Moral Hazard and Texas Banking in the 1920s

Linda M. Hooks
Assistant Professor
Washington and Lee University

and

Kenneth J. Robinson*
Senior Economist and Policy Advisor
Federal Reserve Bank of Dallas

*The views expressed are those of the authors' and should not be attributed to the Federal Reserve Bank of Dallas or the Federal Reserve System. Hooks acknowledges support from a Glenn Grant from Washington and Lee University

MORAL HAZARD AND TEXAS BANKING IN THE 1920s

Abstract

Using recently collected examination data from a sample of Texas state-chartered banks over the period 1919-1926, the role of moral hazard in increasing ex-ante asset risk is analyzed. During this period, a state-run deposit insurance system was in place that was mandatory for all state-chartered banks in Texas. Nationally chartered banks were not allowed to participate in the insurance program. Analyzing individual bank-level data, we find evidence that declines in capitalization were positively correlated with increases in loan concentrations at insured banks. We argue that this is consistent with a moral-hazard effect at work. No such relationship is found between capitalization and risk at uninsured banks.

I. Introduction

Interest in the impact of deposit insurance on bank activities revived during the banking difficulties of the 1980s. A number of analysts argued that insured banks are subject to moral hazard. Under an imprecisely-priced deposit insurance program, banks face an economic incentive to pursue additional risks than they would otherwise undertake in the absence of deposit guarantees. Thus, it is argued that one source of the financial difficulties of the 1980s was the existence of federal deposit insurance at banks and thrifts.

That deposit insurance may affect a bank's investment decisions has long been of concern to observers of banking. Opponents of government-sponsored deposit insurance in the early 1900s noted that insurance might serve as a subsidy from conservatively run banks to more aggressive banks. Despite these concerns, a number of states in the early 1900s adopted deposit insurance systems. In Texas, the state legislature of 1909 passed what was known as the Meachum-Greer bill (or Senate Bill Number 4), which established a deposit insurance program for all state-chartered banks.

Using data collected from bank examination reports from the 1920s, the experience of Texas banks under the state deposit insurance program is investigated in an effort to explore the role of insurance coverage in affecting the risk profile of banks. The Texas experience is especially interesting because the insurance program was mandatory for state banks, but national banks were not allowed to join. As such, nationally chartered banks can serve as a control group in the empirical tests of whether deposit insurance encourages banks to pursue more risky activities. To our knowledge, this is the first paper to examine the moral-hazard issue using individual bank data for a state insurance program in which participation was mandatory. Because we use newly-collected examination data on Texas banks beginning in 1919, we are able

to provide a new data source for testing the view that deposit insurance has a significant impact on banks' investment decisions.

We find evidence consistent with moral-hazard incentives at work. Specifically, state-chartered banks, which were covered by the state's deposit insurance system, pursued more risky activities following declines in their capital positions. We do not find such a relationship between capital and asset risk for uninsured national banks.

The paper proceeds as follows. Section II reviews the literature on moral hazard, followed by a description of Texas banking in the early part of the century in Section III. Section IV describes the deposit insurance programs implemented by the state of Texas, followed by a review of the new data on Texas banks in Section V. The empirical model is presented in Section VI, followed by a discussion of the results in Section VII and our conclusions in Section VIII.

II. Previous Evidence on Deposit Insurance and Moral Hazard

The idea that deposit insurance affects a bank's incentives is well established in economic theory. As Kareken and Wallace (1978) point out, a bank facing a fixed-rate deposit insurance system has an incentive to take additional risks, an example of the moral-hazard problem. Merton (1977) shows that by guaranteeing deposits, the insurer effectively has issued a put option on the assets of insured institutions. Deposit insurance gives the owners of an insured bank the right to sell the firm's assets to the insurer for the face value of deposits upon their effective maturity date, or the date of the next regulatory examination. The well-known comparative static properties of the standard options-pricing model highlight the perverse incentives inherent in fixed-rate deposit insurance systems -- the value of bank equity is maximized by increasing both leverage and asset

risk (Smith, 1976 and Marcus, 1984). Moreover, the gains to increasing asset risk rise as a bank approaches insolvency.

Declines in capital then enhance the value of the put option inherent in deposit insurance and provide incentives for extra risk-taking. Kane (1989) identifies the "zombie" problem in which a financial institution with low capital has additional incentives to take on risk. As shown in Buser, Chen, and Kane (1981), and Marcus (1984), however, bank charter value can mitigate the risk-taking incentives of deposit insurance. If charter value is sufficiently large, value maximization can dictate protection of the charter, and in this case, increases in leverage and asset risk would reduce rather than enhance shareholder wealth.

Although moral hazard is well defined theoretically, only a few studies have attempted to estimate empirically the importance of this effect. Barth and Bradley (1989) find that the behavior of insolvent thrifts differed in some ways from their solvent counterparts. Beginning in 1982, mortgage assets, as a percent of total assets, declined at both solvent and insolvent institutions, but the decline was more pronounced at insolvent thrifts. Within the mortgage category itself, however, insolvent institutions rapidly increased their commercial mortgage lending relative to solvent thrifts, an area of lending generally associated with greater risk. Overall though, Barth and Bradley find little evidence that thrifts took significant advantage of new powers granted them in the early 1980s.

Keeley (1990) offers empirical support to the view that increased competition and the concomitant decline in charter values exacerbated the moral-hazard problem among commercial banks. Gunther and Robinson (1991) find evidence of moral hazard in Texas banks during the 1980s. Brewer and Mondschean (1994) look at the extent to which underpriced deposit

insurance has distorted the risk/return tradeoff for thrift shareholders. They find evidence that the stock prices of thrifts with a high risk of failure reacted favorably to shifts from traditional mortgage lending toward more volatile loans and investments, such as junk bonds.

While these studies generally find evidence consistent with moral-hazard incentives at work, it is not possible to know what choices banks would have made if they were not covered by deposit insurance. This issue arises in almost any study of present-day banking because almost all banks are covered by FDIC insurance. Thus, there is generally no control group without deposit insurance which could be used to distinguish the effects of deposit insurance from other influences on banks' decision-making.

To overcome this control problem, a number of studies have relied on historical data on banking when investigating moral hazard. Individual states experimented with deposit insurance many years before the federal government adopted it, and the experience of banks in these states provides insights into the effects of deposit insurance. Wheelock (1992), Wheelock and Kumbhakar (1995), and Wheelock and Wilson (1995), examine individual banks in Kansas that participated in a state deposit insurance program in the 1920s, on a voluntary basis. These studies provide evidence that those banks which chose insurance coverage took additional risks.

