a healthy and stable economy".*[1] But this is only the bright side of deposit insurance, and there is a potential dark side too. Once this insurance is introduced, bank depositors no longer have incentives to monitor their banks, which allows banks to potentially increase their risk to excessive levels. The main goal of this research is to study how these two effects interact and shape the risk of the banking system.

To study if deposit insurance increases banks' risk taking and failures I analyze the introduction of deposit guarantee systems in eight U.S. states between 1908 and 1917. There are several advantages of using this historical event. First, at the time the insurance systems came into effect, banks could broadly be classified as state or national banks, depending on if they obtained they charters at the state or federal level. By a ruling of the Comptroller of the Currency, national banks were not allowed to participate in the guarantee systems. Thus, these banks can be used as a control for state wide shocks that also affected the insured state banks. Second, participation in the insurance schemes was made mandatory for all state banks in five of the eight states. This allows to partially overcome endogeneity concerns in the results because of self selection of riskier banks into the insurance system.[2] Finally not all U.S. states introduced deposit insurance, and the ones that did, did so at different times, which provides cross sectional and time series variation.

The data used in this study can be broadly divided into two sets. The first part of the analysis uses annual balance sheet and failure data aggregated by type of bank (state vs. national) for each state. The data was collected from *All Bank Statistics 1896 - 1955 (1959)* and from the *Annual Reports of the Comptroller of the Currency.* There is also very limited data on interest rates on deposits on the reports, which is used to shed some light on the pricing effects of deposit insurance. The second set of data consists of micro level data on banks' balance sheet for a subsample of treated and control states. This data is available in annual or bi-annual reports issued by the institution in charge of bank supervision in each state. Individual bank data makes possible to perform the analysis with equally weighted ratios and growth rates instead of the implicit size weighted totals from the aggregate data. More importantly it allows me to study how individual bank and geographic characteristics shaped the effects of deposit insurance.

The main findings of this paper are four. First, I find that banks with deposit insurance experienced a higher growth rate in deposits than uninsured banks. The annualized excess growth

[1] FDIC Chairman Sheila C. Bair, October 7, 2008.

[2] National banks had the option to recharter as a state bank, so there are still some endogeneity concerns.

rate varies from 5.6% to 7.6% depending on the specification. I also observe a substitution of demand for time deposits in insured banks. Second, I find that insured banks did not increase their risk as measured by their capital structure or illiquid assets holdings. Third, using limited evidence on interest rate changes, I find that insured banks lowered the rate paid on deposits relative to uninsured banks. Fourth, using hand collected micro level data, I find that insured banks located in rural counties, and in counties with low mortgage levels in the pre insurance period, experienced the highest growth rate in deposits and the highest increase of lending as a percentage of total assets respectively.

Overall the evidence suggests that deposit insurance affected depositors behaviour but not banks' risk taking. The increase in deposits in insured banks, the substitution of demand for time deposits, and the limited evidence on interest rates is all consistent with an increase in depositors' confidence in insured banks. However despite these benefits, the results indicate that insured banks did not exploit deposit insurance to significantly increase the risk of their balance sheets. One possible explanation for this result relates to the presence of double liability for bank shareholders, which could have deterred excessive risk taking.[3] As will be explained in the last section, in future work I plan to use information on bank management and ownership to explore this hypothesis.

To my knowledge this is the first attempt to study the effects of the early 1900s deposit insurance systems, using individual bank balance sheet data and a difference in differences approach. Wheelock and Wilson (1995) (WW), and Hooks and Robinson (2002) also use micro data on banks to answer related questions using different approaches. Wheelock and Wilson (1995) study bank failures in the state of Kansas in a period when there was deposit insurance. They conclude that membership in the guarantee system increased the failure rate of banks. There are three important differences between my work and this earlier paper. First, the participation decision to join the insurance system was set at the bank level in Kansas. Thus the results have the problem of self selection into the insurance system. It is reasonable to expect that riskier banks decided to participate, which cast doubts on the real effects of deposit insurance on bank failures. In my work, I use micro data for banks in states were participation was mandatory, to overcome this potential endogeneity problem. Second, while WW studies failures, I focus on balance sheet items such as bank leverage and the ratio of liquid assets to total assets, which provides a more direct measure of bank risk taking. Finally, and related to the previous points, I use a difference-in-differences approach, while WW only uses data for Kansas, which does not allow them to compare their results with failure rates of similar banks in a control state, that was subject to deposit insurance.

Hooks and Robinson (2002) study how deposit insurance affected the decision of troubled banks to increase their risk even further. Using individual bank data for Texas they conclude that deposit insurance increased failure rates for state banks. They also find evidence that banks in weak financial condition increased the risk of their asset portfolios, which they claim is consistent with a "go for broke" strategy. The differences between this paper and my project are similar to the ones

[3] In case of a bank failure, shareholders with double liability do not only risk to lose the total value of their equity, but they are also responsible for up to the par value of their stocks. During the period of this study, state banks' shareholders in most states, and all national banks' shareholders were subject to double (or multiple) liability.

discussed above. First the guaranty system in Texas was not a mandatory one, nor voluntary, but a mix system as described below in section 2. My research with individual bank data focuses on states with mandatory insurance systems. The question being asked also differs. While they focus in the incentives for already troubled banks, I study the effects on all state banks. Finally their approach does not run a formal difference in difference estimation, nor do they use a state without deposit insurance as an additional control.

This project is also related to the literature that uses aggregate bank data to study the consequences of these deposit insurance systems. Calomiris (1992) concludes that while failure rates were not higher for states that introduced deposit insurance, the ratio of asset shortfall in liquidated banks to capital in all other banks was much higher in these states.[4] My project extends the previous analysis by studying the effects on ex-ante risk measures such as leverage and the percentage of illiquid assets to total assets. In addition I estimate diff-in-diff and diff-in-diff-in-diff models using state fixed effects to control for unobserved heterogeneity and shocks unrelated to the introduction of deposit insurance.

The paper proceeds as follows. Section 2 contains a brief summary of banking and deposit insurance regulation during the time period considered in this project. Section 3 describes the data and empirical strategy. Section 4 presents an analysis of bank risk taking and bank failures using aggregate data. The main analyses based on micro level data is presented in section 5. Finally section 6 concludes.

2 Bank Regulation and Deposit Insurance

Between 1908 and 1917, eight states introduced deposit insurance for bank depositors. This was not an isolated experiment, but part of a long history of regulatory changes by the federal and state governments. Even the growth in bank deposits experienced in the decades before guarantee laws were enacted, was a consequence of competition between the federal government and the states. In 1864 the federal government imposed a 10% tax on state bank notes, which was banks' main source of financing. The goal was to encouraged the growth of national banks which were required to buy government bonds for operation. This led state banks to shift their business model from note issuances toward deposits. The early twentieth century schemes were not the first guarantee systems in U.S. history. Six states experimented with different insurance schemes in the mid 1800s. According to Calomiris (1989), the three successful cases of Indiana, Ohio and Iowa shared the common characteristics of putting the supervision of banks in the hands of the insured banks themselves.[5] This is argued to have reduced risk taking, by the better monitoring member banks were able to perform on each other.

Oklahoma was the first state to introduce deposit insurance in the 1900s. The law was enacted in December of 1907, and became effective in 1908. Seven other states followed Oklahoma's lead.

[4] Asset shortfall is defined as the difference between total deposits and the value of liquidated assets. It cannot be observed directly, so it is approximated using information for all suspended banks.

[5] New York, Vermont and Michigan are classified as failed experiences by Calomiris (1989).

These were all located west of the Mississippi river, except for the state of Mississippi. Table 1 presents a list of these states. Participation in the guarantee system was made mandatory in five of these states and voluntary in three. Because of a ruling by the Comptroller of the Currency in 1908, national banks were not allowed to take part in the deposit insurance programs, so only deposits in state banks were insured. In Texas, banks had to choose between taking part of a deposit guaranty fund as in the other seven states, or to post a bond or other securities equal to their capital. Thus, the second option was not a form of insurance, but just a requirement to increase banks' reserves. Hence, the Texas guarantee system was a middle point between voluntary and mandatory, but it is classified as voluntary in this study.

