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Do Lender of Last Resort Policies Matter? The Effects of Reconstruction Finance Corporation Assistance to Banks During the Great Depression

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Abstract

The paper uses a unique set of Depression-era bank financial data in a two-step system of equations with instrumental variables to estimate the effectiveness of lender of last resort (LOLR) strategies in a survival model with self-selection bias. Decreasing RFC loan collateral requirements over 1932–1933 facilitate the analysis of a relationship between LOLR collateral and survival. The results suggest that the RFC's practice of subordinating depositors' and investors' interests through senior claims on banks' best assets may have caused banks to fail. Although recapitalization after March 1933 helped banks survive the Great Depression, recapitalization is not a typical LOLR strategy.

Key words: Reconstruction Finance Corporation, lender of last resort, central bank policy.

Systemic banking crises hurt all banks, regardless of financial condition. Moreover, such crises can carry high economic costs if relationship capital is lost and good investments are liquidated when fundamentally solvent institutions fail. Therefore, the issue of how central banks and bank regulators respond to banking crises is of intense interest in the banking literature.

Most researchers agree that the effects of crises attributable to asymmetric information can be mitigated by providing discount window access to illiquid but otherwise solvent banks. All else held constant, such programs should reduce bank failure rates for participating institutions and preserve relationship capital and going-concern value in solvent institutions (Mishkin, 1992; Calomiris, 1994; Kaufman, 1996).

Discount window access alone, however, may not always be enough to keep illiquid banks from failing. Hence, discount window access may not be enough to end a particular crisis or keep it contained to a particular geographical area. That was indeed the experience of the Reconstruction Finance Corporation (RFC) when it extended assistance to troubled banks during the U.S. Great Depression. Beginning in February 1932, the RFC responded to local and regional banking crises by extending assistance to banks. As banking crises spread, the RFC gradually assumed greater default risk on funds provided for that assistance, first by relaxing collateral requirements on RFC loans, then by recapitalizing banks directly through preferred stock purchases. As a result, the RFC's experience provides a natural experiment in effective responses to banking crises. This paper analyzes the RFC's experience and suggests that the RFC's assistance to banks,

whether in the form of lending or preferred stock purchases, became more effective as more default risk was assumed.

Section 1 of this paper briefly describes the RFC's activities relating to banking sector assistance during the Great Depression. Section 2 introduces the data and establishes that RFC loans were associated with subsequent bank failure whereas preferred stock purchases were not. Section 3 introduces the estimation strategy and assumptions. Section 4 then more closely analyzes the RFC lending and preferred stock purchase programs by applying survival analysis to a sample of banks in a region of the United States that experienced repeated and prolonged banking crises during the Great Depression. RFC lending is separated into conservative (low credit risk) and liberal (high credit risk) collateral regimes. The analysis illustrates that the amount of credit risk assumed by the RFC affected how banks withstood local and regional crises during the Great Depression. Moreover, preferred stock purchases (with the highest credit risk) demonstrate the strongest positive association with bank survival. Section 5 concludes.

1. Motivation and background

Sudden local banking crises are one of the most pervasive features of the Great Depression. During banking crises, depositors remove funds *en masse* from the banking system. When bank deposits are withdrawn during a crisis, they may be deposited in nonbank financial intermediaries or held as cash, potentially reducing the supply of business credit and thereby propagating an economic decline. For instance, Wicker (1996) reports that, after a banking crisis in the greater Chicago area in June 1931, postal savings deposits increased by over 40%.

Nonetheless, even after repeated crises in the Chicago area in June, September, and October 1931, the Federal Reserve Bank of Chicago did not undertake any special program to address the crises and their effects. The central bank took no ''positive action to intervene directly to keep open any of the troubled banks. No direct assistance was offered other than to discount eligible paper of the [Federal Reserve] member banks. No accommodation was available to nonmember banks'' (Wicker, 1996, p. 85).[1] Because of the Federal Reserve System's demonstrated reluctance to take action that could alleviate these and other banking crises, the RFC was created to provide assistance to weak but not insolvent banks that could reduce the incidence of bank failures and limit deposit disintermediation (*RFC Circular #1*, 1932).

To alleviate recurring banking crises during the Great Depression, the RFC employed three assistance strategies sequentially over three consecutive time periods: February 2, 1932 (the RFC's inception)–July 21, 1932; July 21, 1932–March 3, 1933; and March 3, 1933–December 31, 1936 (the end of the RFC's focus on banking difficulties). During February 2, 1932–July 21, 1932, RFC loans were the only form of assistance offered by the agency. During this period, Eugene Meyer, chairman of the Federal Reserve Board, was also chairman of the RFC. As such, Meyer kept rates, terms, and collateral on loans at the RFC identical to those available at the Federal Reserve. That is, the RFC made short-maturity (six-month) loans at high rates (6%) collateralized by banks' best-quality, most-liquid assets.

Meyer was replaced as RFC chairman, and RFC loan requirements were relaxed beginning July 21, 1932. However, even this more liberal RFC loan policy did not prevent the acceleration of banking crises during early 1933. As a result, on March 3, 1933, the Emergency Banking Act further liberalized RFC operations by allowing the RFC to recapitalize banks through preferred stock purchases.[2]

These three strategies form a continuum of credit risk assumption by the RFC that correlates with the effectiveness of RFC responses to banking crises. In the analysis that follows, I use differences in RFC programs across these three periods to demonstrate that RFC assistance became more effective at reducing bank failures and resolving banking crises as the agency assumed greater default risk.

