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Bank Capital and Portfolio Management: The 1930s "Capital Crunch" and the Scramble to Shed Risk*

We model the trade-off between low-asset risk and low leverage to satisfy preferences for low-risk deposits and apply it to interwar New York City banks. During the 1920s, profitable lending and low costs of raising capital produced increased bank asset risk and increased capital, with no deposit risk change. Differences in the costs of raising equity explain differences in asset risk and capital ratios. In the 1930s, rising deposit default risk led to deposit withdrawals. In response, banks increased riskless assets and cut dividends. Banks with high default risk or high costs of raising equity contracted dividends the most.

I. Introduction

Focusing on New York City banks in the 1920s and 1930s, this study examines how banks manage their asset risk and capital ratio during normal times and in response to severe shocks. Recent models of banking under asymmetric information argue that bank capital can be costly to raise and that depositors penalize banks that offer high-risk deposits. We develop and apply a simple framework that identifies the tradeoffs among the alternative means of satisfying depositors' preferences for low-risk deposits (i.e., low asset risk versus high capital). That framework also

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illustrates how bank "capital crunches" can arise—contractions in lending that result from losses in bank capital.

In our empirical work, we examine how banks simultaneously targeted their asset risk and capital ratios to achieve low deposit risk in the interwar period, and how banks responded to large adverse shocks to their capital during the Depression, which temporarily raised the default risk of their deposits.

We focus on the behavior of New York City banks during the interwar period for two reasons. First, our choice of sample reflects a historical interest in the role of bank credit during the Great Depression. Second, data on the behavior of historical banks (banks that existed prior to regulatory standards that now constrain capital and portfolio choices) are uniquely valuable for testing theories of bank portfolio and capital choices under asymmetric information. The choice of New York reflects the importance of the city as a banking center, as well as the availability of data for these banks.

We find that during the 1920s profitable lending opportunities and low costs of raising capital prompted banks to accumulate capital and increase their asset risk, while still maintaining low default risk on deposits. In response to loan losses in the early 1930s and the high costs of raising new capital, banks faced significant pressure from depositors to reduce deposit risk. Banks cut dividends but avoided new offerings of stock and, thus, allowed capital to remain low. The primary means to reduce depositor risk, and thus prevent deposit withdrawals, was the contraction of the supply of loans. Banks replaced loans into riskless assets. This was a gradual process that took place over several years, owing to large adjustment costs of loan liquidation. Cross-sectional differences in the adverse-selection cost of issuing new equity (which we identify using secondary market bid-ask spreads) explain differences in banks' choices of asset risk and capital ratios.

These results provide evidence consistent with the view that the contraction in bank credit during the Depression was largely a result of a "capital crunch" that forced banks to limit their loan portfolio risk. Our results also provide an explanation for the decline in bank capital and the increase in bank cash reserves during the 1930s. Previous work has viewed capital and liquid assets of banks in isolation and has produced opposing claims about changes in the risk preferences of bankers during the interwar period. Friedman and Schwartz (1963)—focusing on holdings of liquid assets—argue that banks became more risk-averse in the 1930s, while Berger, Herring, and Szego (1995)—focusing on book capital measures—reach the opposite conclusion. We find that bank risk aversion (measured as the targeted level of deposit risk) did not change from the 1920s to the 1930s; the difference between the 1920s and the 1930s was the relative importance of capital and liquid assets as mechanisms for insulating depositors from loan risk.

Our discussion divides into six sections. Section II reviews the theoretical literature on bank portfolio and financing choice, and the literature's relationship to the debate over the role of bank credit contraction during the Great Depression. Section III develops a simple model that provides the basis for our empirical work. Section IV contains the empirical analysis of individual New York City banks' behavior from 1920 to 1940. Section V discusses our contribution to the question of whether banks became more or less risk-averse in the wake of the Great Depression. Section VI concludes.

II. Portfolio Risk and Financing Choices under Asymmetric Information

What is the optimal risk structure of a bank's portfolio? How is that portfolio risk distributed between bank debt and capital—in other words, what is the optimal leverage of a bank? Recent models in corporate finance—especially those that analyze the financing problem of banks—argue that there is a connection between these two questions. In particular, this new literature implies that the "debt capacity" of a firm (the maximum economical amount of debt it can issue) is a decreasing function of its asset risk.

The frameworks of Leland and Pyle (1977), Campbell and Kracaw (1980), and Myers and Majluf (1984) derive the more general point that the riskier the claims offered to outsiders, the more costly it will be to raise funds from outsiders. Those models imply that it is always desirable (if possible) for informed "insiders" to hold equity and for outsiders to hold low-risk debt. If firms are driven to issue risky claims to outsiders, doing so is highly costly, since outsiders have to be convinced of the quality of the firm's assets. Indeed, the difficulty of raising funds from outsiders in the form of junior claims explains why underwriting costs for equity offerings are often very high, particularly for "information-problematic" firms (Calomiris and Himmelberg 2001).

An implication of the asymmetric-information models of corporate finance is that firms can reduce the "lemons cost" of raising funds by reducing (in an observable way) the riskiness of their portfolios. If a firm shifts toward more cash assets, its asset risk declines, and the lemons premium on its outside claims also falls. Lower asset risk raises the firm's capacity to issue low-risk debt.

In banking, there are special problems that tend to reinforce the incentives to issue low-risk debt to outsiders, and thus banks face special incentives to manipulate the composition of their assets (the ratio of cash to total assets) in order to limit the riskiness of their debt. Models of banking under asymmetric information tend to emphasize two special aspects of the banking firm: the potential conflict of interest between bankers and depositors (first emphasized by Diamond [1984]) and banks' role as issuers of transactable media. Both of these problems faced by banks encourage them to offer extremely short-term (typically demandable), low-risk debt. That is, banks efficiently segment their risk, concentrating most risk in the equity and debt holdings of insiders and thus insulating outsiders from bearing risk.

The agency argument for this risk segmentation begins by assuming that because banks are information specialists that are given control over financial assets, agency problems in banking are likely to be especially pronounced. In Calomiris and Kahn (1991) or Calomiris, Kahn, and Krasa (1992), limiting depositors' risks by offering them demandable debt helps to resolve agency problems between the banker and the depositors either by limiting the bank's propensity to take on excessive risk or by preventing the bank from absconding with depositors' funds.

The role of banks as suppliers of transacting media is modeled by Gorton and Pennacchi (1990). They stress that it is difficult for outsiders to value bank portfolios and that this can make it hard to transact in bank claims. Low-risk debt claims on the bank (deposits) will be more easily traded among uninformed third parties because the unknown risk of the bank's portfolio has little effect on their value. Because depositors value the liquidity of their claims, banks will find it advantageous to offer low-risk debt to finance themselves.

These models of banking under asymmetric information imply that banks will face strong market pressure to offer low-risk debt to outsiders, both because such debt protects depositors from inappropriate bank behavior, and because it enhances the liquidity of bank claims. Banks that try to raise funds from outsiders by offering riskier claims will suffer cost penalties (or, as in Calomiris and Kahn [1991], may not be able to raise external funds at all).