There are several important differences between the insurance schemes considered in this study, and the current deposit insurance system. First, while in today's system the government explicitly guaranties deposits, in the early 20th century deposits from failed banks were supposed to be paid from a fund (under state control), constructed from fees paid by participating banks. Thus, they are better described as a form of mutual insurance instead of as a government insurance system. Second bank shareholders in most states did not enjoy limited liability as is common today. Owners from both state and national banks were subject to double (or multiple) liability for the par value of their stocks. Finally it is important to note that there were very strict limitations on bank branching at the time, so the banking system was mostly populated by smaller unit banks.

Table 1: Summary of state deposit insurance systems

State	Law enacted	Law effective	End of insurance	Mandatory participation for state banks
Kansas	3/6/1909	6/30/1909	1929	No
Mississippi	3/9/1914	1914	1930	Yes*
Nebraska	4/25/1909	7/1/1911	1930	Yes
North Dakota	3/10/1917	1918	1929	Yes
Oklahoma	12/17/1907	2/14/1908	1923	Yes
South Dakota	3/5/1915	1/1/1916	1931	Yes
Texas	5/12/1909	1/1/1910	1925	No
Washington	3/10/1917	1917	1929	No

*Starting 5/15/1915.

2.1 Nebraska and South Dakota insurance systems

I present next a description of the insurance systems in Nebraska and South Dakota, which are two of the states for which individual bank data has been collected.[6] The deposit insurance law was enacted in Nebraska on April 25, 1909, but the guaranty system only became effective after two years of litigations in July 1911. All state banks were required to take part of the insurance system, while national banks were not allowed, as ruled by the Comptroller of the Currency in 1908. All type of deposits, secured and non secured were covered.[7] The system considered semiannual fees

[6]The remaining part of this section is based mainly on Warburton (1959) and FDCI (1998).

[7]Starting 1925 only non-secured deposits were guaranteed.

equal to 0.25% of average deposits during the first four years, reduced to 0.05% thereafter until the fund reached 1.5% of deposits. The law also considered special assessments in case the funds dropped to less than 1% of deposits. The State Banking Board was in charge of the administration of these funds. The fees were not collected from the banks, but they only needed to credit the corresponding amount to the State Banking Board. In case a bank went into voluntary liquidation or rechartered as a national bank, it had to pay all the assessment that had been credited.

The fund was depleted in the mid 1920s by a series of bank failures, and receivers of the troubled banks had to start issuing certificates guaranteed by the Guarantee Fund Commission. However in 1927 this practice was no longer possible, because of the low demand for these certificates driven by bad expectations for the fund's future. Opposition mounted among bankers toward the guarantee system, as they feared all new fees to be collected were going to be used to pay for already failed banks' depositors. Finally, in March 1930 the state legislature repealed the guarantee law.

In South Dakota, the guarantee law was enacted in 1915, and the insurance started in 1916. There had been previous attempts to introduce a guarantee for deposits since 1905. Even though some authors (e.g. Calomiris, 1990) report that deposit guarantee started in 1909, the law enacted that year was intended to fail from the start. According to Robb (1921), they set high fees for participation and the requirement of at least 100 banks to voluntary join for the law to become effective. This number was not reached and the law never came into effect. The 1915 law dictated mandatory participation for all state banks, while just like in all other states, national banks were excluded. The guarantee applied only to unsecured deposits. The Depositors' Guaranty Fund Commission was created to administer the fund. The fee for participation was 0.25% of average deposits annually, until the fund reached 1.5%. The law did not specified special assessments in case the fund could not cover all expenses, but did allow for the issuance of interest paying certificates if necessary. In case a state bank liquidated or converted to a national charter, it was paid back the fees that had not been expended.

The guarantee fund was depleted in 1923, and depositors from failed bank had to be paid with certificates of indebtedness. After four year over which depositors were paid with these certificates, the law was modified in 1927. Banks still had to pay annual assessments, but the funds a bank paid were only to be used in case that bank failed. Finally in 1931 the State Supreme Court ruled that the remaining funds should be distributed according to the rules of the previous guarantee law.

3 Methodology, Data and Sample Selection

3.1 Empirical Strategy

The main results in this paper are estimated using a difference-in-differences-in-differences strategy. The first difference is taken over time: after vs. before the introduction of deposit insurance in each state. The second difference is taken within state: state vs. national banks. The third difference is taken between states: treated (introduced deposit insurance) vs. control state (did not introduced deposit insurance). Equation 1 presents the baseline bank-level OLS regression.

$$Y_{i,s,t} = bank_i + year_t + \beta_1 Post_t.Statebank_i + \beta_2 Post_t.Insurance_s + \beta_3 Post_t.Insurance_s.Statebank_i + \epsilon_{i,s,t} \quad (1)$$

where $Y_{i,s,t}$ is the outcome variable of interest (e.g. leverage ratio or percentage of illiquid assets) for bank i in state s and year t. The regression also includes $bank_i$ and $year_t$ which are bank and year fixed effects respectively. $Post_t$ is a dummy equal to one for the years after the introduction of deposit insurance in each pair of treated-control states, and zero otherwise. $Insurance_s$ is a dummy equal to one for states that introduced deposit insurance, and zero for the control states. $Statebank_i$ is a dummy equal to one for state banks, and zero for national banks. Note that in equation (1) all time invariant fixed effects (e.g. state, bank type) are not included, because their are subsumed by the bank fixed effects. Equation (1) can be modified by replacing the dummies $Post_t$ and $Insurance_s$ in the interaction terms, by year and state fixed effects respectively. This is the preferred specification for the results presented in this paper.

The coefficient of interest in equation 1 is β_3, which is the one on the triple interaction term. This term is one only for banks with deposit insurance in the years after its introduction (treated banks). If banks that received deposit insurance increase risk taking, then β_3 would be positive when $Y_{i,s,t}$ is a variable that proxies for bank risk.

3.2 Aggregate Data

Data for this study comes from several sources. Aggregate information by state comes from *All Bank Statistics 1896 - 1955* (1959). The data is reported yearly for national and state institutions. It includes the totals for loans, financial investments, and cash, as well as a breakdown of these items into three or four components. In addition it provides information on total deposits, borrowings, and capital and surplus. The total number of state and national banks is also included.

One advantage of using this data source is that it corrects previous sources, for example by discounting bank branches from the total number of banks. The main disadvantage is that for most states it aggregates all institutions that are not national banks into one category, which makes impossible to disentangle state banks from trust companies, savings banks, or private banks.

Information on banks' failures is collected from the *Annual Reports of the Comptroller of the Currency*. The reporting format changes over the period studied in this paper, which does not make possible to construct a time series of state banks failures only. Thus state banks failures are added to savings banks, trust companies, and private banks failures. State banks represent the majority of the failures in this series. For example in 1925 out of the 648 failures, 600 were state banks.

There is very limited data on interest rates available in the *Annual Reports of the Comptroller of the Currency*. Only in the 1899 and 1910 editions there is information on the rates paid by a subsample of state and national banks. The 1915 report is the only other instance where data is reported for state banks, but it does not include data on national banks. Starting in 1920 data

is periodically reported only for national banks. For now, only the data from the 1899 and 1910 editions has been collected and used for the preliminary results presented in this document.

The results presented in section 4 consider different combinations of treated and control groups for robustness. Two sets of states are considered as the treated group: all eight states that introduced deposit insurance either mandatory or voluntary, and only the five states that introduced mandatory deposit insurance.[8] As a control group, two different sets of states are used. Table 2 presents a description of the treated and control groups.