2. Data

The primary objective of the paper is to measure how RFC assistance may have reduced the incidence of bank failure conditional on bank financial characteristics and regional economic heterogeneity. The analysis is based on a bank-level panel data set consisting of four components: individual bank financial characteristics, incidence and time of bank failure, RFC loans and preferred stock investments at each bank, and county-level economic conditions.

Since all data are handcoded, I restrict the analysis to a sample of U.S. banks chosen on the basis of whether financial data are available, the extent to which banks in the area experienced banking crises, and the economic importance of the banks involved.

Data availability is first conditioned on whether bank financial data could be collected from archived microfilm of original Federal Reserve member bank *Reports of Condition and Income*. Although this choice restricts the analysis to Federal Reserve member banks, it offers far more detail on bank assets and liabilities than any of the abstracts of condition published by the state and national banking authorities at the time. Neither state nor national authorities published the individual bank earning and expense data available on the *Reports of Condition and Income* (see Mason, 1998, for a further description of this data source).

The sample of banks is restricted to those located in an important financial center that experienced substantial banking difficulties: the Chicago area. Most experts agree that banks in and around Chicago experienced symptoms of repeated banking crises during the Great Depression, whereas banks in New York and elsewhere typically did not. In fact, Chicago often is held as the quintessential example of any size banking center that experienced dramatic banking difficulties, including classic bank runs during June 1932 (James, 1938; Friedman and Schwartz, 1963; Calomiris and Mason, 1997).

The final sample includes all 357 Illinois member banks in the Seventh Federal Reserve District, for a total of 979 bank-year observations. The resulting data set is the largest, most detailed, and—containing both national and state-chartered banks—the most institutionally diverse data set of individual bank financial characteristics during the Great Depression yet analyzed (see, for instance, Wheelock and Kumbhakar, 1994, and White, 1984).

Failure data for these banks is handcoded from the Comptroller of the Currency's

Annual Report (national banks) and the Illinois Auditor of Public Accounts's *Statement Showing Total Resources and Liabilities of Illinois State Banks* (state banks). Receiverships and voluntary liquidations are treated as bank failures. Banks that reopen after receivership are not considered failed. Of the 357 sample banks, 119 failed during the period December 1931–December 1936.

Of the 79 banks that received RFC loans, 44 (56%) failed. Of the 80 banks that received RFC preferred stock, 10 (12.5%) failed. RFC loans and preferred stock authorizations for these banks are handcoded from monthly *Reports of Activities of the Reconstruction Finance Corporation*.[3]

The original RFC *Reports* present the amount of each loan and preferred stock purchase and the date each was authorized. Previous work typically focused on the amount of such loans and preferred stock purchases divided by their number as a measure of the average size of RFC outlays (Friedman and Schwartz, 1963; Butkiewicz, 1995; Keehn and Smiley, 1988, 1993). But a substantial number of banks were granted increased assistance in the form of subsequent loans or preferred stock purchases, which may bias average assistance levels downward. These multiple outlays were especially prevalent in the RFC loan program. Mason (2001) documents that, nationwide, 32% of banks borrowed more than once from the RFC and 12% borrowed more than twice. Nearly 68% of the amount of loans went to banks borrowing more than once from the RFC, and over 37% went to banks borrowing more than twice.

Since many banks received multiple RFC loans, it is important to use bank-level data instead of loan-level data in analyzing the effects of RFC loans on bank failures.[4] Table 1 illustrates the bias that can arise from using loan-level data. The first column in table 1 constructs the mean amount of assistance as the total amount of RFC loans (preferred stock purchases) divided by the number of loans (preferred stock purchases). This construct is similar to that used in previous research (Friedman and Schwartz, 1963; Butkiewicz, 1995; Keehn and Smiley, 1988, 1993). When RFC assistance is compared this way, higher RFC loan and preferred stock purchase amounts are associated with a higher chance of survival.

In contrast, the second column of table 1 shows the effect of correcting for the multiple-loan bias. Column two is constructed by cross-tabulating the data by bank and calculating the mean amount of RFC assistance as the total amount of loans (or preferred stock) to each unique bank divided by the number of unique banks. Once the data are corrected for multiple authorizations to the same banks, it appears that preferred stock helped banks survive but loans did not. The formal econometric analysis in the next section suggests this may be a result of strict collateral requirements on early loans and that, as collateral requirements were liberalized (and ultimately lifted with preferred stock purchases), RFC assistance became more effective at helping banks survive the Great Depression.

3. Estimation strategy and assumptions

The main point of the empirical work in this paper is to model bank failure during the Great Depression while controlling for RFC loans and preferred stock purchases. However, the RFC required banks to initiate the application before being considered for a

Table 1. **Univariate comparison of bank failure outcome, by level of aggregation**
All data are from the monthly *Reports of Activity of the RFC*. Transaction-level averages are the sum of all RFC loans or preferred stock purchases divided by their number. Bank-level data control for RFC lending or purchasing preferred stock in banks more than once. Bank-level averages are the sum of loans or preferred stock authorized to each bank divided by the number of banks to which the RFC authorized loans or preferred stock. The principal difference between transaction- and bank-level data lies in the lack of a significant difference between failures and survivors receiving loans when measured at the bank level.

	Transaction Level		Bank Level	
	Failures	Survivors	Failures	Survivors
Loans:				
Mean amount	$95,043	$167,922*	$203,046	$249,484
N	94	52	44	35
Preferred stock:				
Mean amount	47,000	758,769*	47,000	845,485*
N	10	78	10	70

*Difference between failures and survivors is statistically significant at the 15% level.

loan or preferred stock purchase. Since the application process could be costly, a bank may be reluctant to apply without a reasonable probability that it would receive assistance. Therefore, bad or marginal candidates might not apply, and models based on these data would be affected by self-selection bias (Maddala, 1983, p. 291).