These models also offer insights on how banks are likely to respond to shocks. If a bank experiences loan losses (which reduce the bank's capital in market value terms and raise both the asset risk and leverage of the bank), the riskiness of bank debt will consequently rise. For example, even if depositors cannot observe the precise characteristics of the bank's portfolio, they can observe economic downturns and make projections about the consequent average loan losses experienced by banks. Depositors who were previously content with the low riskiness of their claims will respond to the increased risk of bank debt by penalizing their banks—either by demanding a penalty interest rate (a rate that contains a "lemons premium") or by withdrawing their funds and placing them in other banks, in postal savings accounts (popular during the interwar period), or under the proverbial mattress.

In this environment, banks face strong incentives to limit deposit risk. It will be difficult for a bank to reduce its portfolio risk by selling risky assets—after all, the function of the bank is to hold loans that are not readily marketable (Froot and Stein 1998). The two practical means of reducing deposit risk are (1) to liquidate loans as quickly as possible as they mature and replace them with cash assets or (2) to accumulate new capital, either by retaining more earnings or issuing new capital. None of these alternatives is costless, especially during a recession.

In a recession, attempts to liquidate loans as they mature may force borrowers into financial distress and, thus, reduce the value of bank loans. Furthermore, banks build valuable customer relationships over time through their investments in information (for theory, see Rajan [1992] and Calomiris [1995]; for empirical evidence, see Slovin, Sushka, and Polonchek [1993] and Petersen and Rajan [1994]). Abandoning a loan customer means shedding an asset that earns positive quasi rents for the bank (profits in excess of the risk-adjusted return on marketable assets, which reward banks for ex ante investment in

TABLE 1 **Aggregate Balance Sheet Data of New York City Fed Member Banks for Selected Dates (End-of-Year Data)**

Year	L	$C + T$	$L/(C + T)$	A	D
1922	3,663	1,778	2.06	7,689	6,374
1925	4,732	1,745	2.71	8,952	7,552
1929	6,683	2,004	3.33	13,583	10,173
1931	4,763	2,592	1.84	10,417	7,781
1933	3,453	3,405	1.01	9,496	7,284
1934	3,159	5,289	.60	11,372	9,512
1936	3,855	7,061	.55	13,734	11,824
1940	3,384	13,325	.25	19,688	17,744

SOURCE.—Board of Governors of the Federal Reserve System (1976, pp. 80–82).
NOTE.—Variable definitions: L = bank loans, C = cash assets (cash plus reserves), T = U. S. Treasury securities, A = total assets (book value), and D = total deposits.

information). Thus, loan liquidation is costly, and the loan liquidation process may be very protracted (we will argue below that during the Great Depression the process took years to complete).

Accumulating additional bank capital is also expensive. Issuing new equity in the middle of a recession is costly because the costs of adverse selection (lemons premiums) are countercyclical. Potential purchasers of bank equity are aware of a significant increase in downside risk within the banking system and face high costs of distinguishing good from bad bank loan portfolios. Cutting dividends provides only limited amounts of new capital to the bank (particularly when earnings are low) and reduces stockholder liquidity at an inopportune time (which can backfire on the bank by reducing the value of bank stock).

Thus, during recessions, banks seeking to avoid deposit outflows are caught between the Scylla of loan disposal costs and the Charybdis of high adverse selection costs of raising equity. This costly adjustment process—where banks trade off the costs of losing deposits against the costs of losing loan value and the costs of raising equity—is often referred to as a “bank capital crunch” (Bernanke and Lown 1991).

Macroeconomists (including Fisher [1933] and Bernanke [1983]) emphasize that bank capital crunches entail severe contractions in the supply of bank credit and that these magnify recessionary contractions of economic activity. There is a growing microeconometric literature tracing the effects of bank capital losses on the supply of credit, and a related macroeconometric literature examining the links between bank credit supply and the level of economic activity (Baer and McElravey 1993; Kashyap and Stein 1995; Peek and Rosengren 1997; Van den Heuvel 2002).

Macroeconomists (see Calomiris [1993] for a review) have emphasized the potential importance of the bank capital crunch (and consequent bank credit-supply contraction) during the Great Depression. As table 1 shows, the decline in bank lending by New York City banks during the 1930s was impressive. Furthermore, evidence that bank credit contraction was correlated with economic contraction can be found in Bernanke (1983) and Ramos (1995). But these papers do not convincingly identify a contraction in bank loan supply, induced by the capital crunch. Critics of the Fisher (1933) and Bernanke (1983) view might argue that the correlation between bank credit and economic activity reflects expectations of poor economic conditions that depress the demand for loans. Thus, an important missing link in the existing literature is the one that connects banking distress to the decline in bank lending. In the discussion and evidence that follow, we argue that analysis of individual banks can help to identify the sources of credit contraction.

In addition to contributing to the understanding of the Great Depression, an examination of the behavior of New York City banks in the 1920s and 1930s provides a useful and somewhat unique testing ground for theories of capital crunches induced by asymmetric information problems in banking. Previous empirical work on bank capital crunches has examined recent bank behavior, but such behavior may be an artifact of capital regulation rather than an equilibrium outcome chosen by banks in response to asymmetric-information problems. Currently, banks' capital ratios are regulated as part of the government's safety net and accompanying prudential regulation. Those regulations—particularly, the Basel capital standards and their incarnation in the United States through the Financial Institutions Reform Recovery and Enforcement Act (1989) and the Federal Deposit Insurance Corporation Improvement Act (1991) statutes—have created a regulatory link between capital ratios and portfolio risk (Baer and McElravey 1993; Van den Heuvel 2002). Insured banks may face strong incentives to raise their leverage and expand their lending without concern over depositor discipline (since depositors are now insured by the government). To the extent that banks operate on a "regulatory margin" (rather than setting capital and portfolio risk to satisfy their uninsured providers of funds), capital crunches may simply indicate that regulators are enforcing risk-based capital standards—which are designed to force banks to link their capital ratios and loan ratios.

An examination of the 1920s and 1930s affords a unique opportunity to test theories of bank portfolio and capital structure under asymmetric information in an environment where capital and portfolio risk are not constrained by regulatory capital standards. New York City banks during the 1920s and 1930s are an ideal sample for our purposes. Because these banks were large, publicly traded institutions, their balance sheet data and stock prices (which we use to infer market values of capital, bank asset risk, and deposit default risk) are readily available throughout the interwar period. Furthermore, the risk choices of publicly traded New York City banks probably were not significantly influenced by the passage of deposit insurance in 1933. New York City banks' deposits were typically too large to be covered by deposit insurance in the 1930s (Saunders and Wilson 1995).