Table 2: Description of treated and control groups used in the analysis

Group	# States	Description
Treated Group		
Mandatory	5	Mississippi, Nebraska, North Dakota, Oklahoma, and South Dakota.
All	8	Kansas, Texas, Washington, and 5 states with mandatory participation.
Control Group		
All	40	All contiguous U.S. states.
Adjacent	13 (11)*	States adjacent to states with deposit insurance.

*Sample of adjacent states depends on the treated group.

3.3 Individual Bank Data

The second and main part of this study uses individual bank information. The data for state banks was hand collected from annual or bi-annual reports published by the institution in charge of banking supervision in each state. These reports present detailed information of assets and liabilities for each bank under state supervision. However they differ slightly across states. A common report includes approximately 12 items for resources and 12 for liabilities. *Loans* is usually the most important asset, while capital, and deposits prevail among liabilities.

Information on national banks' balance sheets is available in the *Annual Reports of the Comptroller of the Currency*. The data include less items and is more aggregated than the state reports, but it allows to disentangle loans, financial assets, and reserves on the assets side, and deposits, equity and other type of liabilities.

I collected data for six states, three states that introduced deposit insurance (Nebraska, South Dakota, and Mississippi) and three control states (Colorado, Minnesota, and Alabama). The selection of the three states that introduced deposit insurance is based on the characteristics of their insurance schemes and on data availability. Their systems were mandatory for all banks which allows the study of deposit insurance effects without the endogeneity concerns present in a voluntary system. There is not enough information for the other two states with mandatory

[8] As explained above, Texas is considered as a state that introduced voluntary deposit insurance, because banks had the option between taking part of a guarantee system or posting a bond which effectively meant increasing its reserve requirements.

insurance. Oklahoma did not publish bank reports before the introduction of deposit insurance, while the North Dakota reports stopped including information on individual state banks in 1914.

The selection of the control states is also driven by data availability, their banking legislation and the condition of them being adjacent to Nebraska, South Dakota, and Mississippi. Colorado is chosen as the control state for Nebraska, Minnesota as the control state for South Dakota, and Alabama for Mississippi

Data is available yearly or every two years for these states, but to minimize data collection costs, I only collected data for two years for each state. Nebraska enacted the deposit insurance law in 1909, so data for Nebraska and Colorado was collected for 1908 and 1914. [9] South Dakota enacted the insurance law in 1915, so 1914 and 1919 are the chosen years for South Dakota and Minnesota. Mississippi enacted the law in 1914, and data for 1913 and 1917 was collected for that state and Alabama. Finally, information for all national banks for the same state-years mentioned above has also been collected.

The major limitation of the individual bank level data is that there is no information on interest rates nor on the portfolio composition. Both of these variables could have played a significant role in how banks adapted to the new operating environment. Banks might have increased the risk of their portfolios by speculating in farm loans and thus increasing their failure probability during the agricultural crisis of the 1920s. The data available does not allow me to study this potential channel. Similarly, national banks might have reacted to state banks' deposit insurance, by offering their clients higher interest rates.

3.4 Summary Statistics

Table 3 presents the summary statistics for all state and national banks in my sample. Panel A summarizes national banks, while panel B presents the same statistics for state banks. National banks represent only a 23% of the total banks in the sample, but they are on average larger than state banks. The mean (median) total assets of national banks is 4.6 (2.6) times the corresponding value for state banks. The sum of loans and overdrafts is the most important asset for both types of banks representing more than 60% of their total resources. Deposits and equity are the most important sources of funding, with their sum representing more than 85% of total liabilities. The biggest difference between national and state banks is in the ratio of financial investments to total assets ($inve\_at$). While this items represents 19% of total assets for national banks it only represents 3.9% for state banks.

[9] There is no report for Colorado state banks for 1908, so data for Feb. 5, 1909 is used instead.

Table 3: Summary statistics: This table reports summary statistics for all state and national banks in Alabama, Colorado, Minnesota, Mississippi, Nebraska, and South Dakota for two data points: one year before the deposit insurance law was enacted and 3 to 5 years after. *loan_ovdf_at* is the ratio of the sum of loans plus overdraft to total assets. *inve_at* is the ratio of the sum of all financial investments (bonds and stocks) to total assets. *cash_due_at* is the ratio of the sum of cash at the bank and reserves at other banks to total assets. *equi_at* is the ratio of total equity to total assets. *deps_at* is the ratio of total deposits to total assets.

Variables	No. of Obs.	Mean	Std. Dev.	p10	median	p90
Panel A: National Banks						
total_assets	1732	1,107,271	4,431,521	158,448	399,311	1,517,894
loan_ovdf_at	1732	0.617	0.115	0.463	0.635	0.746
inve_at	1732	0.192	0.092	0.090	0.176	0.307
cash_due_at	1732	0.177	0.090	0.080	0.159	0.298
equi_at	1732	0.173	0.082	0.082	0.158	0.282
deps_at	1732	0.680	0.141	0.484	0.707	0.840
Panel B: State Banks						
total_assets	5765	239,466	388,448	49,374	150,909	476,217
loan_ovdf_at	5765	0.691	0.139	0.518	0.716	0.837
inve_at	5765	0.039	0.067	0.000	0.004	0.127
cash_due_at	5765	0.215	0.128	0.094	0.186	0.374
equi_at	5765	0.194	0.127	0.081	0.165	0.329
deps_at	5765	0.765	0.143	0.587	0.801	0.902

4 Aggregate Data Results

I present in this section an analysis using aggregate data by state and type of bank. I study how the introduction of deposit insurance affected banks' deposits, risk, failures and interest rates.

4.1 Deposit growth and risk taking

In this subsection I study if the introduction of the guarantee systems led to an increase in state banks' risk, and to a disproportionate growth in their deposits. I also explore how the composition of deposits changed after deposits became insured. I focus on two proxies for risk, equity over total assets, and loans over total assets. A decrease in equity over total assets, or an increase in the percentage of loans in the balance sheet would provide evidence that insured banks became riskier.

Figure 1 presents the evolution of the normalized difference in deposits between state and national banks in states that introduced deposit insurance (solid line) and their adjacent states (dashed line). The differences were normalized to zero in period zero, and period 1 is the first complete year when deposit insurance was effective in each state. The picture shows that in treated states, the difference in deposits between state and national banks significantly increased after deposit insurance was introduced. This change is not observed in the control states.

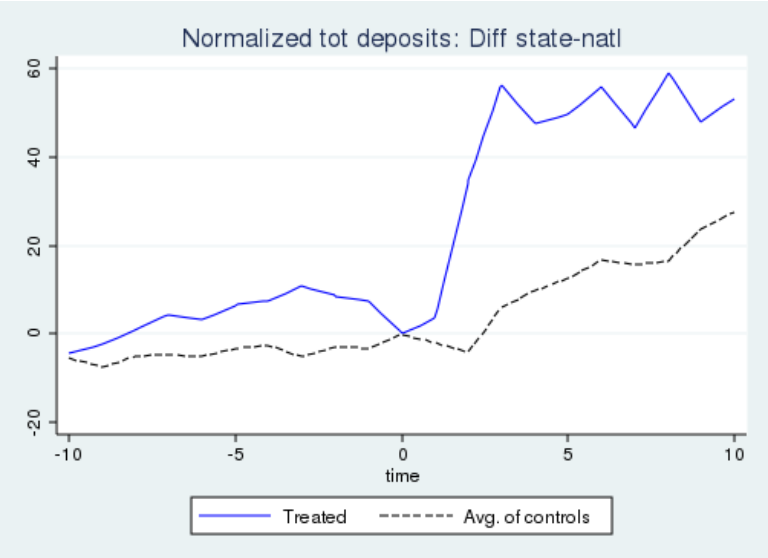

Figure 1: Normalized difference in total deposits between state and national banks in states that introduced deposit insurance (solid line) and their adjacent states (dashed line). The differences were normalized to zero in period zero, and period 1 is the first complete year when deposit insurance was effective.