I adjust for self-selection bias in the data by first modeling RFC loan and preferred stock authorizations, then using the predicted values as bias-adjusted proxy variables for RFC loans and preferred stock purchases that would have occurred without self-selection.[5] However, this two-step estimation strategy may not produce an identified specification, because the RFC gave loans and purchased preferred stock in banks that were weak and this same fundamental weakness caused bank failure. If the RFC decision and bank failure are driven by the same variables, the two processes are indistinguishable econometrically.

Simonson and Hempel (1993) and Jones (1940) give evidence that RFC decisions were made on the basis of more than financial condition alone. The RFC typically considered many additional environmental factors that could affect the bank's need and eventual repayment, such as economic conditions in the region, the importance of a particular bank to its market, and other New Deal assistance allocated to the bank's market. I demonstrate that, while a bank's financial condition is important to obtaining RFC assistance, these other environmental characteristics can act as instruments that effectively provide the necessary conditions for model identification (Greene, 1990).

The next section estimates two bivariate probit models that generate predicted values for RFC loans and preferred stock purchases that would have been received by each bank in the absence of self-selection bias. Then, a model of accelerated bank failure that includes the bias-adjusted loan and preferred stock variables is constructed to measure the effects of loans and preferred stock purchases on subsequent bank failure. I use the estimated coefficients on these bias-adjusted proxies for loans and preferred stock purchases to draw conclusions about the effectiveness of RFC programs.

4. RFC assistance and bank failure estimates

4.1. The first-round bivariate probit model

The proxy variables for loans and preferred stock purchases are estimated in separate bivariate probit models. The results that follow are robust to using a probit estimate of the propensity to receive assistance or a tobit estimate of the amount of assistance relative to bank size. The bivariate probit is used because it offers the ability to estimate the loans and preferred stock in a simultaneous equations framework that properly identifies the RFC decision as correlated with, but not completely determined by, the same factors that dictate the fundamental condition of the bank.

The bivariate probit model is specified as

$$y_{i1t} = \hat{y}_{i2t} + \hat{B}_1 x_{i1t-1} + \varepsilon_{i1} \qquad y_{i2t} = \hat{y}_i + \hat{B}_2 x_{i2t-1} + \varepsilon_{i2}$$

where

$$y_{i1} = \begin{cases} 1, & \text{if } z^*_{i1t} > 0 \\ 0, & \text{otherwise} \end{cases} \qquad y_{i2} = \begin{cases} 1, & \text{if } z^*_{i2t} > 0 \\ 0, & \text{otherwise} \end{cases}$$

$$[\varepsilon_{i1}, \varepsilon_{i2}] \sim \text{ bivariate normal (BVN)}[0, 0, 1, 1, \rho]$$

Each model contains two equations: a RFC loan (or preferred stock purchase) equation and a bank failure equation. The dependent variable z^*_{i1t} is whether RFC loans (or preferred stock purchases) were authorized and z^*_{i2t} is whether the bank failed.

The dichotomous dependent variables, y_i, are actual outcomes for bank failure and RFC loans (or preferred stock purchases). The probability estimates, $\hat{y}_i$, can be thought of as potential outcomes. The model therefore presupposes that actual bank failure depends on the degree to which it is possible for banks to obtain assistance from the RFC, and RFC assistance depends on the probability of bank failure. Each model is solved simultaneously as a system of equations that formally accounts for the interrelationship between bank weakness and RFC loans (or preferred stock purchases) (Maddala, 1983). These variables also summarize the effect of potential bank failure on RFC loans (or preferred stock purchases) and therefore serve as a check on whether the RFC actually fulfilled its objective of giving loans to and purchasing preferred stock in weak banks.

The bivariate probit loan model uses bank failure data and RFC assistance data from February 1932 through March 1933 and bank financial data from December 31, 1931. The bivariate probit preferred stock purchase model estimates bank failures and RFC preferred stock purchases between March 1933 and December 1935. Since the national bank Call Reports from December 31, 1932, were destroyed, the RFC preferred stock model uses December 31, 1933 financial data.[6]

Table 2 presents the results of two the bivariate probit models. Each bivariate probit model consists of two equations, an assistance equation and a failure equation, that are estimated simultaneously to derive the self-selection bias-adjusted RFC loan and preferred stock purchase variables in a process that identifies failure risk separately from assistance

Table 2. **Bivariate probit model of RFC discount loans and preferred stock purchases**
Each model is a system of two equations, jointly estimating the determinants of RFC loans or preferred stock and failure. Two models are estimated. Column 1 presents a model for RFC loans and column 2 for preferred stock. The RFC loan model is estimated for the time period February 1, 1932, to March 31, 1933. The RFC preferred stock model is estimated for the time period March 1, 1933, to December 31, 1935. Panel A reports the RFC loan and preferred stock equation for each model. Panel B reports the failure equation. Bank financial data are from Federal Reserve *Reports of Condition and Income*. RFC loan and preferred stock data are from monthly *Reports of Activity of the RFC*. Other assistance data from *County Reports of Federal Expenditures*. Other economic data are from *1930 Census of Manufacturing*. Standard errors are in parentheses.