III. Theoretical Framework

We develop and apply a simple model, which combines Black and Scholes (1973) contingent-claims pricing of deposits with information asymmetry between bankers and outside funding sources, and which identifies the trade-offs among the alternative means of satisfying the depositor low-default-risk constraint. The equilibrium choice of capital and portfolio structure reflects the opposing influences of the cost of raising bank capital from outsiders and the quasi rents from lending that are forgone when banks contract portfolio risk.

The dynamic macroeconomic process giving rise to capital shocks, and banks' costs of adjustment to reach long-run equilibrium, are not modeled here explicitly. The comparative statics of the long-run model of bank capital and asset risk choice, however, provide insight about the nature of long-run adjustment to recessionary shocks. Adverse economic shocks will reduce bank capital, raise the adverse-selection costs of issuing equity, and reduce quasi rents from lending. The model predicts that such exogenous changes will produce no long-run change in the riskiness of deposits but will result in persistent reductions in capital and in substitution into riskless assets and away from loans. The costs to the bank of liquidating loans (quasi rents forgone and counterproductive financial distress of clients) may make the reduction of deposit risk and asset risk a gradual and protracted process.

The scale of the bank (A) is assumed to be predetermined. Assume that a bank can hold two kinds of assets, risky loans (L) and riskless "reserves" (R):

$$A = L + R. \tag{1}$$

Asset risk is defined as the standard deviation of asset returns (s_A). From equation (1) we know that:

$$s_A = (L/A)s_L, \tag{2}$$

where s_L is the exogenously given riskiness of loans (the standard deviation of the returns to the loan portfolio). For convenience, we adopt the other basic assumptions of Black and Scholes (1973) regarding the evolution of asset returns over time and the normality of s_A, although we consider variations in the Black and Scholes model that incorporate extended liability of shareholders, where appropriate. The role of the Black and Scholes model in our framework and empirical work is to provide a concrete shape to the isorisk map for deposits—a set of lines shown in figure 1—not to test alternative frameworks for pricing deposit risk, of which the Black and Scholes model is one. Given the exogeneity of loan portfolio risk, the choice variable of the bank for setting asset risk is (L/A).

Banks earn quasi rents from lending (as in Rajan [1992]). That is, banks possess private information and, hence, valuable client relationships that make the risk-adjusted profits from lending positive. Thus, banks are not indifferent to the relative size of their loan and riskless asset portfolios; in our model, if external finance were not costly because of asymmetric information, banks would choose to hold all their assets in loans (because we abstract from physical transaction demand for reserves unrelated to the risk of bank assets).

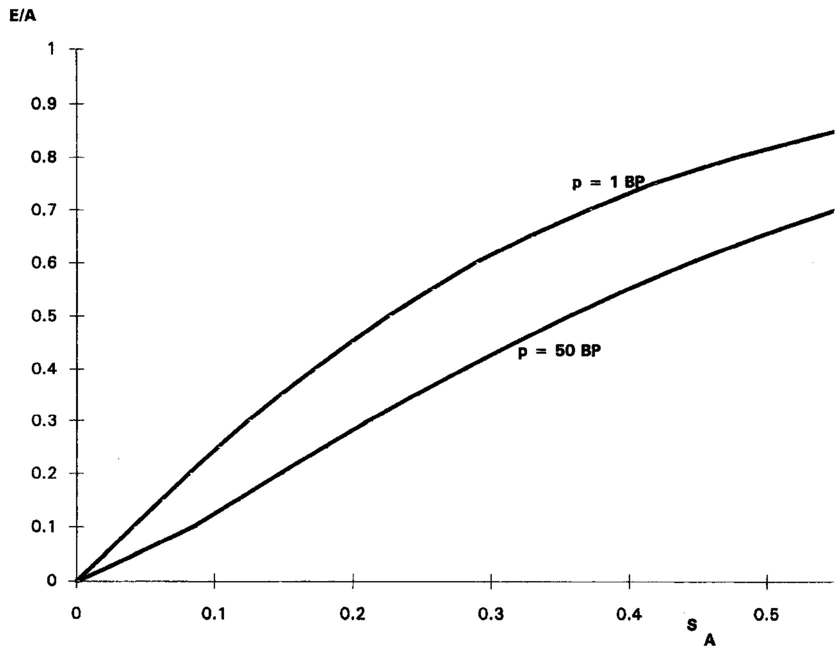

FIG. 1.—Depositor indifference curves

We assume for simplicity that total quasi rents (r) are a fixed proportion (a) of loans made by the bank. Our results would be qualitatively unchanged if, more realistically, we specified a as a declining function of L:

$$r = aL. \tag{3}$$

Equations (2) and (3) imply:

$$r = aAs_A/s_L. \tag{4}$$

We assume (for simplicity) that bankers raise all equity externally and face adverse-selection costs when issuing equity. According to Calomiris and Raff (1995), during the 1920s and 1930s, fees paid by stock issuers to underwriters typically exceeded 10% of the value of the equity being sold. Additionally, the negative signaling effect of a stock issue may impose underpricing costs on existing shareholders, who sell new shares at a depressed price.

The deadweight cost (C) borne by insiders for issuing equity is assumed to be proportional to the amount offered (see Altmkilic and Hansen [1997] and Calomiris and Himmelberg [2001] for supporting evidence), and the riskiness of assets (s_A) magnifies adverse-selection cost. That is:

$$C = b(s_A)E, \tag{5}$$

where E is the amount of equity issued by the bank. Thus, the market capital-to-asset ratio of the bank is E/A. For simplicity, we assume that the b function is linear in s_A.

The riskiness of bank debt is measured using Black and Scholes (1973). Bank deposits are assumed to have a 1-year maturity—a convenient way of allowing deposits to be at risk of default without sacrificing the continuity assumptions of Black and Scholes. If one assumed a 1-day maturity, given the continuous price movements of Black and Scholes, deposits would always be virtually riskless. Of course, asset prices do not always move continuously, and effective deposit maturity depends on the frequency with which depositors decide on whether to withdraw their funds (which is why default risk is significant even for zero-maturity bank debt). Although we recognize that the specific assumptions we adopt regarding debt maturity and asset returns continuity may give rise to estimated default premiums that are inaccurate in the cardinal sense, our emphasis is on variation in default premiums over time and across banks, and our method seems likely to create reasonable orderings of bank default risk. We also recognize that the Black and Scholes (1973) model assumes costless information and is thus not strictly consistent with our other assumptions of bank quasi rents and adverse-selection costs. But again, we emphasize that our primary empirical goal in using Black and Scholes is to measure differences in deposit risk over time and across banks, rather than to price deposit risk in an absolute sense.