Table 4 presents the results for all balance sheet items regressions. The coefficient of interest is the one on *insured_year* which is a dummy variable equal to one for all state banks in states with deposit insurance in that year. Panel A presents the results for the diff-in-diff regressions using only state banks. Panel B presents the results for a diff-in-diff-in-diff, where the dependent variable is

the difference between the value of state and national banks. As mentioned above, a ruling by the Comptroller of the Currency forbade national banks to participate in the state insurance systems. Thus, by focusing on the difference between state and national banks, I can control for state wide shocks unrelated to deposit insurance. All regressions the state and year fixed effects, and standard errors are clustered by state.

Columns (1) and (2) of panel B, show that the result of figure 1 is statistically significant. The difference in growth rates between state and national banks in states that introduced deposit insurance, is higher than in control states. This conclusion holds if either all states (column 1) or only adjacent states (column 2) are used as the control group. Columns (3) and (4) indicate that the ratio of demand deposits over total assets decreased, while columns (5) and (6) show that over the same period the ratio of time deposits to total assets increase. Thus, the combined evidence suggest that depositors became more willing to lend their funds to insured banks for longer period of times, renouncing the option to ask for their money back on demand. [10]

The analysis on the evolution of banks' risk is presented in columns (7) to (10) of table 4. Columns (7) and (8) in panels A and B suggest that after deposit insurance was introduced, there was no significant change in the ratio of illiquid assets (loans) to total assets. In unreported results I also find no change on the ratio of total reserves (cash and due from banks) to total assets in insured banks. The results are surprising given that deposit insurance was expected to be associated to a lower probability of bank runs, thus reducing the need for banks to hold assets that are easier to liquidate. Finally columns (9) and (10) present mixed evidence on capital structure changes in insured banks. If only state banks are used as the control group, panel A suggests that insured banks became riskier in terms of increasing their leverage. However once national banks are included in panel B, this change is smaller and not statistically significant.

In sum, deposit insurance allowed state banks to grow at higher rates than their competitors, while also resulting in a partial replacement of demand for time deposits. However insured banks do not seem to have increased their risk, as proxied by illiquid assets holdings or leverage. It is still possible that the loan portfolio of insured banks became riskier, which would not be observed in the available data. However, given that a riskier loan portfolio would result in a higher probability of failure, I can indirectly test for this hypothesis in the next section, by studying failure rates.

4.2 Bank failures

In this section, I study if banks with deposit insurance had higher failure rates than banks whose deposits were not insured. Even though the results presented above show that insured banks did not increase their leverage nor their holdings of illiquid assets, it is possible that they increased their risk in ways not observable with the available data. For example banks with insurance might

[10] As is well known the assumption of parallel trends between control and treated groups cannot be tested. However I study on table A.1 in the appendix if there were parallel trends in the dependent variables in the pre insurance period. The results show that the parallel trends assumption holds for most of the dependent variables and specifications presented in this section. Most importantly the parallel trends assumption cannot be rejected for all diff-in-diff-in-diff specifications that use only adjacent states as the control group (even numbered columns on panel B).

had increased the risk of their loans. A consequence of this would be an increased failure rate in the years after insurance was introduced. Alternatively deposit insurance might have accomplished its intended goal of reducing bank runs and consequently bank failures.

Table 4: Growth in total deposits (columns 1 and 2), demand deposits over total assets (columns 3 and 4), time deposits over total assets (columns 5 and 6), loans over total assets (columns 7 and 8), and equity over total assets (columns 9 and 10). Panel A: State banks only. Panel B: Difference between state and national banks. Period 1900-1920. Only states that introduced mandatory deposit insurance are included in the treated group. Odd (even) numbered columns use all (only adjacent) states as control group.

	Growth in tot deps.		Demand Deps. over TA		Time Deps. over TA		Loans over TA		Equity over TA	
	All	Adjac.	All	Adjac.	All	Adjac.	All	Adjac.	All	Adjac.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: State Banks										
insured_year	0.0137	0.0121	-0.0178*	-0.0139	0.0417**	0.0391*	0.0117	-0.00204	-0.0248**	-0.0263**
	(1.21)	(0.90)	(-1.74)	(-0.81)	(2.68)	(1.88)	(0.41)	(-0.07)	(-2.57)	(-2.46)
_cons	0.133***	0.123**	0.486***	0.518***	0.249***	0.204***	0.602***	0.616***	0.230***	0.236***
	(4.91)	(2.48)	(62.41)	(42.89)	(32.12)	(14.81)	(75.78)	(45.39)	(39.22)	(27.26)
year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	900	320	939	336	945	336	945	336	945	336
R^2	0.292	0.360	0.365	0.492	0.467	0.569	0.188	0.305	0.618	0.689
Panel B: Difference State-National Banks										
insured_year	0.0793***	0.0755**	-0.0382**	-0.0457*	0.0613***	0.0525**	0.00279	0.00448	-0.0142	-0.00696
	(2.81)	(2.37)	(-2.09)	(-2.13)	(4.18)	(2.87)	(0.13)	(0.21)	(-1.50)	(-0.66)
_cons	-0.0260	-0.0769	-0.0334***	-0.0120	0.202***	0.142***	0.0718***	0.0771***	-0.00538	0.0193
	(-0.84)	(-1.35)	(-3.12)	(-0.74)	(16.87)	(9.84)	(8.74)	(7.47)	(-0.75)	(1.75)
year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	900	320	939	336	945	336	945	336	945	336
R^2	0.058	0.137	0.134	0.283	0.165	0.260	0.019	0.094	0.042	0.071

t statistics in parentheses. Standard errors clustered by state.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The empirical strategy is the same as the one presented above for balance sheet items. I first use only state banks in states with no insurance as the control group in the difference-in-differences presented in panel A of table 5. Then I estimate a diff-in-diff-in-diff model using national banks in all states in panel B. Columns (1) and (2) present the results for the 1900-1920 period. Given that the demise of the guaranty systems came in the 1920s, it is expected that states with deposit insurance experienced lower failure rates in this period. In column (1) all states are used as the control group, while in column (2), only the adjacent states are used as control. The coefficient on *insured_year* in column (1) indicates that relative to all states, the states with deposit insurance experienced higher failure rates, but the results of column (2) suggest that this higher rate was common to all states in the area, and not specific to states with deposit insurance.

In columns (3) to (8) of table 5 I study if during the crises of the 1920s the failure rates were higher in states with deposit insurance. First, columns (3) and (4) present the diff-in-diff-in-diff results, which suggest that states with insurance experience similar failure rates than the control states. In columns (5) and (6) I use only the 1921-1930 period, to focus more narrowly on the crisis years. Even though the evidence on column (5) again indicates higher failure rates in states with insurance, column (6) suggest that all states in the area suffered from higher bank failures, and not only the ones with deposit insurance. Finally in column (7) and (8), I introduce a new dummy variable *insurance* which is equal to one for all states that had deposit insurance at some point in this decade, and zero otherwise. The goal of using this variable is to study if the guaranty schemes made the banking system more fragile, which could have resulted in higher failure rates after they were cancelled. The coefficients on *insurance* on panel A and B show that this is not the case. States that introduced deposit insurance did not experienced higher failure rates, even considering the years after they were cancelled as treated years.

In sum, the results show that there were no significant differences in the failure rates of banks whose deposits were insured relative to the control banks. This is consistent with the results presented above using balance sheet variables which indicated no higher risk taking by insured banks in terms of leverage or illiquid asset holdings. Thus, while detailed data on the risk of the loans is not available for this study, these results suggest that banks did not make riskier loans after they became insured.

4.3 Interest Rates

As discussed above, there is only limited information available regarding interest paid on deposits. In 1910 laws of deposit insurance had been enacted in Kansas, Nebraska, Oklahoma and Texas. They specified mandatory participation in Nebraska and Oklahoma. In 1910, only in four states were the interest rates offered by state banks lower than by national banks, and three of them had deposit insurance: Kansas, Nebraska, and Oklahoma. In Texas, a state with a *mixed* deposit insurance system, state banks were paying only 7 basis points more than national banks.