	(1)	(2)
A. RFC assistance equation		
Constant	−8.632***	−5.479***
	(1.891)	(1.848)
Log of total assets	0.389***	0.297***
	(0.105)	(0.119)
National bank dummy	0.570**	0.639**
	(0.344)	(0.263)
Reserve city bank dummy (Chicago and Peoria)	7.401***	2.161
	(2.835)	(3.773)
Amount of mortgage assistance loans/total amount of loan assistance to the county	−1.316*	−0.537
	(0.929)	(0.913)
Number of mortgage assistance loans/total number of households in the county	15.379*	2.477
	(9.654)	(9.283)
Federal Emergency Relief Administration grants/total amount of grants in the county	0.194	4.225*
	(3.775)	(3.230)
Manufacturing employment/total employment, 1929	−1.379	−1.993
	(2.160)	(1.684)
Value added by manufacturing/total value of products, 1929	0.272	0.103
	(1.528)	(1.346)
Unemployment rate in 1930	−1.452	−0.856
	(6.602)	(7.463)
Log of total assets × reserve city bank dummy (Chicago and Peoria)	−0.495***	−0.194
	(0.187)	(0.242)
Predicted probability of failure	6.416***	1.379**
	(1.626)	(0.817)
B. Bank failure equation		
Constant	−0.148	−3.829
	(0.938)	(4.848)
Illiquid assets/total assets	2.442***	4.778***
	(0.878)	(1.550)
Bonds, stocks, and securities owned/illiquid assets	−0.211*	−1.588
	(0.139)	(4.226)
Real estate owned/illiquid assets	0.016	0.761
	(0.040)	(6.748)
Loans and discounts/illiquid assets	−0.557	−2.982
	(0.585)	(4.221)
Paper eligible for rediscount at the Fed/loans and discounts	−0.089	−0.600
	(0.100)	(0.874)
Net worth/total assets	0.014	−3.929
	(0.286)	(3.176)

Table 2. **(continued)**

	(1)	(2)
Bills payable and rediscounts/debt	−0.251***	4.707*
	(0.075)	(3.605)
Interest and discount on loans/total earnings	0.024	3.580**
	(0.332)	(1.926)
Recoveries/total earnings	0.000	0.843
	(0.037)	(2.363)
Losses/total expenses	0.008	0.816
	(0.123)	(0.832)
Predicted probability of RFC assistance	0.328*	0.351
	(0.258)	(3.129)
Correlation coefficient between the assistance and failure processes	0.049	0.872***
Log-likelihood	−261.9	−168.2
Restricted (slopes = 0) Log L	−315.1	−230.7
Chi-squared ($k-1$ df)	106.6	124.9
Number of observations (banks)	251	241
Number of failures	93	44
Number of banks with RFC authorization of each type	75	72

*, **, ***Statistically significant at the 10%, 5%, 1% level.

decisions. Panel A in table 2 contains the RFC loan and preferred stock purchase equations, while panel B contains the bank failure equations.

The failure equations in table 2, panel B are based on similar constructs found in both contemporary and historical failure analyses.[7] Since Simonson and Hempel (1993), Olson (1988), Comptroller of the Currency (1934), and Jones (1940) all provide conjectural evidence that regulatory forbearance was minimal during this period, the independent variables in the bank failure equation are limited to fundamental bank characteristics.[8]

Banks' capital adequacy (net worth/total assets) and liquidity (illiquid assets) are expected to be associated with decreased failure risk. Since real estate owned and reported losses indicate the level of foreclosed and nonperforming assets, they should be positively associated with increased failure risk. Credit risk variables like other bonds, stock and securities, and loans and discounts also should be associated with increased failure risk, while eligible paper is expected to be associated with decreased failure risk. For a given level of loans, interest and discount earnings should be higher in the event of increased credit risk and therefore would be expected to be associated with increased failure risk. Since interest rates generally are declining during this period, interest rate risk on liabilities (bills payable and rediscounts) is expected to increase failure risk. Recoveries may be positively associated with failure risk, if they capture a rebound in bank asset values following a trough.

The signs on the bank failure equations in table 2, panel B are consistent with those found elsewhere in historical and theoretical banking literature.[9] Variables like illiquid assets, other real estate owned, and losses all positively influence bank failure. Liquid assets (measured by bonds, stocks, and securities owned), net worth, and paper eligible for

rediscount at the Federal Reserve all reduce the probability of failure. Although loans and preferred stock are associated with increased probability of bank failure (although the coefficient is statistically significant only for loans), at this stage, the relationship may be tainted by self-selection bias and therefore is premature.

Table 2, panel A includes the RFC loan and preferred stock equations. As mentioned previously, the bivariate probit models exploit differences in the RFC assistance and regulatory bank failure decision variables for identification. The RFC may have been more likely to help banks if they were important to the local market. The first set of variables included in the RFC loan (or preferred stock purchase) equation therefore reflects banks' importance to the industry as reflected by size (the log of total assets), national and reserve city bank dummy variables, and a reserve city/bank size interaction variable.[10]

Whether banks benefited from indirect assistance through other New Deal programs in their local area also may affect the probability that a bank receives direct RFC loans (or preferred stock purchases). One source of indirect assistance was loans to bank borrowers to help them meet mortgage and other loan payments. This assistance is reflected in the amount and number of RFC mortgage loans (as a proportion of the total amount of loan assistance of all types in the county). The models also include Federal Emergency Relief Administration assistance to the county that provided funds for the poor and unemployed. If other assistance that indirectly benefited banks already was being channeled to the region, the RFC may have been less likely to help the bank directly. Data on indirect assistance are gathered from the *County Reports of Federal Expenditures*.

The RFC may have helped banks located in regions with high unemployment or where large-scale manufacturing firms were located. Therefore, the model also includes county-level *1930 Census of Manufacturing* (U.S. Department of Commerce, 1930) data on unemployment rates, the ratio of the value of manufacturing to total output in the county, and the type of manufacturing in the county, all of which are expected to increase the propensity for assistance.