Using data aggregated at the state level, Calomiris (1990a, 1990b) finds that deposit insurance in the early 1900s increased incentives for bank risk taking, with the effect being stronger for states with mandatory insurance than for states with voluntary insurance. Looking at individual U.S. thrifts, Grossman (1992) determines that a thrift in the 1930s, when first admitted to the voluntary federal insurance program, did not take more risks than an uninsured thrift. But, after several years, risk did increase. In sum, these studies suggest that, based on individual bank

and thrift data, moral-hazard incentives exist for voluntary insurance programs, and based on aggregated data, similar incentives exist for mandatory programs as well.[1]

To our knowledge, this paper is the first to use individual bank level data to examine an insurance program which was mandatory. Because Calomiris concludes from state-level data that mandatory deposit insurance enhanced the moral-hazard problem, the evidence for moral hazard should be stronger with the individual Texas bank data than for a state with a voluntary program. This paper builds on previous work estimating moral-hazard effects by incorporating proxies for ex-ante measures of risk. In particular, we are able to make use of two measures of loan concentration that have not been available in previous studies -- the proportion of loans secured by agriculture and the proportion secured by real estate. Finally, this paper provides additional evidence on moral hazard by examining individual bank behavior from a sample of nationally chartered banks that were ineligible to participate in the state's insurance system. The availability of these data, along with the structure of the Texas banking system in the early part of the century, offer a unique opportunity to examine whether the existence of deposit insurance heightened asset risk.

III. A Brief History of Texas Banking

Texas' attitude towards banking was one of ambivalence, if not outright hostility. At the state's constitutional convention, held in 1845, the following clause was adopted: "No corporate body shall hereafter be created, renewed, or extended, with banking or discounting privileges" (Grant and Crum, 1978, p. 15). Although nationally-chartered and private banks existed in Texas

[1] On a related issue, White (1981) finds that states with unit banking were more likely to choose deposit insurance.

in the 1800s, the Texas legislature passed the Texas State Bank Law authorizing state-chartered banks only in 1905.[2] A boom in state-chartered banking followed, and by 1910, there were a total of 584 state banks in Texas. Chart 1 shows that state banks quickly outgrew private banks in terms of asset holdings. However, nationally-chartered banks held the majority of the state's banking assets.

In part, the rapid increase in the number of state banks was the result of relatively modest requirements for establishing a state bank compared to a national bank. Obtaining a state charter required that the owners file an application with the Department of Insurance and Banking, but did not require further investigation by the state before the charter was granted. However, in 1913, the state legislature amended the law to require the state Commissioner of Banking and Insurance to investigate potential bank owners and the local market before approving a charter, thus effectively increasing the difficulty of obtaining a state charter.

The 1905 law also established a capital requirement for state-chartered banks which was lower than the capital requirement for nationally-chartered banks.[3] As a result, the cost of opening a bank fell, and small towns that previously had few or no banks saw an increase in the number of state-chartered banks. In 1913, the Federal Reserve Act required each state bank that

---

[2] Grant and Crum (1978) provides a more complete history of the state-chartered banking industry in Texas, and this section draws upon it. For a comparison of state banks to national banks in Texas, see Shirley and Nichols (1931).

[3] For state banks, the minimum capital needed ranged from $10,000 to $100,000, depending on the population of the city. For national banks, the requirement ranged from $25,000 to $200,000, again depending on population. In only one population category did the state requirement equal the national requirement; elsewhere, the state requirement was lower than the national bank requirement. See White (1983) for a summary of capital requirements by state.

became a member of the Federal Reserve System to meet the capital requirements for a national bank, thus eradicating this advantage of a state charter for Federal Reserve member banks.

A state bank did have some flexibility in lending that a national bank did not have. A state bank could lend using real estate as collateral, as long as the bank did not lend more than 50 percent of its capital or more than 50 percent of the market value of the collateral. A national bank could lend on real estate only up to an amount equal to 25 percent of its capital. Also, while a national bank could lend only up to 10 percent of its capital to a single borrower, a state bank could lend up to 25 percent of its capital to a single borrower.

Although the 1905 law encouraged the opening of new state banks, it also imposed a number of restrictions. One major regulation imposed was that shareholders of state banks faced double liability on their shares. Further, the law limited geographic expansion of a bank by allowing only "unit banking," which prohibited both state and national banks from establishing branches. Several years later, state-chartered banks were also required to join the newly created deposit insurance system.

IV. The Texas Deposit Insurance Program

Concerns about bank stability following the panic of 1907 led, in 1909, to the creation of a bank deposit insurance program organized by the Texas state government. The Depositors Guaranty Law mandated participation in the insurance program for all state-chartered banks in Texas. It also allowed national banks to participate on a voluntary basis. However, the Comptroller of the Currency had ruled in 1908 that national banks could not participate in state deposit insurance programs, so national banks in Texas did not join the state system. The

insurance program became effective on January 1, 1910, and officially operated until February 11, 1927, although it experienced difficulties before 1927.[4]

In the Depositors Guaranty Fund, a state bank paid an insurance premium into an insurance fund. The initial assessment for a member of the Guaranty Fund equaled one percent of the previous year's average demand deposits. In the following years, the annual insurance assessment was to be one-fourth of one percent of average demand deposits, or up to two percent in an emergency. A bank's assessment did not depend on the riskiness of its investments. The Guaranty Fund protected only non-interest-bearing deposits, but the amount of protection for these deposits was unlimited.

A state bank could also obtain insurance through a program known as the Bond Security System, in which a bank filed annually with the state a bond equal to the amount of its capital. The number of banks which chose this alternative was small, peaking in 1914 at 62 banks, or seven percent of all state banks (Grant and Crum, 1978).[5] The proportion of banks in this alternative program remained small because a bank was not allowed to switch from one insurance program to the other until fairly late in the time period during which the Depositors Guaranty Fund operated.

As noted above, all state-chartered banks were required to participate in the insurance program, while no nationally-chartered banks were permitted to join. State bankers actually considered deposit insurance to be one of the main advantages of a state charter (Weaver, 1926).

---

[4]Robb (1921), Shibley (1914), and the FDIC *Annual Report* (1956) provide a comparison of the Texas law to other contemporary laws. Shibley includes a copy of the Texas law in an appendix.

[5] None of the banks in our sample chose this form of deposit insurance.

Although few state banks wished to avoid the insurance program, a bank could do so if it was willing to convert to a national charter. In the first year of the program's existence, no state banks chose this option, and very few did so through the mid-1920s. This is likely the result of several factors, mainly the perceived advantages to marketing a bank as insured, and the relatively small cost of participating in the insurance program, which averaged only $50 annually in the 1910s (Weaver, 1926). Another important factor was that state law made charter conversion quite costly. According to the law, a state bank could convert to a national charter only if it liquidated completely and re-opened under a new national charter. In 1923, the legislature changed the law to allow a state bank to convert to a national charter without a complete liquidation. The number of conversions rose after this change, as noted below, but did not constitute a large portion of banks in any of the remaining years of the Depositors Guaranty Fund.