Panel A of table 6 presents the results when only state banks are used in the analysis. All 37 states for which data for state and national banks is available for 1899 and 1910 are included in

Table 5: Bank failure rate. Panel A: State banks only. Panel B: Difference between state and national banks. Only states that introduced mandatory deposit insurance are included in the treated group. In columns 1, 3, 5, 7 the control group includes all other states. In columns 2, 4, 6, 8 the control group includes only states adjacent to the treated states. Different time periods over 1900-1930.

	1900-1920		1900-1930		1921-1930		1921-1930	
	All	Adjac.	All	Adjac.	All	Adjac.	All	Adjac.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: State Banks								
insured_year	0.00164	0.0000586	0.0143	0.00777	0.0265**	0.0135		
	(1.41)	(0.04)	(1.56)	(0.98)	(2.28)	(1.03)		
insurance							0.0276**	0.0145
							(2.61)	(1.18)
_cons	0.00861***	0.00351*	0.00861***	0.00351	0.0169***	0.0185*	0.0167***	0.0390***
	(3.38)	(1.98)	(2.84)	(1.25)	(4.24)	(1.91)	(4.23)	(4.89)
year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	Yes	Yes	Yes	Yes	No	No	No	No
N	945	336	1395	496	450	160	450	160
R^2	0.067	0.114	0.195	0.439	0.084	0.224	0.095	0.229
Panel B: Difference State-National Banks								
insured_year	0.00193**	0.000837	0.00598	0.00314	0.0114**	0.00689		
	(2.09)	(0.59)	(1.21)	(0.68)	(2.14)	(1.17)		
insurance							0.0131**	0.00875
							(2.68)	(1.59)
_cons	0.00729***	0.00178	0.00729***	0.00178	0.0116***	0.00412	0.0114***	0.0185**
	(2.99)	(0.69)	(2.78)	(0.62)	(3.25)	(1.26)	(3.22)	(2.21)
year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	Yes	Yes	Yes	Yes	No	No	No	No
N	945	336	1395	496	450	160	450	160
R^2	0.043	0.066	0.090	0.245	0.051	0.118	0.060	0.129

t statistics in parentheses. Standard errors clustered by state.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Interest Rate on Deposits. Panel A: State banks only. Panel B: Difference between state and national banks in 1899 and 1910.

Treated group:	All insured states		Only mandatory	
Control group:	All	Adjac.	All	Adjac.
	(1)	(2)	(3)	(4)
Panel A: State Banks				
insured_year	-1.787***	-1.371**	-2.674***	-2.258***
	(-3.61)	(-2.32)	(-8.31)	(-5.14)
_cons	3.662***	4.410***	3.634***	4.475***
	(61.44)	(33.04)	(63.25)	(38.78)
year f.e.	Yes	Yes	Yes	Yes
state f.e.	Yes	Yes	Yes	Yes
N	74	20	70	16
R^2	0.476	0.756	0.534	0.878
Panel B: Difference State-National Banks				
insured_year	-1.450***	-1.188*	-2.245***	-1.983***
	(-3.11)	(-2.14)	(-5.43)	(-3.82)
_cons	0.500***	0.930***	0.494***	1.012***
	(9.61)	(7.42)	(9.91)	(8.87)
year f.e.	Yes	Yes	Yes	Yes
state f.e.	Yes	Yes	Yes	Yes
N	74	20	70	16
R^2	0.360	0.614	0.458	0.796

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

columns (1) and (3), while only the adjacent states are used as control in columns (2) and (4). The coefficient on *insured_year* indicates that the differences are economically and statistically significant. Banks in states that had enacted a deposit insurance law before 1910, reduced the interest rate offered to depositors by 1.79% relative to banks in all other states in the sample (column 1). If only mandatory states are included in the treated group this difference increases to 2.67%. The result is robust to reducing the control group to adjacent states only (columns 2 and 4).

Panel B of 6 presents the diff-in-diff-in-diff estimations using national banks. Column (1) shows that relative to the change in national banks, the net effect is 1.45%, which is statistically significant. Overall the results support the conclusion that banks that became insured experienced a reduction in their financing costs relative to national banks and state banks in control states.

5 Individual Bank Results

The previous section suggests that the principal effect of deposit insurance was an increase in the aggregate growth rate of deposits. However, there could be significant differences in how different banks reacted to the introduction of deposit insurance. For example, the literature states that small rural banks were the strongest proponents of its introduction, and they could have benefit the most out of it because of their inability to diversify their risks in the pre insurance period. Another unanswered question, is that if the results are driven by changes within each bank, or if exit and entry dynamics can explain them. Individual bank data allows me to study these effects, and provide a better understanding of how deposit insurance affects the banking system.

First, I study how different balance sheet items changed in state banks located in states that introduced deposit insurance in comparison to state banks in the control states. The key variable in the tables is ***insured_year*** which is a dummy equal to one for state banks when deposit insurance is present in a state. So this variable is one for state banks in Mississippi, Nebraska, and South Dakota after deposit insurance was introduced and zero otherwise.

Table 7 presents the results for the growth rate in deposits and several balance sheet items using individual bank data. The regressions in Panel A are pooled regressions, so they include all banks in the sample. Panel B presents the within banks regressions, which include bank fixed effects, so only banks present in the pre insurance and insured period affect the results. Column (1) shows the results for the percentage growth in total deposits, which is computed by bank, so it cannot be included in the pooled regressions in Panel A. The dependent variables in columns (2) to (9) are all defined as the ratio of the respective variable over total assets.

The coefficient on *insured_year* indicates that state banks in states that introduced deposit insurance benefited from an increase in their total deposits. The economic magnitude is significant, the annualized growth rate is 5.8%. So over a 5 year period this coefficient implies that insured banks growth was 32% higher than state banks in state with no deposit insurance. Columns (2)-(5) present the result for different assets standardized by total assets. There are no important

differences between the coefficients in panels A and B. Both indicate that after becoming insured, banks increased their holdings of illiquid assets (loans to total assets), while decreasing their liquid assets (financial investments and cash holdings). Column (4) suggest that there were no changes in the percentage of their resources held in other banks.

The last four columns of table 7 present the results for liabilities. Columns (6) and (7) in both panels indicate that insured banks replaced equity with deposits as a source of funding. Finally columns (8) and (9) indicate that there were no changes in others sources of funding.

In the analysis of table 8 I include individual national bank data. As discussed above, national banks operated in the same geographical areas as state banks, and competed with them, but were not allowed to participate in the guarantee systems because of a ruling of the Comptroller of the Currency. Thus national banks allow me to filter out shocks that affected all banks in each state.

As the micro level data for national banks is coarser than for state banks, there are less balance sheet items available for the regressions. The structure of the table is the same as in table 7, panel A presents the pooled regression results, and panel B presents the within bank regression results. Column (1) shows that after controlling for state specific shocks, the conclusion that insured banks experienced higher growth rates remains statistically and economically significant. Relative to national banks and control states, insured banks grew 3% more per year. In both panels A and B, the coefficient on *insured_year* suggest that there were no differences in the ratio of loans to total assets (column 2), investments to total assets (column 3), or cash and due from banks over total assets (column 4). However the results of columns (5) and (6), indicate that there was a substitution in the insured banks financing from equity to deposits. The smaller magnitude of the coefficient on panel B, suggests that this result was driven by within bank variation, and also by entry and exit of banks.

Table 7: Diff-in-diff using state banks only. Column (1): Annual percentage growth in total deposits. Columns (2)-(9) ratio of variable over total assets. Panel A: Pooled regressions. Panel B: Within bank regressions.