The Black and Scholes (1973) model solves simultaneously for three variables: (1) the riskiness of bank deposits (P)—defined as the credit risk spread (basis points of annual return) that would fairly compensate depositors for the default risk on deposits—as a function of the maturity of debt (assumed here to equal one), (2) the capital ratio of the bank in market value terms (E/A), and (3) the riskiness of bank assets (s_A). The specific functional form is illustrated in figures l and 2. For our purposes, it is sufficient to point out here that a general form of the equation is:

$$P = f(s_A, E/A), \text{ where } f_1 > 0 \text{ and } f_2 < 0. \tag{6}$$

To close the model, we assume that banks target specific levels of P in the long run. One can interpret this long-run target as the result of a combination of stockholder preferences and depositor preferences for low default risk. Gorton and Pennacchi (1990) show that adverse-selection costs reflecting asymmetric information about bank assets will encourage banks to concentrate risk in equity offerings as a means of creating a set of liquid claims (deposits) that can be transacted without significant adverse-selection costs. Calomiris and Kahn (1991) provide a different model of depositor preference for low-risk deposits, which emphasizes the advantages of giving depositors the option to withdraw their funds on demand.

Alternatively, Winton (1993) and Kane and Wilson (1998) argue that the composition of stockholders and changes in extended liability rules could affect, and did affect, banks stockholders' tolerance for risk on their claims. From the perspective of that argument, the effect of extended liability de-

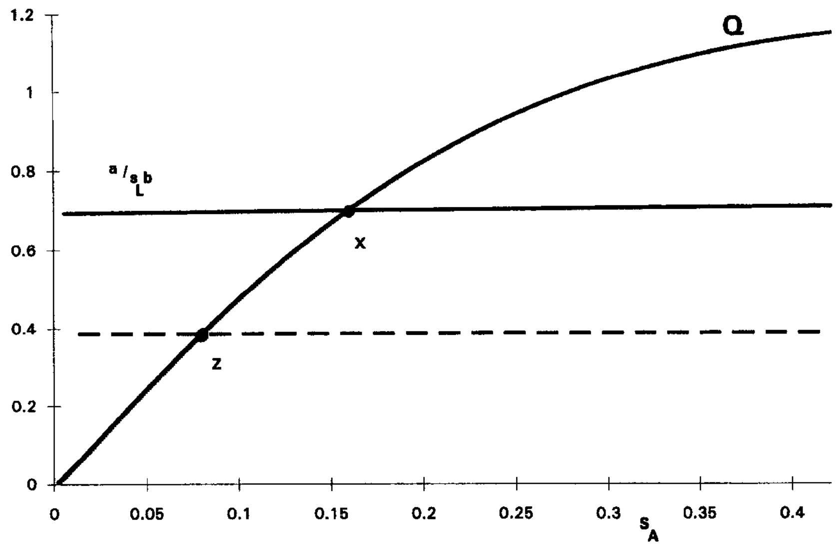

FIG. 2.—Long-run comparative statics with $p = 1$BP (basis point)

pended crucially on the composition of stockholders. If stockholders were informed and wealthy insiders with low risk aversion, extended liability could increase bank managers' chosen level of default risk. By contrast, if stockholders were less wealthy risk-averse outsiders, stockholder risk aversion might limit bank asset risk and deposit default risk by more than the amount necessary to satisfy depositors' preferences. In our empirical work we will consider whether depositor or stockholder preferences were binding constraints on the long-run choice of P during our sample period.

Formally, in our model, we assume that a penalty would be paid by the bank (an increased difficulty of attracting depositors or bank stockholders) if it tried to raise the value of P above a given low level (P_M). For simplicity, we assume that the penalty is zero for risk levels below P_M and prohibitively large for raising default risk above P_M, and thus we effectively assume that banks will always target a long-run equilibrium combination of E/A and L/A that offers depositors deposits with risk equal to P_M. Any strictly convex penalty function would achieve a similar result, namely, resulting in an upper bound on targeted deposit default risk. The assumed nonlinearity of the penalty is consistent with several theoretical interpretations. For example, in the context of the Gorton and Pennacchi (1990) model, a bank's failure to keep its deposit risk sufficiently low may result in its being excluded from the payments system (e.g., being ejected from the clearinghouse). Alternatively, in the context of the Calomiris and Kahn (1991) model, banks offering high-risk debt may simply be unable to attract depositors at any price. In our empirical work, we will allow each bank's choice of P to vary across banks and over time depending on bank characteristics related to stockholder preferences.

The banker's objective is to maximize profit, which equals the difference between quasi rents earned from lending and the physical costs of placing equity. In other words, we assume that the outside depositors and stockholders of the bank receive a fair expected compensation (commensurate with the true asset risk of the bank) and, thus, that the banker merely retains the rents from lending net of the costs of issuing equity. One way to enforce this arrangement would be to tie the banker's compensation to the bank's performance.

Assuming that the banker maximizes profits (J), he maximizes the value of the following expression, choosing E/A and s_A (which is the same as choosing E/A and L/A), subject to the constraint of equation (6) and the constraint that $P = P_M$:

$$J = (as_A A/s_L) - bs_A E. \tag{7}$$

Assuming that $P = P_M$, this expression can be rewritten as equation (8), using equation (6) to express E/A as a function $g(s_A)$:

$$J/A = as_A/s_L - bs_A g(s_A). \tag{8}$$

Recall that A is predetermined. Differentiating with respect to s_A, the first-order condition for profit maximization is given by:

$$a/bs_L = g(s_A) + s_A g'(s_A), \tag{9}$$

where g' is the first derivative of g.

The solution to equation (9) can be illustrated diagramatically. Figure 1 describes deposit isorisk curves for a one-basis point deposit risk premium and a 50-basis point risk premium, drawn in the space defined by s_A and E/A. Figure 2 graphs the two sides of equation (9), assuming that $P =$ one basis point. In figure 2, we define $Q = g(s_A) + s_A g'(s_A)$. The equilibrium value of s_A is determined by the intersection of Q and a/bs_L. For example, whether the bank chooses to locate at point X or point Z depends on s_L and the relative sizes of a and b. The larger is a (or the smaller is b), the more the banker will prefer to satisfy depositor risk preferences by choosing a combination of higher E/A and higher s_A. The functional form of the Black and Scholes (1973) model (which determines g, and hence the shape of Q) guarantees an interior solution for profit maximization (because Q cuts a/bs_L from below). Stated differently, the second-order conditions for profit maximization are satisfied because the Black and Scholes model implies that $2g' > -g'' s_A$.