In practice, these county economic characteristics exert little marginal influence on the probability of receiving loans (or preferred stock purchases). County-level variables accounting for the prevalence of manufacturing (as opposed to agriculture) in the county, the type of manufacturing in the county, and the unemployment rate add little explanatory ability to either of the loan and preferred stock purchase equations.

The amount of RFC mortgage loans in the county has a negative effect on the probability of a bank obtaining loans or preferred stock from the RFC. However, this effect is offset by the number of mortgage assistance loans issued (as a proportion of the total number of households in the county). Therefore, it seems that, if only a few large loans are issued, they will have a negative effect on the probability of a bank receiving assistance. Conversely, if the same amount is distributed among a large number of borrowers, the probability of a bank receiving assistance from the RFC may increase substantially. Federal Emergency Relief Administration grants add little explanatory ability to the RFC loan equation but exert a significantly positive influence on RFC preferred stock purchases.

Banks' importance to their local market (as reflected in bank size and national and reserve city bank dummy variables) has a significant positive effect on whether banks receive loans and preferred stock assistance. Additionally, in the RFC loan model, the

reserve city bank size interaction variable exerts a significantly negative effect greater than that of the bank size coefficient. This result suggests that, while the probability of receiving assistance increases with size outside reserve cities, it decreases with size for reserve city banks.

The relationship between bank size and reserve city location suggests that RFC loan decisions were not based entirely on fundamental bank financial conditions. This could be due to the Federal Reserve Banks taking responsibility for assistance to reserve city banks or more likely (as suggested in James, 1938, and Olson, 1988), local clearinghouses and other large businesses cooperating with lending authorities to assume much of the market risk of assistance through loan participations and deposit haircuts. Moreover, small rural banks may have been unwilling or unable to pay the significant fixed costs of obtaining RFC loans, such as for travel to a regional RFC office and examination by RFC officials. These results suggest RFC loans were distributed on the basis of factors outside of fundamental bank financial conditions, providing identification for the of RFC loan model.

Although the RFC preferred stock purchase equation is not as robust as the loan equation, it still captures a strong relationship between bank importance and RFC preferred stock purchases, especially with respect to the bank size and national bank dummy variables. Therefore, the model suggests that RFC preferred stock purchase decisions were not based entirely on fundamental bank financial conditions and the preferred stock model can be identified as well.

An additional advantage of including a summary measure of the probability of failure lies in the ability to observe whether the RFC attempted to fulfill its stated objectives. Since the RFC sought to restore economically weak banks, it is not surprising that the coefficient on the predicted probability of failure is positive in both the RFC loan and preferred stock purchase equations. The sign of this coefficient suggests that the RFC in fact targeted weak banks for both the loan and preferred stock purchase programs.[11]

4.2. Bank survival model using self-selection-adjusted RFC loan and preferred stock purchase variables

This section estimates a survival model of bank failure and uses the self-selection bias-adjusted measures of RFC activity to draw conclusions about the effects of loans and preferred stock purchases on subsequent bank failure.

The survival model holds three principal advantages over probit, logit, or discriminant analysis models. First, survival models use the time clapsed before failure as the dependent variable. The present model estimates the number of days, beginning December 31, 1931, and ending December 31, 1936, until failure. If a bank did not fail during this period, its time is censored in a manner similar to the procedure used in tobit analysis. Survival models therefore measure how values of the independent variables not only affect the incidence of failure but how they affect the length of time clapsed before failure. Such measurement utilizes data more efficiently than probit, logit, or discriminant analysis and therefore produces better estimates of the factors contributing to bank failure.

Second, probit, logit, and discriminant analysis tend to be sensitive to the length of window used to measure the failure event. The accelerated failure time model mitigates

this sensitivity by using panel data, which, again, make more efficient use of the data in the event of important time-varying effects within the observation window (Kiefer, 1988).

Third, survival models offer further advantages over logit, probit, or discriminant analysis because they focus on the conditional rather than unconditional probability of failure and therefore adjust for survivorship bias in the present analysis (Kiefer, 1988).

This paper uses a parametric survival model to fully account for the changes in bank financial condition during the observation period. Implementing the parametric model requires choosing a parametric distribution whose shape closely mimics the baseline survival rate of the sample over time. Bank failures during the Great Depression were high shortly after December 1931 and subsided thereafter. Since time, for the present purpose, begins at December 31, 1931, this paper uses the Weibull function to parameterize the model so that the hazard function declines over time in a similar fashion (Kiefer, 1988).

An important assumption of the survival model is that all agents face the same initial baseline failure probability. Violation of this assumption may result in inefficient estimates. This is another reason to restrict the analysis to a specific location, time, and macroeconomic environment (Kiefer, 1988; Lancaster, 1985).

The survival model estimates a log-linear hazard model specified as

$$t = \exp(\beta_0 + \beta_1 X_1 + \cdots + \beta_i X_i + \varepsilon)$$

where X_i includes individual bank financial characteristics and t is the number of days the bank survives after December 31, 1931. This specification is similar in nature to those used by Lane et al. (1986), Whalen (1991), and Cole and Gunther (1995) with modern financial data and Wheelock and Kumbhakar (1994) with historical data.[12]

The independent variables for the survival model are the same as those selected for the bank failure equation of the bivariate probit models (although, since we now are modeling survival, the expected signs are reversed). Again, the statistically significant determinants of survival in the basic model (table 3, column 1) are consistent with those found in the historical and theoretical banking literature (Alston et al., 1994; Calomiris and Mason, 2000; Cole and Gunther, 1995; Lane et al., 1986; Whalen, 1991; Wheelock and Kumbhakar, 1994; White, 1984). The proportion of illiquid assets in the portfolio and bills payable and rediscounts at the Federal Reserve (as a proportion of total debt) decrease survival, whereas the level of liquid assets measured by bonds, stocks, and securities owned; loans and discounts (as proportions of illiquid assets); and paper eligible for rediscount at the Federal Reserve (as a proportion of loans and discounts) help banks survive.