	(1) Perc. growth in deposits	(2) loans	(3) invest	(4) due from banks	(5) cash	(6) equity	(7) deps	(8) borrowing	(9) due to banks
Panel A: Pooled Regressions									
insured_year	-	0.0469***	-0.0134***	0.00239	-0.0129***	-0.0367***	0.0258***	0.00180	0.00398
	-	(7.20)	(-4.54)	(0.43)	(-10.69)	(-7.23)	(4.05)	(0.72)	(1.31)
_cons	-	0.559***	0.0427***	0.268***	0.0612***	0.279***	0.666***	0.0338***	0.0106***
	-	(60.69)	(10.92)	(29.60)	(33.04)	(42.08)	(82.84)	(10.82)	(5.65)
year f.e.	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
bank f.e.	-	No	No	No	No	No	No	No	No
N		5764	5764	5759	5739	5764	5764	5764	3137
R^2		0.188	0.294	0.145	0.301	0.268	0.237	0.094	0.126
Panel B: Within Bank Regressions									
insured_year	0.0577***	0.0450***	-0.0193***	0.00592	-0.0112***	-0.0248***	0.0132**	0.00278	0.00488*
	(12.58)	(6.82)	(-6.25)	(1.03)	(-9.28)	(-5.73)	(2.39)	(1.09)	(1.66)
_cons	0.0124**	0.664***	0.0102***	0.222***	0.0443***	0.202***	0.771***	0.00890***	0.0162***
	(2.24)	(147.40)	(5.98)	(49.82)	(48.60)	(65.28)	(207.26)	(5.99)	(22.86)
year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	No	No	No	No	No	No	No	No	No
bank f.e.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2301	4626	4626	4621	4609	4626	4626	4626	2515
R^2	0.309	0.177	0.449	0.118	0.278	0.317	0.232	0.069	0.011

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Diff-in-diff-in-diff using state and national banks. Column (1): Annual percentage growth in total deposits. Columns (2)-(6) ratio of variable over total assets. Panel A: Pooled regressions. Panel B: Within bank regressions.

	(1) Perc. growth in deposits	(2) loans	(3) invest	(4) cash and due from banks	(5) deps	(6) equity
Panel A: Pooled Regressions						
insured_year	-	0.00140	0.0111	0.00344	0.0231**	-0.0203***
	-	(0.13)	(1.59)	(0.37)	(2.03)	(-2.61)
_cons	-	0.541***	0.221***	0.237***	0.576***	0.243***
	-	(44.84)	(26.75)	(23.73)	(39.40)	(31.34)
year f.e.	-	Yes	Yes	Yes	Yes	Yes
state f.e.	-	Yes	Yes	Yes	Yes	Yes
state bank dummy	-	Yes	Yes	Yes	Yes	Yes
bank f.e.	-	No	No	No	No	No
All interactions	-	Yes	Yes	Yes	Yes	Yes
N	-	7496	7496	7496	7496	7496
R^2	-	0.232	0.588	0.215	0.321	0.298
Panel B: Within Bank Regressions						
insured_year	0.0296***	0.00435	-0.000344	0.00823	0.0142	-0.00725
	(3.44)	(0.39)	(-0.05)	(0.87)	(1.46)	(-1.17)
_cons	0.0392***	0.632***	0.0830***	0.211***	0.770***	0.175***
	(4.70)	(124.14)	(26.35)	(46.03)	(175.27)	(55.77)
year f.e.	No	Yes	Yes	Yes	Yes	Yes
state f.e.	Yes	No	No	No	No	No
state bank dummy	Yes	No	No	No	No	No
bank f.e.	No	Yes	Yes	Yes	Yes	Yes
All interactions	Yes	Yes	Yes	Yes	Yes	Yes
N	3026	6076	6076	6076	6076	6076
R^2	0.376	0.202	0.397	0.183	0.257	0.335

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Finally, I address the concern that state banks and national banks are not comparable because of their substantial differences in their size distribution. In panel A of table 9 I drop all state banks that are smaller than the smallest national bank in the pre insurance period in my sample and all national banks that are larger than the largest state bank in my sample in the pre insurance period. I drop in total 388 banks with observations in both periods and I present the results for regressions with bank f.e. only.

Column (1) of table 9 confirms that insured banks experienced higher growth rates. Columns (5) and (6) indicate that, after restricting the sample to treated and control banks of similar size, there is a substitution from equity to deposits in the insured banks financing. The table also shows that there are no differences in the ratios for loans, financial investments, and cash and due from banks, between insured and uninsured banks.

Table 9: Diff-in-diff-in-diff using state and national banks. Column (1): Annual percentage growth in total deposits. Columns (2)-(6) ratio of variable over total assets. Common support of size (total assets) in pre insurance period. I drop all state banks smaller than the smallest national bank, and all national banks, bigger than the largest state bank.

	(1) Perc. growth in deposits	(2) loans	(3) invest	(4) cash and due from banks	(5) deps	(6) equity
insured_year	0.0302***	0.0132	0.000557	-0.00453	0.0220**	-0.0168***
	(3.80)	(1.16)	(0.08)	(-0.47)	(2.31)	(-3.11)
_cons	0.0486***	0.664***	0.104***	0.203***	0.756***	0.166***
	(6.42)	(115.34)	(27.90)	(41.05)	(155.11)	(58.99)
year f.e.	No	Yes	Yes	Yes	Yes	Yes
state f.e.	Yes	No	No	No	No	No
state bank dummy	Yes	No	No	No	No	No
bank f.e.	No	Yes	Yes	Yes	Yes	Yes
All interactions	Yes	Yes	Yes	Yes	Yes	Yes
N	2650	5300	5300	5300	5300	5300
R^2	0.397	0.290	0.399	0.220	0.247	0.357

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.1 Bank size

The literature studying deposit insurance in this period describes small rural banks as the strongest supporters of its introduction. In this section I study if small state banks in states with insurance experienced higher growth rates than larger banks, relative to the control states.

In order to allow for non linear effects I classify banks into terciles of size (total assets) in each state in the pre insurance period.[11] I construct a dummy variable *small_pre* which is one for the banks in the lowest size tercile and zero for the banks in the highest size tercile.

Table 10 presents the regression results using log growth of total deposits and of total assets as the dependent variables (columns 1 and 2), and the change in the ratio of several balance sheet variables over total assets (columns 3-10). The coefficient of interest is the one on *tr_small_pre* which is a dummy equal to one for banks in treated states that were in the bottom tercile of size in the pre insurance period. Thus, this is effectively a diff-in-diff-in-diff estimation studying the difference between small and large banks, between treated and control states in the change over time of each dependent variable.

Columns 1 and 2 suggest that smaller banks did not benefited more than larger banks from the introduction of deposit insurance in terms of experiencing higher growth rates. In addition and contrary to what was expected given the previous literature, smaller banks that got insurance became safer by increasing their cash holdings (column 5), and increasing the ratio of equity to total liabilities (column 7). Finally column 9 shows that smaller banks significantly decreased the share of bills and notes rediscounted (*borrowing*) in their balance sheet, which has been used in previous studies as a proxy for troubled banks.

[11] Because of the size distribution differences between state and national banks I cannot estimate a diff-in-diff-in-diff (including national banks) with a size interaction interaction variable. There are no national banks in the lower tercile of bank size in South Dakota in the pre insurance period and there are only 3 and 6 in Mississippi and Nebraska respectively.

Table 10: Differences in growth and balance sheet items as a function of size. Log growth in total deposits and total assets (columns 1 and 2), and changes in ratios of variable over total assets (columns (3-10). State banks only.