The comparative statics illustrated in figure 2 are intuitive. When quasi rents from lending are high (for a given cost of issuing capital), bankers prefer to lend more and issue more capital to insulate depositors from the asset risk implied by greater lending. Higher equity issuing costs (for any given set of

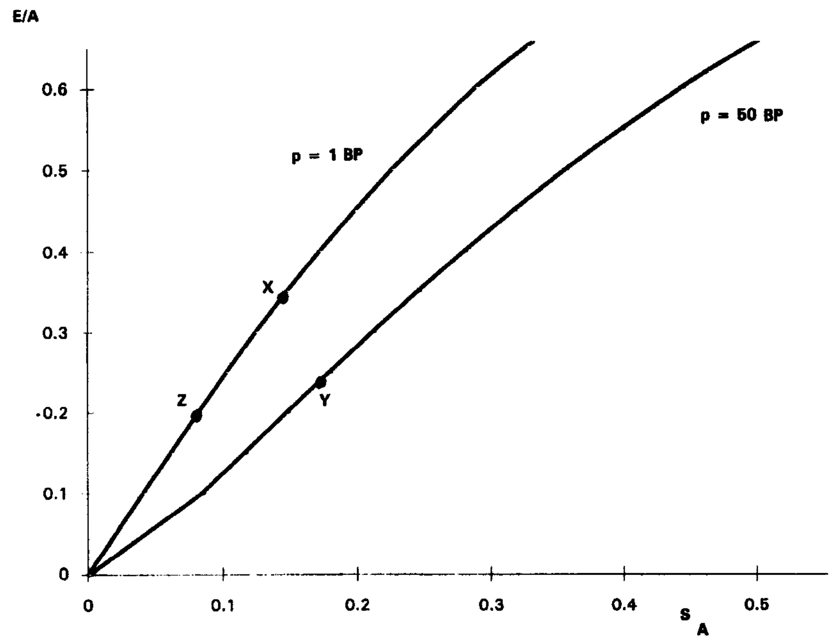

FIG. 3.—Impact of capital shock

lending opportunities) lead bankers to prefer lower equity (hence, they are constrained by depositor preferences to lend less).

Figures 2 and 3 show why it can be difficult to determine whether cross-sectional differences, or differences over time, in banks' chosen combinations of capital and asset risk reflect differences in the marginal cost of raising capital (parameter *a*) or differences in bank lending opportunities (parameter *b*). In figure 2, it is not possible to say whether a bank located at point *Z* has a high *b* or a low value of *a* compared with a bank located at point *X*.

Figure 3 illustrates how reactions to exogenous shocks that reduce capital are similarly hard to trace to changes in *a* or *b*. Figure 3 plots points *X* and *Z* from figure 2 in the space defined by E/A and s_A. Suppose that point *X* in figure 3 represents a bank's position in 1928, and point *Z* represents that same bank's position in 1936. According to the Fisher (1933) and Bernanke (1983) view of the contraction of credit during the Great Depression, the long-run movement from point *X* to point *Z* over the 1930s reflects a combination of exogenous capital loss and a high cost of replacing capital. Alternatively, however, one could argue that the Depression reduced the bank's profitability from lending. A decline in quasi rents from lending can provide an alternative explanation for the movement from *X* to *Z*.

The goals of our empirical work are, first, to show that the framework described here and illustrated in figures 1–3 provides a realistic depiction of bank behavior, and, second, to distinguish between "loan-supply" and "loan-demand" explanations for the contraction in banks' targeted capital and asset risk, which occurred during the 1930s.

IV. Empirical Analysis

Historical Background

The period from 1920 to 1940 witnessed three severe U.S. business cycle contractions: the recession of 1920–21, the Great Depression of 1929–33, and the recession of 1937–38 (for details, see Balke and Gordon [1989] and Romer [1989]). A brief, mild recession also occurred in the second and third quarters of 1924.

In comparison to the other downturns, the Depression was unusually severe in magnitude and duration. The 1920–21 contraction in industrial production (the seasonally adjusted series published by the Federal Reserve Board [Fed]) began in March 1920 and reached bottom in April 1921, and the recovery was complete by November 1922. In the 1924 downturn, industrial production recovered its January 1924 peak level in December 1924, personal income (reported in Barger [1942]) recovered fully by the fourth quarter of 1924, and factory employment (reported by the Bureau of Labor Statistics) recovered by November 1925. The contraction in industrial production that began in September 1929, in contrast, did not reach bottom until March 1933, and the recovery in industrial production was not complete until December 1936. The departure from gold in March 1933, however, was associated with rapid economic recovery, measured by the rate of growth of the economy. Although unemployment remained high throughout the 1930s and the level of gross domestic product remained below trend until World War II, 1934–36 was one of the periods of fastest economic growth in U.S. history. A brief recession in 1937–38 was followed by another period of rapid growth as the United States became an engine of wartime production, first for its allies, and later for itself.

The history of U.S. interwar business cycles is reflected in the balance sheet aggregates of New York City banks in ways that are consistent with our previous theoretical discussion. As shown in table 1 (which reports data for all New York City Fed member banks), the time of aggressive economic expansion, from 1922 to 1929, was associated with rapid loan growth and reductions in the ratio of liquid assets (cash plus Treasury securities) relative to loans and discounts. Banks saw large quasi rents from lending during the boom and were willing to undertake massive issues of new equity to support their increased portfolio risk (to offset the effects on deposit default risk from the rise in asset risk).

Tables 2 and 3 report market-based data for publicly traded banks in New York City (the data appendix describes variable definitions and sources). As shown in table 3 (which reports data for a sample of banks that remained in

TABLE 2 **Summary Statistics for All Banks in the Sample ("Unstable Sample")**

Year	MVE/BVE	E/A (%)	s_A	BID-ASK (%)	P	St.Dev. P	MVA	No. of Banks
1920	1.10	14.05	2.29	2.97	.49	2.5	227	27
1921	1.25	15.63	2.23	2.58	.13	.7	229	28
1922	1.31	14.86	3.85	3.25	40.27	240.1	188	44
1923	1.28	15.00	1.75	2.94	.19	1.2	193	39
1924	1.56	16.60	2.61	2.85	.00	.0	245	41
1925	1.89	18.59	4.76	3.07	3.44	14.3	212	55
1926	1.90	19.11	2.83	2.77	.01	.0	234	46
1927	2.27	24.98	5.80	3.21	.23	1.0	225	51
1928	2.81	27.73	7.46	3.46	.13	.5	382	44
1929	2.04	27.02	13.48	4.55	30.33	76.0	420	43
1930	1.39	20.74	6.92	6.26	15.24	69.9	369	42
1931	.81	14.89	7.13	8.86	127.60	364.5	380	29
1932	1.10	16.80	9.17	6.28	26.23	37.1	498	21
1933	.73	12.08	5.10	7.25	46.86	136.0	413	23
1934	.91	11.67	2.96	5.62	6.70	30.6	523	21
1935	1.23	14.26	5.04	4.71	12.78	55.8	609	22
1936	1.18	13.92	3.20	3.86	.72	3.3	653	22
1937	.84	10.82	2.84	4.75	.35	.8	580	22
1938	.80	9.94	3.08	6.20	7.23	21.3	591	23
1939	1.03	10.98	3.71	6.36	.29	1.2	686	24
1940	.74	7.87	2.17	8.56	10.73	55.0	576	32