The Depositors Guaranty Law also mandated a relationship between bank size, in terms of deposits, and bank capital. In effect, the law established a capital-to-deposit ratio requirement, somewhat like current U.S. capital-to-asset requirements. A bank with $10,000 of capital initially could acquire deposits equal to no more than five times its capital plus surplus. The law allowed progressively higher multiples of deposits relative to capital plus surplus, up to a maximum of ten times capital plus surplus for a bank with capital greater than $100,000.

The early years of the Depositors Guaranty Fund were uneventful. The 1910s were relatively stable years for banks, and thus for the insurance program.[6] However, a downturn in

[6] Prior to the 1920s, the failure rate of Texas state and national banks remained below one percent.

economic activity in the early 1920s precipitated fairly widespread financial difficulties. Table 1 shows bank liquidations in Texas from 1919 through 1926. This time period coincides with the availability of our examination data and with the operations of the Depositors Guaranty Fund. The liquidation rate began to increase fairly steadily for state-chartered banks in the early 1920s before leveling off a bit. However, liquidations then jumped to almost 17 percent in 1925. Except for 1921, the liquidation rate of Texas national banks was below their state-chartered counterparts, sometimes by a fairly substantial margin. These differences in liquidation rates could reflect the impact of moral-hazard incentives at work at state-chartered banks.

The emerging banking difficulties of the 1920s began to strain the resources of the Depositors Guaranty Fund. Insurance assessments began to rise to meet increased demands on the insurance fund associated with the costs of covering insured deposits in failed banks. The Depositors Guaranty Fund began to charge special assessments on banks, over and above its regular assessments. These special assessments were imposed on banks in order to replenish the Depositors Guaranty Fund to its mandated $2 million. Table 2 shows that total assessments for all state banks climbed from less than one-tenth of one percent of total assets in 1919, to a peak of 1.68 percent of total assets in 1921. For the state banks in our sample, their assessment burden was initially less than the entire population of state banks until 1922. Insurance assessments peaked for our sample of state-chartered banks at 2.09 percent of assets in 1925.

As the cost of membership rose, some state banks decided to leave the program by converting their state charters to national charters, especially after 1923, when new state laws made conversion less costly than before. Thus began the erosion of the insurance program.

Grant and Crum (1978, p. 49) report only a few conversions in 1924, and 80 conversions, or about ten percent of total state banks, in 1925.

The deposit insurance system deteriorated further in 1926, after the state legislature amended the law to allow a bank to move between the Depositors Guaranty Fund and the Bond Security System, discussed above. A mass exodus to the Bond Security System followed. This, of course, left the Depositors Guaranty Fund in an even more precarious situation, as it had fewer banks on which to levy assessments. A bank failure in September 1926 ultimately pushed the Depositors Guaranty Fund into insolvency. As a result, the state legislature repealed the Depositors Guaranty Law in February 1927, effectively ending Texas' experiment with deposit insurance.[7]

Despite its ultimate demise, the existence of a deposit insurance program for state-chartered banks gives rise to the possibility that moral-hazard incentives contributed to the banking difficulties experienced in Texas during the 1920s. The recent collection of examination reports for a number of state-chartered banks in Texas over the period during which the Depositors Guaranty Fund was in operation provides us with an opportunity to add to the existing empirical literature on the role of moral hazard in increasing banks' risk.

V. New Data on Texas Banks 1919-1926

The empirical work uses newly collected data from Federal Reserve Bank of Dallas *Examiner's Report of Condition.* Along with basic balance sheet information, these examiners'

---

[7] Over the period 1908-1917, seven other states -- Oklahoma, Nebraska, Minnesota, North Dakota, South Dakota, Kansas, and Washington -- also implemented various types of deposit insurance systems, all of which suffered the same fate as the Texas system. See American Bankers Association (1933), Calomiris (1989), and Wheelock (1992).

reports include annual data on a bank's loan portfolio categorized by type of collateral used. A random sample of 89 banks out of approximately 200 available banks comprises our data set.[8] These data represent an unbalanced panel data set because not all banks appear in each year. As Table 3 shows, the sample observations per year capture one-quarter to almost one-half of all state member banks examined by the Federal Reserve in that year, with the sample banks' assets equal to between 10 and 20 percent of total state member bank assets by year.

While these new data provide an interesting data base for a period in which little information on individual banks is available, they do have a number of limitations. First, the examinations were not regularly scheduled at the same time each year, so the time interval between panel observations is not constant. Second, the available archival records indicate that some examination reports have been destroyed, so the sample chosen from existing reports is not a sample drawn from the original population. We are also not able to determine which, if any, of these banks failed. In fact, we have been unable to determine why these examination records even survived. Thus, it is important to acknowledge that these factors might drive some of the empirical results reported.

To complement the data on state-chartered banking, and to provide a control group, data were also collected from basic balance sheet information on nationally chartered banks in Texas. These banks were not covered under any deposit insurance system and would not be expected to exhibit any moral-hazard effects. This data set uses balance sheet information drawn from reports of condition from a random sample of 50 out of approximately 500 nationally chartered Texas

[8] A random sample was necessitated due to the resource constraints encountered in collecting, tabulating, and entering the data from the examination records.

banks that were in existence in 1919.[9] The reporting dates of the national bank reports are the same in a given year for each bank, but at times differ slightly across years. As Table 4 shows, the national bank sample by year equals between 6 and 9 percent of the total number of national banks in Texas with between 10 and 22 percent of total national bank assets in the state.

Finally, Table 5 compares summary statistics for our sample of state and national banks to the population of state and national banks in Texas over the period 1919-1926, when the insurance program was in operation. The typical state-chartered bank in the sample recorded a capital-to-asset ratio of 19 percent, with over 60 percent of its assets in loans. These figures are slightly below those for the average of all state banks in Texas. The size of the average state bank in our sample equals almost $500,000 in total assets, slightly larger than the average of all state banks in Texas. On average, the national banks in our sample were better capitalized than all Texas national banks, but were less-well-capitalized compared to state banks. The loan-to-asset ratio for our sample of national banks is identical to the Texas national bank population, and slightly below the comparable numbers for state banks. The average national bank in our sample recorded total assets equal to $2.5 million, and is thus significantly larger than the average state bank, and larger than the average size of all Texas national banks. From these comparisons, the sample observations used in our empirical estimations of moral-hazard effects appear to be reasonable representations of the populations from which they were drawn.

---

[9] These data are published in *Annual Report* of the Comptroller of the Currency from 1919-1926.

VI. The Empirical Model

Subjecting the theory of moral hazard to empirical testing is far from straightforward. Perhaps the biggest difficulty is quantifying shifts in banks' ex-ante risk-taking. While rapid asset growth is sometimes associated with higher risk, the structure of a bank's assets, measured by loan concentrations, can be a good proxy for risk. Historically, the loan-to-asset ratio has tended to move procyclically. Banks are more willing to extend credit during an upswing in economic activity and retrench their lending during downturns. A higher proportion of loans leaves a bank more exposed to credit risk and more vulnerable to an adverse economic shock. Using other measures of risk, such as the troubled asset ratio or the proportion of nonperforming loans in banks' portfolios, would seem less desirable. These are ex-post measures of risk that could reflect factors other than managerial choice, such as a downturn in economic activity. Moreover, if some banks chose to pursue more risky activities as capital declined, and these ventures proved successful, then they would not be captured by ex-post measures of risk.