	Deps growth	AT growth	loans	invest	cash	due from banks	equi	deps	borrowing	due to banks
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
tr_small_pre	0.0108	0.00164	0.00756	0.000495	0.00646**	0.0156	0.0217**	-0.0105	-0.0229***	0.00376
	(1.05)	(0.19)	(0.46)	(0.07)	(2.24)	(1.08)	(2.09)	(-0.79)	(-4.06)	(1.19)
State f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year f.e. × small_pre	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_cons	0.111***	0.0799***	-0.00951	0.00920	-0.00876***	0.00600	-0.0563***	0.0866***	-0.0240***	-0.00338
	(10.62)	(9.33)	(-0.57)	(1.33)	(-3.01)	(0.41)	(-5.35)	(6.44)	(-4.21)	(-1.05)
N	1495	1507	1507	1507	1492	1504	1507	1507	1507	1507
R^2	0.465	0.493	0.207	0.267	0.130	0.119	0.271	0.225	0.128	0.020

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Overall the results of table 10 suggest that larger banks, relative to smaller banks, used deposit insurance to increase their risk level, both in terms of liquid assets and capital structure. In addition the decrease in alternative ways of costly financing (*borrowings*) for smaller banks, also points to a decrease in their riskiness. Thus, while it does not seem that smaller banks benefited from insurance in terms of higher growth rates, the reduction of *borrowings* represents an improvement in their overall condition.

5.2 Riskier banks

If deposit insurance increases the confidence of depositors in all banks, one could expect the benefits to be higher for troubled or riskier banks. In this section I test this hypothesis using three proxies for a bank's riskiness: the presence of costly financing in the balance sheet, and the initial capital structure both in terms of total equity and capital paid in.

Previous literature has used notes and bills rediscounted (*borrowing*) as a proxy for troubled banks (Calomiris and Mason, 2003). This item is only available for state banks, thus I use state banks in neighbouring states as the control group. As reported in table 11, 20.9% (26.3%) of banks in treated (control) states have non zero borrowings in the pre insurance period. The average percentage of borrowings to total assets, for banks that have nonzero *borrowings* is 8.3% and 9.8% for treated and control states respectively.

Table 11: Descriptive statistics for bank risk proxies in the pre deposit insurance period.

Variable	Treated (MS, NB, SD)	Control (AL, CO, MN)
has_borr	0.209	0.263
borr_at (given *has_borr* > 0)	0.083	0.098
equi_at	0.217	0.201
capital_at	0.159	0.157

Table 12 presents the results for a diff-in-diff-in-diff using troubled banks in control states and non troubled banks in all states as controls. The coefficient of interest is the one on *tr_has_borr_pre*, which is a dummy variable equal to one for banks that have nonzero *borrowings* in treated states. The fact that this coefficient is positive and significant suggests that troubled banks experienced higher growth rates in total deposits (column 1) and total assets (column 3). Columns (2) and (4) show that these results are robust to controlling for bank's size in the pre insurance period.

In unreported results I also study if banks with a non zero value for *borrowings* are more likely to exit the sample between the pre and post insurance period, and I conclude that there are no differences between insured and uninsured states.

Next I explore how the capital structure in the pre insurance period affects growth rates. To the extent that depositors might have considered banks with higher leverage as riskier, one could expect that banks with high leverage in states that introduced deposit insurance experienced higher growth rates that similar banks in the control states. Table 11 reports that the average equity to

Table 12: Log growth in total deposits (Deps) and total assets (AT) as a function of bank's risk in the pre deposit insurance period. State banks only.

	Deps growth (1)	Deps growth (2)	AT growth (3)	AT growth (4)
tr_has_borr_pre	0.0223**	0.0231**	0.0142*	0.0139*
	(2.13)	(2.44)	(1.66)	(1.81)
log_total_assets_pre		-0.0507***		-0.0405***
		(-22.84)		(-22.84)
State f.e.	Yes	Yes	Yes	Yes
Year f.e. × has_borr	Yes	Yes	Yes	Yes
_cons	0.0632***	0.679***	0.0265***	0.518***
	(7.91)	(24.32)	(4.07)	(23.22)
[0.5em] N	2301	2301	2313	2313
R^2	0.371	0.487	0.417	0.524

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

total assets ratio in the pre insurance period is 21.7% and 20.1% for the treated and control states respectively. The last column of the table also shows that there are no significant differences in the ratio of capital paid in to total assets between treated and control states.

To allow for nonlinear effects in the study of how capital structure affects growth rates I divide the sample of banks in the pre insurance period in terciles based on the ratios of equity to total assets and capital to total assets. Then, I estimate the diff-in-diff and diff-in-diff-in-diff models discussed above, but adding an interaction term to compare the top tercile to the bottom tercile for each of the three capital structure ratios. Thus, the coefficient of interest in the regressions is the one on the triple interaction between state banks (vs. national banks) treated states (vs. control states) and lower tercile (vs. top tercile). These coefficients are presented for each of the capital structure variables in the first two rows of table 13. All coefficients are not significantly different than zero, both for growth in total deposits (columns 1 and 2), and total assets (columns 3 and 4). In unreported results I find that the same conclusion is reached when I only use state banks in a diff-in-diff regression.

In conclusion the results of table 13 suggest that there were no differences in the effects of deposit insurance on the growth rates of banks with a riskier capital structure. One interpretation of this result is that depositors did not see capital structure as an important source of bank risk and thus did not prefer lower leverage banks over higher leverage. Another option is that interest rates adjusted to offset the effects of higher risk related to capital structure. Given the lack of deposits' rates data for individual banks I cannot test this alternative explanation.

Table 13: Log growth in total deposits (Deps) and total assets (AT) as a function of bank's capital in the pre deposit insurance period. State and national banks.

	Deps growth (1)	Deps growth (2)	AT growth (3)	AT growth (4)
tr_statebank_low_equi_at_pre	-0.0317		-0.0137	
	(-1.29)		(-0.67)	
tr_statebank_low_capi_at_pre		-0.00278		0.00803
		(-0.12)		(0.43)
State f.e.	Yes	Yes	Yes	Yes
All interactions	Yes	Yes	Yes	Yes
_cons	0.274***	0.315***	0.112***	0.126**
	(6.69)	(6.91)	(3.28)	(3.36)
N	1973	1974	1985	1986
R^2	0.485	0.491	0.486	0.506

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.3 Rural counties

In this section I study if the effects of deposit insurance differed between rural and urban counties.[12] I use two variables to distinguish between county types: population density, and the ratio of rural population to total population. All variables are from the 1910 US Census. I compare the effects between the top and bottom quartile for each variable.[13] Specifically, I define *low_pop_dens* (*high_pop_rur*) as a dummy variable equal to one if the population density (share of rural population) is in the lowest (highest) quartile of the distribution for all counties in the states included in this study, and zero if it is in the highest.

Table 14 presents the results using the log growth in deposits and total assets as the dependent variables. The independent variables are the dummies for low population density and high rural population share, and all the appropriate interactions with dummy variables, to control for state, year and type of bank effects. The first four columns are for the regressions that only use state banks, and the final four columns are for the regressions that additionally include national banks. The coefficients on the first two lines are the ones on the interaction between the dummies for treated states and for population density and share of rural population. Thus the results in the first four columns imply that in states with deposit insurance, state banks in counties with low population density and high share of rural population experienced higher growth rates. The last four columns show that these results are almost unchanged after controlling for the growth rates of national banks in the same geographic area.

[12]The results presented in this and the following subsections are based on data for Colorado, Minnesota, Nebraska and South Dakota only.

[13]I cannot use terciles as in other analyses presented in this paper, because the 33th percentile of urban to total population for these for states is 100%, so I need to construct the dummies using the 25th percentile, which is lower than 100%.

In unreported results I find that if I interact the original population ratios with the treatment dummies the conclusions are qualitatively the same. Lower population density and higher rural share of population are associated with higher growth rates of deposits and total assets, but the results for total assets are not statistically significant at the conventional confidence levels.

Table 14: Log growth in total deposits and total assets as a function of total and rural county population density in the pre deposit insurance period. State and national banks. *Statebank* is a dummy equal to one for state banks.