NOTE.—The "unstable sample" is defined as the sample of banks that varies over time because of entry and exit. The sample of banks is restricted to banks with available stock prices, as described in the data appendix. Data are measured at year end. Variable definitions: MVE is the average market value of equity, BVE is the average book value of equity, E/A is the average market capital-to-asset ratio, s_A is the average asset volatility (standard deviation of asset returns), BID-ASK is the average bid-ask spread as a percentage of share price, P is the average deposit default premium in basis points (1.00 = 1 basis point), St. Dev. P is the standard deviation of P, and MVA is the average market value of bank assets ($millions).

the sample throughout the years 1920–40) and table 2 (which reports sample data allowing exit and entry of banks), the growth in bank lending during the 1920s was associated with significant increases in the market value of bank stock (MV/BV), and in the ratio of capital to assets (E/A). The boom of the 1920s also led to increases in bank asset risk, which peaked in 1929. Our measures of bank asset risk (s_A) and deposit default premiums (P) are derived from observed stock price variation (using weekly stock prices over the last half of each year) and end-of-year bank balance sheet statistics, using the Black and Scholes (1973) formula after 1933 and a variant of the Black and Scholes formula that incorporates the effects of double liability for bank stock valuation, which was relevant prior to 1933. A full treatment of the effects of double liability on the choices of asset risk and capital is relegated to the discussion of our regression analysis.

Recessions (1920–21, 1924, 1929–33, and 1937–38) are associated with declines in lending activity, increases in the ratio of riskless assets (cash plus government securities) to total assets, declines in bank capital, and increases in the default premium on deposits. Relative to other recessions, the Great Depression saw extreme declines in loan ratios and capital ratios. The recessions of 1920–21 and 1937–38 caused a small increase in deposit default risk, which banks were able to eliminate within 1 year. In 1929–30, bank behavior

TABLE 3 **Summary Statistics for "Stable Sample" of 12 New York City Banks**

Year	MVE/BVE	*E*/*A* (%)	s_A	BID-ASK (%)	*P*	St.Dev. *P*	MVA
1920	1.23	16.73	2.33	2.53	.00	.0	306
1921	1.40	18.03	2.78	2.41	.30	1.0	317
1922	1.51	18.40	4.27	2.09	7.75	26.5	363
1923	1.54	20.25	1.85	1.73	.00	.0	352
1924	1.89	21.70	3.72	1.78	.00	.0	434
1925	2.36	24.77	5.49	1.47	.07	.2	482
1926	2.27	26.10	2.88	1.26	.00	.0	530
1927	2.81	32.16	5.89	1.47	.00	.0	573
1928	3.82	34.16	8.28	2.58	.08	.2	858
1929	2.80	33.10	17.45	2.74	33.46	71.3	1,045
1930	2.06	26.86	8.32	2.05	1.24	2.8	998
1931	1.02	18.54	8.03	4.18	9.18	10.4	739
1932	1.16	19.24	10.62	5.64	34.73	46.8	712
1933	.88	15.02	6.10	5.41	41.69	112.5	641
1934	.98	13.88	3.75	5.48	11.72	40.5	781
1935	1.34	16.96	6.32	4.41	23.09	75.4	907
1936	1.32	16.74	4.31	3.66	1.32	4.5	976
1937	.94	12.95	3.74	4.28	.60	1.0	863
1938	.91	12.05	3.49	5.49	7.08	19.5	923
1939	1.39	14.70	5.55	5.63	.50	1.6	1,133
1940	.93	9.55	2.01	6.71	2.14	7.4	1,260

NOTE.—The "stable sample" is defined as the sample of banks that are present in the database throughout the period. The sample of banks is restricted to banks with available stock prices, as described in the data appendix. Data are measured at year end. Variable definitions: MVE is the average market value of equity, BVE is the average book value of equity, *E*/*A* is the average market capital-to-asset ratio, s_A is the average asset volatility (standard deviation of asset returns), BID-ASK is the average bid-ask spread as a percentage of share price, *P* is the average deposit default premium in basis points (1.00 is 1 basis point), St. Dev. *P* is the standard deviation of *P*, and MVA is the average market value of bank assets ($millions).

was similar, but subsequent shocks in 1931, 1932, and 1933 posed an unprecedented challenge to banks, and they were unable to reduce their default risk quickly during those years.

The Depression was also unusual in another respect. In other recessions, deposit outflows were relatively minimal, while during the Depression deposit outflows were large. From June 1930 to June 1932, New York City banks' deposits fell more than 30%. A possible explanation for the unusual decline in deposits over this period is the reaction of risk-intolerant depositors to the severity of bank capital loss and the slow adjustment back to low risk on deposits.

Clearly, the primary means banks employed for controlling their asset risk was the ratio of risky assets to riskless assets, and this variable declined steadily throughout the 1930s. As shown in table 1, the ratio of the (book) value of loans to the sum of cash, reserves, and government securities rose from 2.06 in 1922 to 3.33 in 1929, then declined to 1.84 in 1931, and continued to decline, eventually reaching 0.25 in 1940.

Despite bankers' willingness to substitute away from loans into cash, the combination of high adjustment costs to liquidating loans, and the series of closely timed adverse shocks that buffeted banks in the early 1930s, left banks no alternative but to allow deposit risk to rise from its historical levels (the movement from point *X* to point *Y* shown in fig. 3). Our measure of depositor risk on average for all banks (table 2) rises to a peak of 127.6 basis points in 1931; the average peak for the stable sample of banks reaches its apex of 41.7 basis points in 1933. (The difference between the two samples in tables 2 and 3 reflects the fact that several risky banks exited our sample in the early 1930s.)

The immediate post-Depression years (1934–36) correspond to the adjustment process back to long-run equilibrium with respect to deposit risk (a movement from point *Y* to point *Z* in fig. 3). By the end of 1935, long-run equilibrium had been essentially restored. Deposit risk rose once again briefly during the recession of 1937–38, and again in 1940 because of a decline in bank equity prices, which may have been related to wartime concerns.

Banks did not replace the capital that was lost during the Depression, and capital ratios fell sharply from their peak in 1928–29. Many banks had issued new stock in the 1920s. Several banks issued equity several times during the 1920s. For our sample of banks, we recorded 95 stock offerings from 1920 to 1930 (see table 6), but virtually no new stock was issued after 1930 (as shown in table 6, we identified only four stock offerings for our sample of banks from 1931 to 1940, two of which happened in 1937—in the aftermath of 4 years of economic recovery). The decline in bank propensity to issue stock is consistent with the view that, in the aftermath of the Depression, as the potential for hidden loan losses loomed large, the adverse-selection cost of new stock issues was prohibitive, and thus banks sought to satisfy the depositor risk constraint through continuing reductions in portfolio risk rather than offerings of new equity.

Banks cut dividends dramatically after 1929 (see table 9). Clearly, banks were eager to amass capital but were not willing to pay the costs of accessing equity markets in the 1930s to do so. Of the 21 banks in our 1939 sample, 18 cut (nominal cash) dividends from their 1929 levels, one kept dividends unchanged, and two raised dividends.