To estimate whether moral-hazard incentives were present, we test whether asset risk, as proxied by various loan concentrations, is related to prior capitalization levels among a sample of insured Texas banks operating during the 1920s. Consistent with the theoretical models of Merton (1977), Marcus (1984), and Keeley (1990), we hypothesize that those banks with declines in capital would be the ones most prone to exploit a deposit insurance subsidy and take on added risk. The concentration of assets in loans and the concentration of loans in selected categories serve as our proxies for ex-ante asset risk. If declines in the capital position of banks are associated with subsequent increases in loan concentration, then this would provide evidence consistent with a moral-hazard effect at work.

Chart 2 shows the distribution of average total loans over the time period 1919-1926 for our sample of state and national banks.[10] While some state and national banks recorded fairly large loan concentrations, the state-chartered (insured) banks consistently exhibited larger loan to asset ratios. As stated above, a unique aspect of our data on state-chartered banks is the availability of loan concentrations based on the type of collateral used to secure the loan. Higher proportions of particular loan categories might be superior measures of ex-ante risk if they reflect a reluctance to diversify asset portfolios. This risk could presumably be reduced by altering portfolio compositions toward, say, greater holdings of government securities. Chart 3 shows the distribution of the average amount of both agricultural loans and loans secured by real estate for Texas state banks. Agricultural loans were much more important than real estate loans, and some of the banks in our sample exhibited, on average, fairly large loan exposures to this particular type of credit.[11]

But, while loan exposure was high at some of these banks, the moral-hazard effect would suggest that these loan concentrations might be negatively related to financial strength, as measured by capital. In an effort to determine if loan concentrations were negatively related to prior financial strength, we estimate the following model[12]:

---

[10] While bank examination data are available through the early 1930s, we confine our empirical analysis to the time period 1919-1926 to coincide with the operation of the Depositors Guarantee Fund.

[11] Comparable data on loan concentration categories are not available for national banks. Some state-chartered banks also reported loans secured by stocks and bonds, but these loans represented relatively small components of total loans for these banks.

[12] See the appendix for a complete description of the variables used.

$$LOANASS_{i,t} = \beta_0 + \beta_1 * CAPASS_{i,t-1} + \beta_2 * LOANASS_{i,t-1} + \beta_3 * SIZE_{i,t} + \beta_4 * ECONOMY_t + \epsilon_{i,t}, \quad (1)$$

where $LOANASS_{i,t}$ is the loan to asset ratio for bank i at time t, and $CAPASS_{i,t-1}$ is the (lagged) capital to asset ratio for bank i. If a moral-hazard effect is related to prior capitalization levels, then the expected sign on β_1 is negative. The lagged loan concentration term is included to allow for a partial-adjustment process in lending activity. $SIZE_{i,t}$ is the log of a bank's assets, and is intended to control for bank size, which might be important given that the uninsured banks were larger institutions. To control for changes in economic activity, we use $ECONOMY_t$, which represents a vector of annual dummy variables, while $\epsilon_{i,t}$ is an error term.[13] Our data allow us to use several definitions for the dependent variable, including total loans (LOANASS), agricultural loans (AGLOANS), and loans secured by real estate (RELOANS). Before estimating the empirical model, we first offer some evidence on the efficacy of these proxies for ex-ante risk.

[13] We also try three explicit measures of economic activity in the regressions. First, we used annual cotton production quantities, in bales, by county. Cotton was the major crop in Texas during the sample period. According to *The Texas Almanac* (1931), Texas led the U.S. in cotton production each year in the sample, producing on average about one-third of the total U.S. crop. The annual value of the cotton crop in Texas during this period ranged between 44 and 63 percent of the value of all Texas crops, and approximately half of all Texas land devoted to crops was planted in cotton. Second, we used the annual number of building permits issued in five regions of the state, and then the dollar value of permits issued. These measures were intended to capture some of the non-agricultural activity which cotton production misses. Cotton data were obtained from *The Texas Almanac* (1933), and data on permits and their value were obtained from various issues of the Federal Reserve Bank of Dallas' *Monthly Review of Business and Industrial Conditions*, 1920-1927. However, these variables were not statistically significant in any of the models estimated.

VII. The Results

VII. A. Loan Concentrations as Measures of Ex-Ante Risk

To be desirable proxies for ex-ante bank risk, loan concentrations should be positively related to the likelihood of failure. As stated above, however, we are unable to determine which, if any, of these banks failed. Instead, we examine the statistical significance of a bank's loan concentrations in explaining its subsequent troubled asset ratio (TROUBLED) by estimating the following equation:

$$TROUBLED_{i,t} = \alpha_{0+} \alpha_1 * LOANASS_{i,t-1} + \alpha_2 * SIZE_{i,t} * \alpha_3 * ECONOMY_t + \zeta_{i,t.} \quad (2)$$

If prior loan concentrations are statistically significant in explaining troubled assets, after accounting for size and economic activity, then this would support using loan concentrations as measures of ex-ante risk. The results from estimating equation (2) using the different measures of loan concentrations are found in Table 6. The coefficients on past values of LOANASS, AGLOANS, and RELOANS are all positive and statistically significant. To the extent that those banks with higher proportions of troubled assets are more likely to fail, these results indicate that measures of loan concentration might be useful proxies for ex-ante risk.[14]

VII. B. Risk at Insured Banks

In an effort to detect if moral-hazard incentives increased banks' ex-ante risk, the empirical model given by equation (1) is estimated, with the results in Table 7. For our sample of

---

[14] The coefficients on the annual dummy variables are not shown, but they were jointly significant. In addition, because the data on state bank examinations are for different times during the year, and because agricultural loans are such an important component of the state banks' asset structure (see Chart 3), the models are also estimated using quarterly dummy variables in an attempt to capture the seasonal nature of agricultural lending activity. These quarterly dummy variables, while not shown, were also statistically significant in all of the models estimated.

Texas state-chartered banks, the model is estimated using first total loans as the dependent variable, and then using agricultural loans and real estate loans, all expressed as a percent of assets.[15] The results in the second column of Table 5 use total loans as a percent of assets as the dependent variable and provide evidence consistent with a moral-hazard effect at work.[16] The coefficient on the capitalization variable is negative and significant, indicating that prior declines in capitalization give rise to greater asset risk, as measured by loan concentration. The coefficient on the lagged dependent variable and on bank size are also statistically significant.

The third column of Table 7 uses the ratio of agricultural loans to assets as the dependent variable. Again, results consistent with a moral-hazard effect are indicated by the negative and significant (at the ten-percent level) coefficient on the capitalization term. Finally, the results from using real estate loans are shown in the fourth column of Table 7. Here, the model does poorly. Only the lagged dependent variable is statistically significant. The poor results from using the concentration of real estate loans could reflect the relatively unimportant role real estate lending played for our sample of state-chartered banks, as revealed in Chart 3.