	State Banks Only				State and National Banks			
	Deps growth (1)	Deps growth (2)	AT growth (3)	AT growth (4)	Deps growth (5)	Deps growth (6)	AT growth (7)	AT growth (8)
tr_low_pop_dens	0.119***		0.0855***					
	(3.64)		(6.52)					
tr_high_pop_rur		0.0234		0.0201**				
		(1.54)		(1.65)				
tr_statebank_ low_pop_dens					0.127		0.103**	
					(1.11)		(2.12)	
tr_statebank_ high_pop_rur						0.0257		0.0274*
						(1.35)		(1.92)
State f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Statebank	No	No	No	No	Yes	Yes	Yes	Yes
All interactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
_cons	0.124***	0.0721***	0.0896***	0.0672***	0.0205	0.0473***	0.00861	0.0438***
	(3.03)	(5.70)	(6.00)	(6.55)	(0.57)	(3.46)	(0.36)	(3.73)
N	886	1731	893	1740	1162	2286	1169	2295
R^2	0.355	0.381	0.361	0.395	0.394	0.415	0.404	0.435

t statistics in parentheses. Standard errors are clustered by county.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.4 Debt levels in pre insurance period

In this section I study how household debt levels in the form of mortgages in the pre insurance period influenced banks' response to deposit insurance. Using the 1910 census data, I compute the ratio of total homes with mortgage to the total number of homes (farm and non farm homes) in each county (*totmort_perc*). Then I construct a dummy variable *low_totmort_perc* which is equal to one for the lowest tercile of *totmort_perc* and zero for the top tercile.

Columns (1)-(5) of table 15 presents the results for the regressions using only state banks in treated and control states. The coefficient of interest in these columns is *tr_low_totmor_perc*, which is a dummy equal to one for banks in counties in the bottom tercile of mortgage levels in states that introduced deposit insurance. Columns (6)-(10) presents the results when national banks are also included in the regressions. The coefficient of interest in these columns is *tr_statebank_low_totmor_perc*, which is a dummy equal to one for state banks in counties in the bottom tercile of mortgage levels in states that introduced deposit insurance.

Columns (2) and (7) show that banks that received deposit insurance in counties with low mortgage levels, significantly increase their lending. Columns (3), (4), (8) and (9) indicate that in

order for these banks to increase their lending, they reduced their investment in financial assets as well as their cash and reserves in other banks. Finally columns (5) and (10) present some evidence that these banks also increased their leverage. One possible explanation for this result is that owners of farms used their homes as collateral to secure new loans to finance their growth related to the agricultural boom during these years. The presence of deposit insurance, might have incentivized banks to increase their lending to these farm owners beyond what uninsured banks were willing to do.

Table 15: Growth in deposits and balance sheet variables in counties with low vs. high levels of mortgaged homes in the preinsurance period. State Banks only (columns 1 to 5) and state vs. national banks (columns 6 to 10). *Statebank* is a dummy equal to one for state banks.

	State Banks Only					State and National Banks				
	(1) Deps. growth	(2) loans	(3) invest	(4) cash and due from banks banks	(5) equity	(6) Deps growth	(7) loans	(8) invest	(9) cash and due from banks	(10) equity
tr_low_totmor_perc	0.0168	0.0945***	-0.0292***	-0.0530***	-0.0355**					
	(0.80)	(4.38)	(-2.74)	(-3.21)	(-2.55)					
tr_statebank_						0.00097	0.0938**	0.0470	-0.135***	-0.0197
low_totmor_perc						(0.04)	(2.42)	(1.40)	(-5.24)	(-1.18)
State f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
statebank	No	No	No	No	Yes	Yes	Yes	Yes		
All interactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
_cons	0.0966***	0.145***	-0.0156	-0.136***	-0.0726***	0.0505***	0.00584	-0.00156	-0.0237	-0.0254
	(4.02)	(4.17)	(-1.29)	(-4.47)	(-3.58)	(4.30)	(0.11)	(-0.10)	(-0.67)	(-1.25)
N	1183	1191	1191	1191	1191	1572	1580	1580	1580	1580
R^2	0.351	0.197	0.262	0.121	0.102	0.399	0.210	0.229	0.124	0.140

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusion

This paper studies the effects of deposit insurance on bank growth, failures and risk taking. The introduction of deposit insurance in eight states for state chartered banks between 1908 and 1917 is taken as a quasi-natural experiment. Using aggregate data I find that banks with deposit insurance experienced higher growths rate in deposits than uninsured banks. However, I find no effects of deposit insurance on leverage, on the ratio of loans to total assets, or on failure rates. I also observe a substitution of demand for time deposits in insured banks. This effect suggests there was an increase in depositors confidence in insured banks, and they became willing to lend their money at longer maturities. Finally, limited evidence on interest rate changes, suggests that insured banks lowered the rate paid on deposits relative to uninsured banks.

Using hand collected micro level data, I further explore the effects on insured banks. I focus on three states that introduced mandatory participation for all state institutions (Nebraska, South Dakota, and Mississippi), to control for potential self selection bias in the states were participation was voluntary. I also collect data on three adjacent states, Colorado, Minnesota, and Alabama, to use as the control group. Micro data on bank balance sheets allows me to study which banks were more affected by the introduction of deposit insurance. The results show that relative to larger banks, smaller banks in states with deposit insurance became safer in terms of capital structure and reserves. In addition troubled banks benefited from the introduction of deposit insurance, by growing faster than troubled banks in the control states. Finally using data from the 1910 census, I find higher growth rates in banks located in lower population density counties, and greater increases in the ratio of loans to total assets in banks located in counties with low house mortgage debt in the pre insurance period.

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A Additional Tables

Table A.1: Parallel trend in pre insurance period test. Growth in total deposits (columns 1 and 2), yearly change in demand deposits over total assets (columns 3 and 4), yearly change in time deposits over total assets (columns 5 and 6), yearly change in loans over total assets (columns 7 and 8), and yearly change in equity over total assets (columns 9 and 10). Panel A: State banks only. Panel B: Difference between state and national banks. Period 1900-1920. Only states that introduced mandatory deposit insurance are included in the treated group. Odd (even) numbered columns use all (only adjacent) states as control group.

	Growth in tot deps.		Demand Deps. over TA		Time Deps. over TA		Loans over TA		Equity over TA	
	All	Adjac.	All	Adjac.	All	Adjac.	All	Adjac.	All	Adjac.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: State Banks										
insurance	0.0352***	0.0320**	0.00143	-0.00117	0.00101	0.00265	0.00323**	0.00223	-0.00234	-0.00291
	(2.75)	(2.33)	(0.56)	(-0.39)	(0.57)	(1.10)	(2.14)	(0.88)	(-1.23)	(-1.42)
_cons	0.153***	0.127***	0.0614***	0.0710***	-0.0155***	-0.0320***	0.0158***	0.0131***	-0.00357**	-0.00461
	(9.49)	(4.03)	(14.28)	(6.92)	(-3.07)	(-3.06)	(4.94)	(3.82)	(-2.42)	(-1.38)
year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	No	No	No	No	No	No	No	No	No	No
N	863	283	863	283	857	283	863	283	863	283
R^2	0.287	0.358	0.250	0.331	0.148	0.316	0.096	0.234	0.269	0.339
Panel B: Difference State-National Banks										
insurance	-0.0201	-0.0201	0.00153	0.000472	-0.000791	-0.00135	0.00327*	0.00262	0.0000175	0.000774
	(-1.05)	(-0.97)	(0.75)	(0.20)	(-0.30)	(-0.42)	(1.83)	(1.07)	(0.01)	(0.28)
_cons	0.0562***	0.0354	-0.0130***	-0.0119*	-0.0148***	-0.0254**	-0.00194	0.00181	-0.00223	-0.00126
	(3.49)	(1.25)	(-3.43)	(-1.80)	(-2.78)	(-2.85)	(-0.50)	(0.40)	(-1.40)	(-0.43)
year f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state f.e.	No	No	No	No	No	No	No	No	No	No
N	863	283	863	283	857	283	863	283	863	283
R^2	0.050	0.137	0.032	0.168	0.119	0.257	0.121	0.297	0.059	0.127

t statistics in parentheses. Standard errors clustered by state.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$