Secondary market bid-ask spreads for bank stock provide another window on the adverse-selection costs banks would have faced to raise equity externally. Tables 2 and 3 report data on average bid-ask spreads (as a percentage of share price) for bank stocks. Bid-ask spreads reflect several influences, but an important component of secondary market bid-ask spreads is the adverse-selection premium charged by market makers to compensate for hidden information about the value of equity. Consistent with our argument that banks suffered much larger adverse-selection problems in equity markets during the 1930s than they had previously—resulting from increases in the potential for hidden asset quality problems in banks—tables 2 and 3 show that bid-ask spreads for bank stocks in secondary markets widened significantly from 1929 to 1933 and remained large during the 1930s. That evidence is consistent with the view that adverse-selection costs limited banks' abilities to offer stock in the 1930s.

Another interpretation of the annual averages of the percentage bid-ask spread is that risk (not adverse-selection costs) was pushing up bid-ask spreads over time. To distinguish between these views, we examine the usefulness of bid-ask spreads as measures of adverse-selection costs further in our panel data analysis below.

In summary, the evidence on the average bank changes over time is consistent with the theoretical predictions we outlined in Sections II and III. Six facts about the changes in bank behavior over time warrant emphasis:

1. Banks target a low long-run equilibrium default risk on their deposits.
2. Low deposit default risk is maintained by a combination of sufficient capital and limited asset risk. In the 1920s, low default risk was maintained despite higher asset risk because banks increased their capital. In the 1930s, low default risk was achieved by lowering asset risk to offset the effect of shrinking capital.
3. The Great Depression was associated with very large consecutive shocks to capital, which were not offset immediately by reduced asset risk (owing to adjustment costs associated with large, sudden liquidations of bank loans). Thus, there is prima facie evidence that banks may have been facing unprecedented finance constraints limiting their ability to lend (the Fisher [1933] and Bernanke [1983] hypothesis). Stated differently, the fact that the path from point *X* to point *Z* in figure 3 was via point *Y* (and not merely along the low-default premium isorisk line) is an indication that the supply of loanable funds was a binding constraint on lending during the Depression. Otherwise (according to our model), if banks had been able to raise capital at low cost, they would not have permitted their default premiums to rise above their low long-run equilibrium value.
4. Consistent with the assumption that some depositors are risk-intolerant (and thus that allowing default premiums to rise temporarily is costly to banks), the high deposit default risk during the early 1930s was associated with contractions in bank deposits, which were reversed as default risk declined. The long-run equilibrium in default risk and deposit flows appears to have been reestablished by 1936.
5. The shift from a reliance on capital to a reliance on low asset risk as a means to limit default risk on deposits reflected the fact that banks were unwilling to issue new stock in the 1930s. The low incidence of new stock issues during the 1930s was associated with higher bid-ask spreads on bank stock in secondary markets, which may serve as a proxy for the adverse-selection costs of issuing equity.
6. Banks cut dividends substantially during the 1930s to preserve internally generated (i.e., cheap) capital in order to restore default risk to its low long-run value.

Panel Regressions

We turn now to microeconometric evidence using panel regressions. Our description of banking trends in the 1920s and 1930s focused on variation across time. Here we concentrate on cross-sectional variation, using firm-level data and controlling for time effects.

We find more direct confirmation for the assumptions of the model and the Fisher (1933) and Bernanke (1983) view that banks were finance constrained in the 1930s. The contraction in bank lending seems to be largely attributable to a contraction in the supply of loans. Bank capital losses created strong incentives for banks to curtail their deposit default risk. Reductions in bank lending were the least-cost response, given the desirability of avoiding both depositor "discipline" and the adverse-selection costs of raising new equity.

The rise in deposit risk after 1928 had clear costs for banks in the form of lost deposits. Risky banks that were unable to cut lending and dividends sufficiently to limit the risk of default on their deposits suffered observable costs from not doing so (i.e., lost deposits).

Banks with high adverse-selection costs tended to choose low-capital, low-asset risk strategies compared with banks with low adverse-selection costs. That evidence lends credence to the view that increases in adverse-selection costs placed binding constraints on banks.

Banks moved aggressively to cut dividends despite the value of dividends for liquidity-constrained stockholders. Banks with high deposit risk and high adverse-selection cost tended to cut dividends more than other banks.

Our discussion divides into four parts. First, we test the central assumption of our model—that banks target low default risk on deposits in the long run—by investigating whether the banks that chose higher asset risk also tended to choose higher capital ratios. Second, we test the hypothesized link between increased depositor risk and deposit outflows. Did banks that allowed their default premiums to rise to relatively high levels also experience relatively large "penalties" in the form of deposit outflows? Third, we test for effects of a financing constraint on bank lending by investigating whether adverse-selection costs explain the differences across banks in their propensity to finance through equity. Finally, we examine cross-sectional variation in changes in dividends to investigate the extent to which banks cut dividends in the 1930s in response to the rising costs of funding themselves through outsiders.

Limited versus Extended Liability

Thus far, our discussion has focused on the role depositors play in disciplining bank behavior by encouraging banks to target a combination of asset risk and capital ratio that limits the default risk on deposits. But it is also important to consider how stockholders' incentives may have affected the level of long-run default risk targeted by banks, particularly given the important changes that occurred during our sample period in the ownership of bank stock and the rules governing the extended liability of back stockholders.

Prior to 1933, double liability was the rule for national and state-chartered New York banks. In 1933, banks were permitted to abolish double liability protection at any time after giving 6 months' notice to depositors. Double liability was soon abolished and replaced by strictly limited liability for state and national banks (see Wilson and Kane 1997; and Kane and Wilson 1998). As Kane and Wilson (1998) show, the timing of the shift away from double liability effectively may have begun much sooner. The number of bank stockholders rose sharply in 1929 (partly because of provisions of the McFadden Act of 1927). The value of double-liability protection depends crucially on stockholders' wealth, as shown by Winton (1993). Kane and Wilson (1998) argue that, as stock became widely held after 1929, wealthy insiders held increasingly smaller proportions of bank stock; thus, de facto, double liability protection may have been reduced.

Kane and Wilson's (1998) findings about, and discussion of, double liability suggest that, in addition to depositor discipline, the composition of stockholders and the rules governing their liability for bank losses may have affected banks' chosen levels of deposit risk. We take account of this possibility in our regression analysis below by including variables that capture the potential effects of changes in double liability rules and bank ownership concentration.

Specifically, we allow the bank's choice of capital and asset risk to depend on the ratio of capital subject to extended liability relative to the total market value of capital (i.e., the par value of bank stock relative to the market value of bank assets). If the presence of double liability permitted greater risk taking, then a dollar of capital subject to double liability should have been associated with more asset risk than a dollar of capital not subject to double liability. Conversely, if stockholder risk aversion constrained bank risk, the effect of high par capital on asset risk would be negative.