---

[15] Two possible sources of endogeneity in this model are choice of charter and bank capital levels. As noted in Section IV, state banks converted to national charters very infrequently during our sample period because it was very costly. Therefore, selectivity bias would appear to be small. For capital, the model attempts to control for endogeneity by using the previous period's capital level. Such a predetermined variable would not be expected to show endogeneity. Thus, we believe endogeneity is unlikely in our model.

[16] Again, annual dummy variables are used to account for economic activity and quarterly dummy variables to account for the seasonal nature of agricultural lending. While not shown, these dummy variables are statistically significant in all of the models estimated.

Overall, the results from these estimations provide some evidence that declines in capitalization led to increases in asset risk, as measured by loan concentrations.[17] Such activity on the part of insured banks would indicate that banks with weakened financial conditions increased the riskiness of their asset portfolios, which would be consistent with a moral-hazard effect at work.[18]

VII. C. Risk at Uninsured Banks

To provide further evidence on the role of moral hazard in increasing risk, we also estimated the empirical model using balance sheet data for nationally chartered banks in Texas over the same time period. These banks were not allowed to join the state insurance program, and thus their deposits were not covered by any guarantees. As such, these banks offer a control

---

[17] To judge the robustness of the results, several alternate specifications were also estimated. First, the examination reports for the state-chartered banks indicate that, for some of the banks, the exams took place during different time periods over the years. To judge what effect this unequal spacing of observations might have on the results, for each bank we created a variable called MONTHS, which measures the number of months between examinations. We then interacted MONTHS with the lagged variables in our model, $CAPASS_{t-1}$ and $LOANASS_{t-1}$, in an attempt to judge whether these estimates are affected by irregular exam dates. These interaction terms were statistically insignificant, providing some evidence that the irregular nature of the exam data did not affect our results. We also used MONTHS interacted with the lagged loan concentrations when estimating equation (1). Again, these interaction terms were not statistically significant.

[18] We also estimated the model with an interaction term defined as $CAPASS_{t-1}$*$LOANASS_{t-1}$, which is intended to capture the possibility of both liquidity and regulatory influences on bank lending activity. These factors might be expected to mitigate the effect of changes in capitalization on lending activity. Those banks that already have a high amount of loan exposure might only be able to increase lending further only when capitalization increases due either to liquidity constraints or regulatory actions. The expected sign on the coefficient of this interaction term is thus positive. However, in the models estimated, this interaction term was statistically insignificant. We also estimated the various models using only those banks with five or more examination records to judge whether the frequency of examinations might affect the results. The same qualitative results found in Table 7 were obtained when limiting the sample to those banks with five or more examination records.

group with which to investigate the moral-hazard problem.[19] Because this group of banks operated in some of the same market areas and over the same time periods as the state-chartered banks, the effects of economic activity should be similar between the two groups of banks.[20] In the absence of a moral-hazard effect, we expect the coefficient on the capitalization variable to be either insignificant or positive. The results from estimating the empirical model for national banks are shown in the last column of Table 7. For this group of banks, we only have data on total loans. The capitalization variable is statistically insignificant, indicating that for this group of banks, ex-ante risk was not correlated with financial strength. Moreover, testing for differences in the coefficients in the model for uninsured national banks versus the comparable model for the insured state banks indicates that the coefficients on the capital term are statistically different from each other across the two models, as are the coeffficients on the lagged dependent variable and bank size. However, the coefficients on the annual dummy variables were not statistically different between these models, indicating that economic activity affected both groups of banks in

[19] Moreover, because the state insurance program was mandatory, and switching charters was relatively expensive, the adverse selection problem discussed in Wheelock (1992) and Grossman (1992) should not be very important.

[20] The state banks in our sample operated in 53 different counties across Texas. The national banks in our sample also operated in about one-fourth of these counties. National banks tended to operate in larger counties. Using data from the 1920 census, the average market size (judged by county population) was 38,009 for national banks and 25,530 for state banks. The median values were 25,456 and 18,080, respectively. Therefore, in an attempt to control for possible differences in market areas due to location, we also estimated equation (1) using both the cotton and permits variables discussed in note 13 above. These measures are intended to capture differences between urban and rural areas. However, neither of these variables was statistically significant, indicating that the differences in market areas between state and national banks were not too large.

a similar manner.[21] These results provide some evidence that for uninsured banks, moral hazard was not present.[22] When combined with the results using data for state-chartered banks, it appears that declines in financial condition gave rise to heightened asset risk. Such a response is consistent with moral-hazard incentives at work.

VIII. Conclusions

It has been well established theoretically that a fixed-rate deposit insurance system can provide banks with moral-hazard incentives to increase risk. Empirical verification of this potential for increases in risk at insured institutions has been difficult to obtain, however. In this paper, we use data on both insured and uninsured banks in Texas during the 1920s in an attempt to estimate whether a deterioration in financial condition at insured banks led to greater asset risk. Using different measures of loan concentration as our proxy for ex-ante risk, we find some evidence that a moral-hazard effect was at work for banks covered by a deposit insurance system. However, using data from a sample of banks operating in the same general area and same time period that were not covered by deposit guarantees, no significant relationship is indicated between loan concentrations and capitalization.

---

[21] In testing the differences in the coefficients on $CAPASS_{t-1}$ across the equations for national and state banks, the value of the t-statistic is 4.6. For differences between the coefficients on $LOANASS_{t-1}$ the t-statistic is 3.9, and on $SIZE_t$, the t-statistic is 5.2.

[22] One potential shortcoming of using loan concentration as a measure of ex-ante risk is the possibility that banks, when facing financial difficulties, could elect to sell off some of their security holdings. In such a scenario, banks would see an increase in their loan to asset ratio following a decline in their capitalization, but this would be unrelated to increases in risk. To investigate this possibility, we regressed banks' securities holdings (as a percent of assets) on their lagged capital to asset ratio (as well as size and the dummy variables). No statistically significant relationship was found between banks' holdings of securities and prior levels of capitalization, indicating that this type of asset restructuring was not behind the empirical results.

Appendix

Description of Variables

Variable	Description
AGLOANS	Loans secured by agricultural products, live stock, or merchandise, warehouse receipts, etc... as a percent of ASSETS.
ASSETS	Total Resources (including notes and bills rediscounted with Federal Reserve Banks).
CAPASS	Capital stock paid in, plus surplus fund, plus all other undivided profit, as a percent of ASSETS.
ECONOMY	A vector of annual dummy variables.
LOANASS	LOANS as a percent of ASSETS.
LOANS	Total loans and discounts.
RELOANS	Loans secured by real estate collateral, including mortgages and stocks and bonds issued by real estate corporations or based upon real estate securities, as a percent of ASSETS.
SIZE	Log of ASSETS.
TROUBLED	The sum of past due (six months or more) loans and notes, plus OREO, expressed as a percent of ASSETS.