Among the earnings variables, losses as a proportion of expenses are associated with decreased survival. But there is an intriguing relationship between loans and discounts (as a proportion of illiquid assets) on the balance sheet and interest and discount on loans (as a proportion of total earnings) on the income statement. Loans and discounts are positively related to with bank survival, while interest and discount on loans are negatively related. In accordance with modern views of the risk-return trade-off, these results seem to indicate that higher-yielding loan portfolios, *ceteris paribus*, were more risky even during the Great Depression.

RFC loans are associated with decreased survival and the coefficient is statistically significant. The model therefore suggests that RFC loans (and, interestingly, the other

Table 3. **Accelerated failure time models with RFC loans and preferred stock purchases**
Each model measures the determinants of log survival time, measured in days, from December, 31, 1931, to December 31, 1935. All survival models use a Weibull parameterization. Bank financial data are from the Federal Reserve *Reports of Condition and Income*. RFC loan and preferred stock data are from monthly *Reports of Activity of the RFC*. The RFC variable in the first three columns pertains to loans, while in the last column it pertains to stock purchases. Standard errors are in parentheses.

	(1)	(2)	(3)	(4)
Constant	11.723***	11.456***	11.720***	7.493***
	(1.693)	(1.743)	(1.726)	(1.013)
Illiquid assets/total assets	− 8.220***	− 8.449***	− 7.367***	− 3.564***
	(1.566)	(1.569)	(1.559)	(1.089)
Bonds, stocks, and securities owned/illiquid assets	3.225***	3.625***	2.622**	2.568***
	(1.252)	(1.311)	(1.272)	(1.031)
Real estate owned/illiquid assets	4.843	5.237*	5.146*	3.406
	(3.791)	(3.704)	(3.824)	(3.415)
Loans and discounts/illiquid assets	3.975***	4.368***	3.303***	2.811***
	(0.983)	(1.110)	(1.014)	(0.819)
Paper elligible for rediscount at the Fed/loans and discounts	1.191**	1.271**	1.113**	1.283***
	(0.591)	(0.587)	(0.597)	(0.513)
Net worth/total assets	2.040*	2.324*	1.618	1.375
	(1.384)	(1.475)	(1.587)	(1.225)
Bills payable and rediscounts/debt	− 3.722***	− 3.745***	− 3.620***	− 2.750***
	(1.378)	(1.379)	(1.404)	(1.145)
Interest and discount on loans/total earnings	− 1.763**	− 1.795**	− 1.883**	− 0.588
	(0.904)	(0.917)	(0.924)	(0.704)
Recoveries/total earnings	1.187	1.402	0.948	− 0.222
	(1.135)	(1.126)	(1.166)	(1.056)
Losses/total expenses	− 1.058***	− 1.046***	− 1.063***	− 0.586*
	(0.415)	(0.416)	(0.423)	(0.366)
Predicted probability of RFC loan or preferred stock purchase	− 3.663***	− 3.994***	− 2.183	6.873***
	(1.483)	(1.510)	(1.723)	(1.276)
Publication interaction variable		3.461*		
		(2.144)		
Interaction for February 2–Jul 21, 1932, loans			− 2.507*	
			(1.571)	
Interaction for July 21, 1932–March 3, 1933, loans			16.151*	
			(10.293)	
Number of individuals in panel	357	357	357	327
Number of bank-year observations	979	979	979	979
Log-likelihood:	− 990.9	− 989.5	− 986.4	− 971.9
Restricted (slopes = 0) Log-L	− 1094.8	− 1094.8	− 1094.8	− 1094.8
Chi-squared ($k-1$ df)	207.9	210.6	216.9	227.6

*, **, *** Statistically significant at the 10%, 5%, 1% level.

major source of temporary liquidity, Federal Reserve discount-window loans) are associated with accelerated failure rather than survival. The institutional history of the RFC provides two testable explanations for the result. The first and most popular explanation is that publicity of loan and preferred stock assistance was an indicator of bank weakness, precipitating runs on institutions receiving assistance. The second explanation

suggests that RFC assistance subordinated the existing creditor queue when loans were collateralized with banks' best assets. These two explanations are investigated in depth next.

Publicity of RFC loans. On July 21, 1932, the House of Representatives mandated that the monthly *Reports of Activities of the Reconstruction Finance Corporation*, submitted to Congress, including the names of all borrowers and amounts lent, be made public. Contemporaries maintained that making RFC authorizations public prompted failures by signaling which banks were weak (Ebersole, 1993; Friedman and Schwartz, 1963; Kennedy, 1973). More recent quantitative studies of aggregate trends in RFC loans and preferred stock purchases and bank failures support this view (Butkiewicz, 1995; Keehn and Smiley, 1988, 1993).

Previous models have specified as ''published,'' all assistance after July 21, 1932. However, this classification is incorrect. Congress typically is in recess two or three times a year, for several months at a time. While the Clerk of the House mistakenly published the RFC *Monthly Reports* on a monthly basis from July 21, 1932 through March 3, 1933, even while Congress was in recess, he was reprimanded for this transgression when Congress reconvened in April 1933 and instructed to make the reports public only while Congress was in session.

I include a dummy interaction variable to capture not only whether RFC loans were published but also the relative size (to total assets) of the published loan, in table 3, column 2. This variable reflects the RFC loans for which the bank names and the amounts authorized actually were published.[13] The publication variable illustrates a positive significant relationship between loan publicity and bank survival. It is interesting to note, however, that, if the publicity dummy is specified (incorrectly) as all assistance (loans, preferred stock purchases, or both) after July 21, 1932, the resulting coefficient, as others have obtained, is negative and statistically significant.

The nonnegative influence from publicity at the micro level is not unexpected. Calomiris and Kahn (1991) suggested that small depositors may monitor the condition of banks indirectly by observing the actions of larger depositors or others that find it economical to expend greater effort gathering information on the bank's condition. Because in the 1930s banks were primarily local concerns, their actions were easily monitored in this fashion. Furthermore, applying for an RFC loan was a decision most often made by a bank's board of directors. Federal Reserve borrowing also is a decision for the board of directors, and although the Federal Reserve does not publish the names of borrowers, the directors and staff of the borrowing institution usually are informed in a timely manner.[14] These insiders may act as the informed depositors in a Calomiris-Kahn framework, informally communicating the condition of the bank to all concerned. If investors (and depositors) were well informed during both the pre- and postpublication periods, there is no reason RFC loans should accelerate failure as long as the loans *per se* did not increase risk. The next section evaluates whether the RFC loans in fact did increase investor and depositor risk.

RFC loan collateral, subordination, and increased risk. Historians acknowledge that RFC loan collateral policies might have had a destabilizing effect on borrowers (James, 1938, p. 1044):

> High collateral requirements forced [banks] to isolate their most liquid assets as security for RFC loans. In April 1932, for example, the Reconstruction Finance Corporation loaned the Reno National Bank over $1,100,000, but in the process took as collateral over $3,000,000 of the bank's best securities. This in itself left the bank unable to meet any future emergency demands for funds by depositors. (Olson, 1977, p. 154)

Additionally, the short maturities and conservative allocations of RFC loans often made it necessary for banks to borrow several times, often cumulatively, using progressively ''less marketable and less valuable assets'' (Olson, 1977, p. 154).

In borrowing from the RFC, banks hypothecated their best assets to secure senior short-term debt. Therefore, the best, most-liquid assets of the firm were removed from the pool that would have been liquidated to pay investors (including depositors) in the event of failure. This practice subordinated the interests and claims of existing investors to those of the new (RFC) investors. Some of the existing investors were equity holders, who were liable for up to double their initial investment in the firm in the event of failure.[15] It is possible, therefore, that stockholders may have voluntarily liquidated the bank to minimize expected losses. Alternatively (or additionally), depositors could have run banks to protect themselves from further violations of the creditor queue, forcing banks to fail—hence the observed negative association between RFC loans and subsequent bank survival.

It is not possible to test directly whether the seniority of RFC loan collateral led to the increased probability of failure for borrowing banks. However, we can gain insight into the presence of such an effect by testing whether the coefficient on RFC loans varies according to the quality and quantity of collateral used to secure RFC loans. The legislation that broadened RFC assistance powers in July 1932 also expanded the class of assets eligible to serve as collateral for RFC loans and reduced interest rates. If a positive change is associated with the effects of RFC lending after July 1932, that would constitute evidence that the degree of collateralization had a negative impact on bank survival.

Table 3, column 3 includes interaction variables (size of assistance/liquid assets) for RFC loans made February 2–July 21, 1932, and July 21, 1932–March 3, 1933 to estimate the different effects of loans across periods. The magnitude and sign of the interaction coefficient for the July 21, 1932–March 3, 1933 period suggest that RFC loans authorized during the panics leading up to the Bank Holiday in March 1933 had a positive effect (net of that effect during March 3, 1933–December 31, 1936) on bank survival. However, the interaction coefficient on RFC loans made February 2–July 21, 1932, is negative and statistically significant. Therefore, loans made when the RFC was most conservative about collateral requirements had the strongest negative effect on bank survival.[16] The nature of RFC lending changed for the period March 3, 1933–December 31, 1936. Since preferred stock purchases quickly became the favored form of assistance for both banks and the RFC after March 3, 1933, RFC loans were made to only the worst banks during that period. The results of this analysis therefore suggest it is more likely that collateral claims on bank assets, rather than publicity arrangements, prompted accelerated failures under the RFC loan program, and this effect subsided when collateral requirements were relaxed.

RFC preferred stock purchases. Table 3, column 4 contains the results of a survival model with RFC preferred stock purchases. The effects of bank financial characteristics

in the model are qualitatively similar to those in the previous models. However, RFC preferred stock purchases are associated with increased survival instead of accelerated failure. This result, while not as surprising as that for RFC loans, agrees with the results from that model. First, if publicity *per se* were an important problem with RFC assistance, the effects of the RFC preferred stock purchase program would not differ so substantially from those of the RFC loan program. Both would tend to illustrate negative (or no) relationships with bank survival. Second, the positive relationship between RFC preferred stock purchases and bank survival is consistent with the results that attribute the failure of banks receiving RFC loans to a subordination of existing debt and equity claims. That is, effective bank policy requires the lender to assume substantial default risk, whether through collateral or equity.