Data Sources: *Examiner's Report of Condition*, Federal Reserve Bank of Dallas, 1919-1926.
Annual Report, U.S. Comptroller of the Currency, 1919-1927.

References

American Bankers Association (1933), *The Guarantee of Bank Deposits*.

Barth, James R. and Michael G. Bradley (1989), "Thrift Deregulation and Federal Deposit Insurance, " *Journal of Financial Services Research* 2 (September): 231-259.

Board of Governors of the Federal Reserve System (1959), *All-Bank Statistics, United States 1896-1955*, Washington, D.C.: Board of Governors of the Federal Reserve System.

Brewer, Elijah III and Thomas H. Mondschean (1994), "An Empirical Test of the Incentive Effects of Deposit Insurance: The Case of Junk Bonds at Savings and Loan Associations," *Journal of Money, Credit, and Banking* 26, No. 1 (February): 146-164.

Buser, Stephen A., Andrew H. Chen, and Edward J. Kane (1981), "Federal Deposit Insurance, Regulatory Policy, and Optimal Bank Capital," *The Journal of Finance* 35 (March): 51-60.

Calomiris, Charles W. (1989), "Deposit Insurance: Lessons from the Record," *Economic Perspectives*, Federal Reserve Bank of Chicago 13 (May/June): 10-30.

Calomiris, Charles W. (1990a), "Is Deposit Insurance Necessary? A Historical Perspective," *The Journal of Economic History* 50, No. 2, (June): 283-295.

Calomiris, Charles W., (1990b), "Do Vulnerable Economies Need Deposit Insurance? Lessons from the U.S. Agricultural Boom and Bust of the 1920s," in Philip Brock, ed., *If Texas Were Chile: Financial Risk and Regulation in Commodity-Exporting Economies*, (Washington, DC).

Comptroller of the Currency, (1919-27), *Annual Report*, Washington, D.C.

Federal Deposit Insurance Corporation (1956), *Annual Report*, Washington, D.C.

Federal Reserve Bank of Dallas (1919-29), *Annual Report*, Dallas, Texas.

Federal Reserve Bank of Dallas (1919-1926), *Examiner's Report of Condition*, Department of Examination.

Federal Reserve Bank of Dallas (1920-1927), *Monthly Review of Business and Industrial Conditions*, Dallas, Texas.

Grant, Joseph M. And Lawrence L. Crum (1978), *The Development of State-Chartered Banking in Texas from Predecessor Systems Until 1970*, Austin, Texas: The University of Texas Bureau of Business Research.

Grossman, Richard S., (1992) "Deposit Insurance, Regulation, and Moral Hazard in the Thrift Industry: Evidence from the 1930s," *American Economic Review*, 82:4, 800-821.

Gunther, Jeffery W., and Kenneth J. Robinson, (1991), "Empirically Assessing the Role of Moral Hazard in Increasing the Risk Exposure at Texas Banks," Federal Reserve Bank of Chicago, *Proceedings of the 27th Annual Conference on Bank Structure and Competition*, (May): 199-220.

Kane, Edward J. (1989), *The S&L Insurance Mess: How Did It Happen*,? Washington, D.C: The Urban Institute.

Kareken, John H. And Neil Wallace (1978), "Deposit Insurance and Bank Regulation: A Partial-Equilibrium Exposition," *Journal of Business* 51 (July): 413-38.

Keeley, Michael C. (1990), "Deposit Insurance, Risk, and Market Power," *American Economic Review* 80 (December): 1183-1200.

Marcus, Alan J. (1984), "Deregulation and Bank Financial Policy," *Journal of Banking and Finance*, 8: 557-565.

Merton, Robert C. (1977), "An Analytical Derivation of the Cost of Deposit Insurance and Loan Guarantees: An Application of Modern Option Pricing Theory," *Journal of Banking and Finance*: 3-11.

Robb, Thomas Bruce, (1921), *The Guarantee of Bank Deposits*, Boston: Houghton Mifflin Co.

Shibley, George H., (1914), *History of Guarantee of Bank Deposits in the States of Oklahoma, Texas, Kansas, Nebraska, and South Dakota 1908-1914*, U.S. Senate, 63rd Congress, Second Session, U.S. Senate Document No. 522, June 23.

Shirley, R.V., and Bervard Nichols (1931), *Trends of Development of Texas Financial Institutions*, Austin, Texas: University of Texas Bureau of Business Research.

Smith, Clifford W., Jr. (1976), "Option Pricing: A Review," *Journal of Financial Economics* 3 (January/March), 3-51.

The Texas Almanac and State Industrial Guide (1931), Dallas, Texas: A.H. Belo Corporation.

Weaver, Findley (1926), "State Banking in Texas," master's thesis, University of Texas, Austin.

Wheelock, David C. (1992), "Deposit Insurance and Bank Failures: New Evidence from the 1920s," *Economic Inquiry* 30:3 (July), 530-43.

Wheelock, David C. and Subal C. Kumbhakar (1995), "Which Banks Choose Deposit Insurance? Evidence of Adverse Selection and Moral Hazard in a Voluntary Insurance System," *Journal of Money, Credit, and Banking*, 27:1 (February), 186-201.

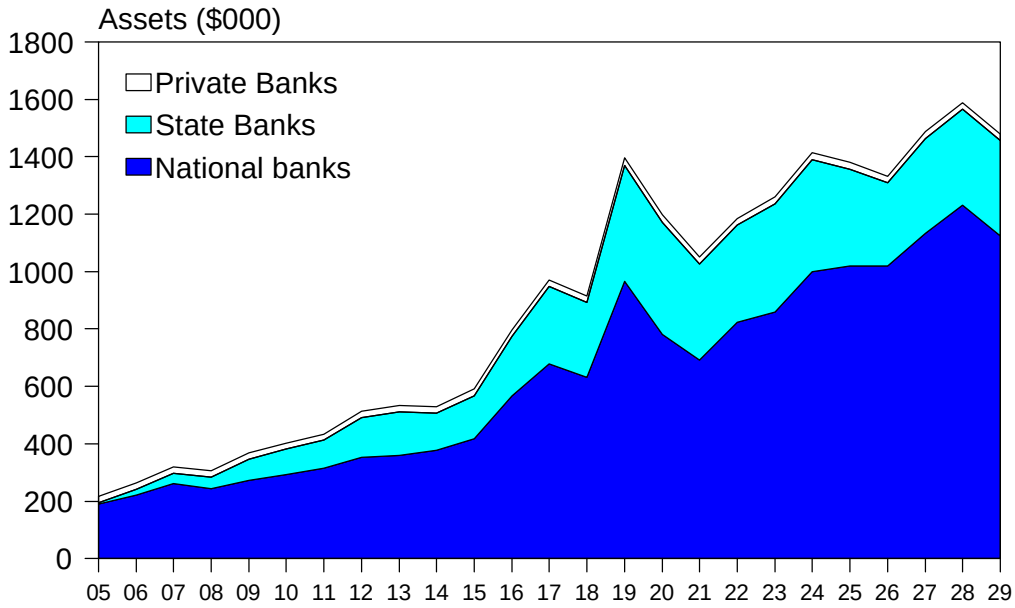
Wheelock, David C. and Paul W. Wilson (1995), "Explaining Bank Failures: Deposit Insurance, Regulation, and Efficiency," *Review of Economics and Statistics*, 689-700.