5. Summary and conclusions

The paper estimates the effect of RFC loans and preferred stock purchases on bank failures during the Great Depression. The results suggest that RFC loans did not help banks survive the Great Depression. Further analysis suggests that result is due primarily to the way RFC loan collateral subordinated existing claims on the firm. When RFC loan collateral requirements were relaxed, the negative influence of loans diminished. The relaxation of collateral requirements culminated in the RFC preferred stock purchase program, which did help banks survive.

The results of my analysis suggest that an effective policy to reduce bank failures required the government to bear substantial default risk. The results pertaining to RFC loans and preferred stock purchases demonstrate that default risk can be assumed in a variety of ways, including reduced collateral requirements or equity (or even junior long-term debt) recapitalization. However, it appears that an effective policy to enhance recovery from banking crises and prevent them from resulting in a more widespread economic downturn relies critically on assuming substantial default risk.

There are limits, however, to applying this conclusion to current crises. Most important, the RFC could not replace the central bank. The RFC relied critically on central bank policy that sustained regular, steady, monetary growth, and the success of RFC operations depended on what happened in the rest of the economy. In a similar vein, the results of the RFC preferred stock purchase program also benefited from heightened perceptions of bank solvency following the nationwide Bank Holiday in March 1933 and the establishment of the FDIC on January 1, 1934, since bank runs subsided after these events. Therefore, although my analysis suggests banking crises can be ameliorated by outside assistance, such policies should not be isolated from the broader institutional reforms that should accompany financial system restructuring.

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Notes

1. This is not to say the Federal Reserve System did not discount obligations for other purposes. The Federal Reserve Banks maintained normal discount window operations to smooth seasonal cash flows associated with agricultural cycles and provide for normal liquidity needs associated with clearing and settlement of payments.
2. The preferred stock sold to the RFC was not typical, in that it carried full voting rights like those granted owners of common stock. These voting rights could be used to take over management if necessary and therefore limit credit risk exposure. See Mason (1996, 2001) for further details on the individual RFC programs and their operations.
3. These reports were made public while Congress was in session after Fall 1932 and were reproduced in the government *Serials* collection, the *Commercial and Financial Chronicle*, and many newspapers and other publications. The sole source for the reports submitted when Congress was in recess remains the Archive of the Clerk of the House of Representatives.
4. Although the effect for the preferred stock program is less profound, I follow the same strategy with data from that program.
5. See Heckman (1976) for econometric details.
6. The majority of RFC investments, both in my Illinois sample and at the national level, were made after December 1933. To capture banks receiving investments in the earlier period and adjust for survivorship bias, I add back the last observed call data for banks that received investments (3 banks out of 72 total preferred stock purchases) or failed (21 banks out of 44 total failures) between March and the observed December 31, 1933 Call Report. This sampling technique does not substantially alter the results of the bivariate probit or the survival models that follow.
7. See, for instance, Altman (1968, 1993); Altman et al. (1977); and Barth et al. (1985)
8. Alston et al. (1994); Calomiris and Mason (1997, 2000); Wheelock and Kumbhakar (1994); and White (1984) all rest on a similar assumption. Although econometrically separating economic failure from regulatory closure as suggested by Maddala (1986), makes sense, it has proven difficult in practice. Cole (1993, p. 295) reported a correlation of 0.9946 between the two processes with contemporary data. Maddala suggested the correlation should be significantly different from 1.
9. See, for instance, Alston et al. (1994); Calomiris and Mason (1997, 2000); Cole and Gunther (1995); Lane et al. (1986); Whalen (1991); Wheelock and Kumbhakar (1994); and White (1984).
10. Reserve cities are Chicago (31 banks) and Peoria (3 banks). Excluding the Peoria banks does not substantially affect the results.
11. An important aspect of the RFC loan and preferred stock purchase models deserves note. The RFC stated at its inception that its main objective was restoring economically weak but not insolvent banks (*RFC Circular #1*, 1932). However, the RFC was financed through the sale of equity to the U.S. Treasury, much like a modern government-sponsored enterprise, and therefore required a modicum of profit to maintain operations. The RFC balanced these competing needs by lending only to ''reasonably sound'' banks. This restriction could have implications for the appropriate specification of the models of RFC loans and preferred stock. If the RFC provided assistance only to reasonably sound applicants, one might expect an *n*-

shaped plot of loan probability on bank condition. That is, as the bank's condition worsens, the probability of receiving assistance may rise, until the probability of repayment approaches a lower bound. The present data set of Federal Reserve member banks does not contain numerous state-chartered, nonmember banks. If these banks suffered disproportionately during the Great Depression, they may be expected to lie below the RFC's lower bound of repayment probability. Plots of the probability of failure and various measurements of lending or the probability of getting loans illustrate the expected quadratic effect (Mason, 1996). However, a quadratic term on the probability of failure in the bivariate probit loan model reduces the explanatory power of that specification. Since this lower tail of the RFC's decision function is not detectable in the present data, the loan determination process is treated as linear.

12. Readers interested in further details of the survival procedures should see Kiefer (1988) and Lancaster (1985, 1990). Numerous applications of this technique are found throughout labor economics in examining the determinants of unemployment and duration of employment spells (for example, Sedo and Whatley, 1998) and medicine (to investigate the duration of illness following a path of medication).
13. I assume that the list containing all RFC assistance from February 2 to July 21, 1932, published in January 1933, was issued too late to have any significant impact on individual banks. However, it may have had the effect of increasing uncertainty about all banks when it revealed loans to banks previously believed sound.
14. I thank Alton Gilbert for this insight.
15. The double liability concept and the incentives it fostered are discussed at length in Kane and Wilson (1998).
16. Experiments with dummy and interaction variables for the Chicago panic of June 1932 (not reported here) provide evidence that the effect cannot be attributed solely to that event.

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