White, Eugene N. (1981), "State Sponsored Insurance of Bank Deposits in the United States, 1907-1929," *The Journal of Economic History* 41 (September), 537-57

White, Eugene N. (1983), *The Regulation and Reform of the American Banking System, 1900-1929*, Princeton: Princeton University Press.

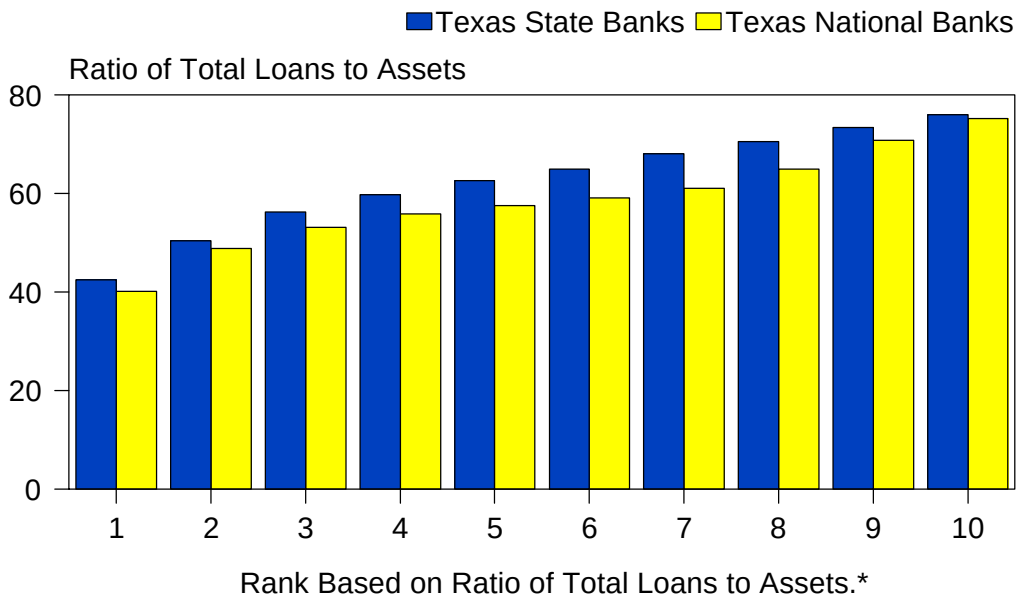
White, Halbert (1980), "A Heteroskedastic-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica* 48 (May): 817-38.

Chart 1
Texas Bank Assets
1905 - 1929



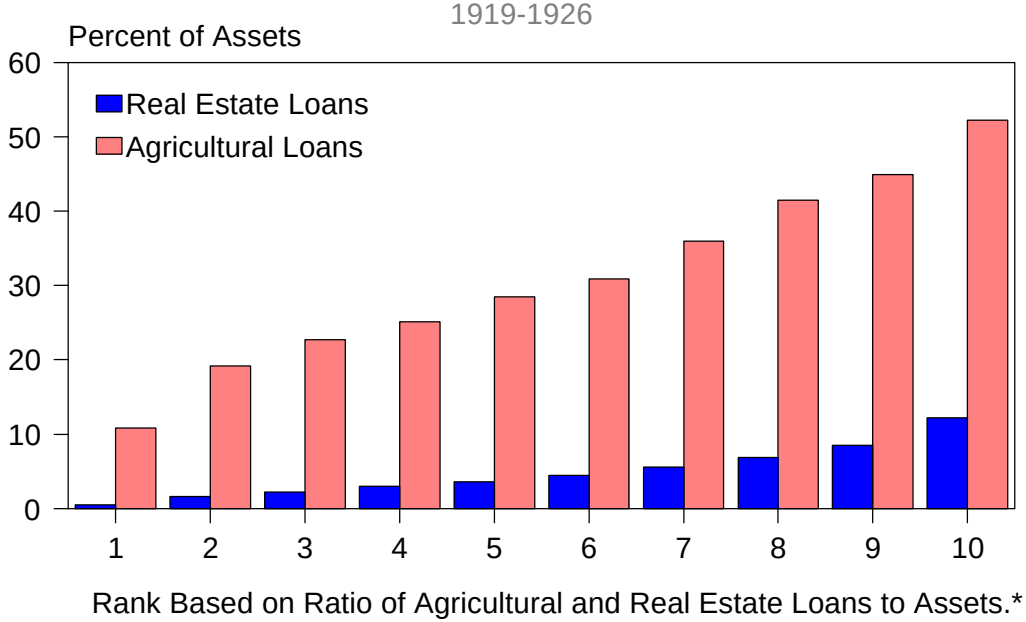
Sources: Grant and Crum; All Bank Statistics 1986-1955, Board of Governors of the Federal Reserve System

Chart 2
Distribution of Lending Activity at Texas Banks
1919-1926



*Bars represent the mean values for each decile.
Source: Examiner's Report of Condition, 1919-1926 , Federal Reserve Bank of Dallas
Annual Report, Comptroller of Currency, 1919-1926.

Chart 3
Distribution of Agricultural and Real Estate Lending at Texas State Banks
1919-1926



*Bars represent the mean values for each decile.
Source: Examiner's Report of Condition, 1919-1926, Federal Reserve Bank of Dallas

Table 1

Bank Liquidations in Texas
1919-1926

Year	State Banks					National Banks				
	Liquidations			Number of Banks	Liquidation Rate	Liquidations			Number of Banks	Liquidation Rate
	Voluntary	Involuntary	Total			Voluntary	Involuntary	Total		
1919	12	3	15	907	1.65	7	0	7	543	1.29
1920	16	2	18	967	1.86	n.a	0	n.a.	543	n.a.
1921	21	22	43	1008	4.27	14	10	24	556	4.32
1922	41	35	76	998	7.62	9	2	11	557	1.97
1923	35	17	52	965	5.38	6	3	9	555	1.62
1924	24	23	47	942	4.99	5	3	8	561	1.43
1925	103	47	150	883	16.99	5	5	10	573	1.74
1926	31	33	64	808	7.92	10	1	11	642	1.71

Sources: for state banks, Grant and Crum, (1978); for national banks, Comptroller of the Currency *Annual Reports*, 1918-1926. From 1919-1922, the data for the state banks are for year-end August 31. From 1923-1926, the data for state banks are for year-end December 31. For the state banks, the number of banks represents the mean of the number of banks in operation at the beginning of the year and the number of banks in operation at the end of the year. For national banks, the data are for year-end October 31, and the number of banks represents the total number the previous year. n.a. = not available.

Table 2

Cost of Deposit Guaranty Fund to Texas State Banks
Total Assessments Levied
1919-1926

Year	All state banks		Sample	
	Assessments (000s of $)	Assessments as a percent of total assets	Assessments (000s of $)	Assessments as a percent of total assets
1919	189	0.06	0	0.00
1920	789	0.19	5	0.03
1921	6,289	1.68	106	0.51
1922	2,168	0.66	305	1.80
1923	1,042	0.32	356	1.80
1924	2,397	0.67	338	1.64
1925	n.a.	n.a.	410	2.05
1926	n.a.	n.a.	321	1.68

Sources: Weaver (1926, p. 72); *Examiner's Report of Condition*, Federal Reserve Bank of Dallas, 1919-192; *All Bank Statistics United States 1986-1955*, Board of Governors of the Federal Reserve System, 1959.

Note: n.a. = not available.

Table 3

Texas State Bank Sample Compared to State Member Bank Population 1919-1926

Year	Sample number of banks	Total number of Fed state member banks examined[a]	Sample as a percentage of Fed members examined	Sample assets (000s)	Total Fed state member bank assets (000s)	Sample as a percentage of total member assets
1919	14	52	26.9	10,523	79,578	13.20
1920	22	68	32.4	15,379	136,019	11.30
1921	63	205	30.7	23,641	115,010	20.56
1922	54	198	27.3	22,122	108,933	20.31
1923	55	187	29.4	25,985	n.a.	n.a.
1924	57	175	32.6	27,688	n.a	n.a.
1925	50	130	38.5	26,446	n.a	n.a.
1926	51	115	44.4	23,820	n.a.	n.a.

[a]Includes all banks in the Dallas Federal Reserve District, which at the time included parts of Arizona, Louisiana, New Mexico, and Oklahoma, and all of Texas.

Sources: *Annual Report*, Federal Reserve Bank of Dallas, 1919-27; *Examiner's Report of Condition*, Federal Reserve Bank of Dallas, 1919-1926.

n.a. = not available.

Table 4

National Bank Sample Compared to National Bank Population in Texas 1919-1926

Year	Sample		All Texas national banks		Sample as a percentage of	
	Number	Assets (000s)	Number	Assets (000s)	Total number	Total assets
1919	50	160,093	543	719,521	9.2	22.3
1920	48	139,111	556	883,067	8.6	15.8
1921	43	80,509	557	718,743	7.7	11.2
1922	42	96,246	555	729,885	7.6	13.2
1923	41	84,759	561	760,596	7.3	11.1
1924	41	97,395	573	810,250	7.2	12.0
1925	40	99,314	642	944,355	6.2	10.5
1926	39	92,892	662	969,465	5.9	9.6

Sources: *All-Bank Statistics*, Federal Reserve Board of Governors, 1959.
Annual Report, U.S. Comptroller of the Currency, 1919-1926.

Table 5

Means of Sample Variables Compared to Population

1919-1926

Variable	State bank sample	All Texas state banks	National bank sample	All Texas national banks
Capital-to-asset ratio (percent)	19.0 (7.50)	19.7	18.9 (6.9)	15.5
Loan-to-asset ratio (percent)	63.3 (13.9)	68.1	59.1 (12.8)	59.1
Agricultural loans-to-asset ratio (percent)	30.8 (15.1)	n.a.	n.a.	n.a.
Real estate loans-to-asset ratio (percent)	5.5 (5.25)	n.a.	n.a.	n.a.
Total assets (dollars)	$478,632 (454,834)	$331,455	$2,555,374 (7,674,529)	$1,403,010

Sources: *Examiner's Report of Condition*, Federal Reserve Bank of Dallas, 1919-1926.
Annual Report, Federal Reserve Bank of Dallas, 1919-1926.
All-Bank Statistics, Federal Reserve Board of Governors, 1959.
Annual Report, Comptroller of the Currency, 1919-1926.

Notes: The table shows standard deviations in parentheses below the means.
n.a. = not available.

Table 6

Estimates of Loan Concentrations as Proxies for Ex-Ante Risk 1919-1926

Dependent Variable: TROUBLED

Independent Variables	Loan Concentration Measures		
	LOANASS	AGLOANS	RELOANS
INTERCEPT	0.1439*	0.1392*	0.2060**
	(0.0697)	(0.0669)	(0.0684)
$LOANASS_{t-1}$	0.0497†		
	(0.0343)		
$AGLOANS_{t-1}$		0.0609*	
		(0.0282)	
$RELOANS_{t-1}$			0.3122**
			(0.1296)
$SIZE_t$	-0.0047	-0.0035	-0.0092*
	(0.0047)	(0.0048)	(0.0052)
R^2	0.08	0.09	0.11
n	223	223	223

Notes: ** = statistical significance at the 1-percent level.
* = statistical significance at the 5-percent level.
† = statistical significance at 10-percent level.
Standard errors are in parentheses and are corrected for heteroscedasticity using White's (1980) procedure. The dependent variable is expressed as a percent of assets. See the appendix for a complete description of the variables used. Annual dummy variables that

proxy for economic activity, and quarterly dummy variables that capture the seasonal effects of agricultural lending activity, are not shown but are statistically significant.

Table 7

Estimates of Moral Hazard
1919-1926

Independent Variables	Texas State-Chartered Banks			Texas Nationally-Chartered Banks
	Dependent Variable			
	LOANASS	AGLOANS	RELOANS	LOANASS
INTERCEPT	1.1692**	0.6739**	0.0359	0.0960
	(0.1682)	(0.1772)	(0.0649)	(0.0776)
$CAPASS_{t-1}$	-0.5562**	-0.2089†	-0.0287	0.1080
	(0.1106)	(0.1214)	(0.0425)	(0.0995)
$LOANASS_{t-1}$	0.3222**			0.6413**
	(0.0571)			(0.0905)
$AGLOANS_{t-1}$		0.3807**		
		(0.0582)		
$RELOANS_{t-1}$			0.5478**	
			(0.0708)	
$SIZE_t$	-0.0567**	-0.0421**	0.0022	0.0043
	(0.0118)	(0.0121)	(0.0046)	(0.0044)
R^2	0.37	0.36	0.35	0.52
n	223	223	223	258

Notes: ** = statistical significance at the 1-percent level.
† = statistical significance at 10-percent level.
Standard errors are in parentheses and are corrected for heteroscedasticity using White's (1980) procedure. The dependent variables are expressed as a percent of assets. See the appendix for a complete description of the variables used. Annual dummy variables that proxy for economic activity, and quarterly dummy variables that capture the seasonal effects of agricultural lending activity, are not shown but are statistically significant.