We also allow the concentration of ownership (measured by the ratio of the number of shares outstanding—which Kane and Wilson [1998] show is a good proxy for the number of stockholders—relative to the total market value of bank assets) to affect the chosen level of deposit risk. Ownership concentration could matter for two opposing reasons. First, to the extent that lower ownership concentration reduced the effective capital of bank stockholders available to be seized (which we call the "poor stockholder effect"), lower ownership concentration would be associated with lower asset risk per unit of capital. By contrast, to the extent that lower ownership concentration enhanced stockholder diversification (what we call the "diversification effect"), lower ownership concentration might have increased the tolerance on the part of stockholders for higher asset risk.

The coefficients on both the par capital-to-market asset value ratio and stockholder concentration are permitted to vary across three subperiods (1920–28, 1929–33, and 1934–40), which allows for differences in the sign and importance of these effects over time. The influence of double liability and ownership concentration on our estimates of deposit default risk and asset risk could vary over time. For example, the ownership concentration effect may have been more different in sign and importance across periods because of changes in the relative importance of the diversification effect and the poor stockholder effect, which could vary over the business cycle. Double liability should also matter differently over time, even after controlling for changes in ownership concentration. Double liability was only in effect prior to 1934, but it might have been most relevant during the period 1929–33, when bank capital was sufficiently low that the put option inherent in double liability had the greatest value for depositors.

Modeling Asset Risk and Bank Capital

We are now prepared to consider more directly the role of market discipline on bank choices of capital and asset risk. If, as we have argued, banks try to maintain low default risk on deposits, then asset risk and capital ratios are not determined independently. For example, bank portfolio risk should increase endogenously in response to exogenous increases in bank capital. Similarly, when capital falls exogenously, banks should reduce their asset risk exposures (or increase their capital) to limit the increases in their deposit default risk. Our model not only implies that risk and capital are positively related, it also has testable implications for the shape of that relationship. As figure 3 shows, the function relating capital ratios and asset risk should have no intercept and should be nonlinear. Differences in depositor default risk tolerance imply the choice of a higher deposit isorisk line (e.g., 50 basis points instead of one basis point). Thus, higher risk tolerance should be reflected in a flatter slope relating the capital ratio to asset risk. Table 4 provides some simple tests of these propositions using data from individual banks.

The regressions reported in table 4 relate changes in bank asset risk to changes in the ratio of the market value of capital to the market value of assets. Our sample includes all available banks (not just the stable sample) for the years 1921–40. We report results for two-stage least squares (2SLS) regressions where possible, which use predicted rather than actual changes in capital as independent variables, to control for endogenous contemporaneous changes in capital. The 2SLS estimates use lagged bank-specific variables and bank type and year indicator variables as instruments. Bank-specific instruments include the bank's lagged capital ratio and lagged asset volatility. Bank type indicator variables identify whether banks are state trusts, state banks, or national banks. We also include lagged industrial production growth as an instrument.

We report several alternative specifications. Our specifications include, in addition to the capital ratio and the square of the capital ratio, lags of the capital ratio and asset volatility (included to allow for the gradual adjustment of asset risk to capital changes), and a variety of other variables included to capture potential depositor or stockholder preferences that may have influenced the desired level of default risk on deposits, which we allow to interact with bank capital in the regressions. (Recall that, according to fig. 3, any variables that affect bank default risk preferences should enter as interaction effects with capital, since the intercept is always zero irrespective of the choice of default risk.)

We included charter type to capture potential differences in depositor preferences related to deposit composition (which may have differed across charter types). Charter-type indicator variables show whether the bank is a trust company or whether it is a national bank, as opposed to a state-chartered nontrust bank. We included a business-cycle indicator (the log difference of industrial production), or, alternatively, year indicator variables, to control for time variation in default risk, given that banks were not always on their long-run default risk schedule. We also included variables that capture differences in ownership concentration and the relative importance of extended liability (i.e., the book-to-market ratio). Finally, we allow the coefficient on the capital ratio to depend on bank size (measured by the inverse of the market value of total bank assets). Bank size should affect the ability of a bank to diversify its loan portfolio and thus limit asset risk.

The regressions uniformly show a large and statistically significant positive relationship between capital and asset risk. The effect of the square of the capital ratio is never significant. When one takes account of cross-sectional and cross-time differences in targeted default risk (in specifications 3 and 4 of table 4), the intercept term is insignificantly different from zero, as predicted by the model.

The bank charter type indicator variables are generally not statistically significant and diminish in magnitude when time effects are included, indicating little difference in risk targeting as the result of charter choice. Lagged volatility enters positively and significantly, supporting the view that adjustment to shocks was gradual. Ordinary least squares (OLS) rather than 2SLS results are reported for the final two specifications, since all the variables used as instruments in the other specifications are captured by the regressors in specifications 3 and 4 of table 4.

The high default risk on deposits shown in tables 2 and 3 in the wake of recessions is apparent in the more positive coefficients on interactive capital ratio-year effects in recession or postrecession years (1922, 1925, 1929–33, and 1939). That is, for any given capital ratio, the slope relating capital to asset risk was steeper during the Depression years than in other years because default risk was higher in those years (as implied by fig. 3). Similarly, in table 4, specification 3, where the growth in industrial production takes the place of the year dummies, the interaction effect is negative, indicating that in the years following low growth in industrial production, banks were temporarily pushed off their long-run default risk choice and accepted higher default risks than normal. Interestingly, 1928 also appears to have been a year of high risk tolerance for banks, perhaps indicating that banks were unusually optimistic about their future prospects.

TABLE 4 **Asset Volatility Regressions**

Variable	2SLS (1)	2SLS (2)	OLS (3)	OLS (4)
Constant	.9885*	1.5098*	−.6135	.1159
	(.3325)	(.6696)	(.4084)	(.3424)
(*E*/*A*)	.2142*	.1822*	.3611 *	.2030*
	(.0171)	(.0686)	(.0421)	(.0614)
$(E/A)^2$		.00128	−.00024	−.00064
		(.00120)	(.00067)	(.00056)
(TC) × (*E*/*A*)		−.0272	−.0536*	−.0292
		(.0278)	(.0202)	(.0160)
(NB) × (*E*/*A*)		−.0413	−.0347	−.0103
		(.0287)	(.0208)	(.0164)
(1/MVA) × (*E*/*A*)			−620,725*	−214,457
			(221,747)	(180,959)
(PAR) × (*E*/*A*)20–28			−.2884	.3434
			(.4917)	(.3987)
(SHR) × (*E*/*A*)20–28			27.339	28.081
			(45.685)	(36.615)
(PAR) × (*E*/*A*)29–33			2.1838*	.6489*
			(.2954)	(.2582)
(SHR) × (*E*/*A*)29–33			11.637*	15.620*
			(5.191)	(4.118)
(PAR) × (*E*/*A*)34–39			.0643	−.1265
			(.6624)	(.5724)
(SHR) × (*E*/*A*)34–39			40.434*	43.612*
			(11.4971)	(9.876)
s_{A-1}			.1134*	.1886*
			(.0394)	(.0397)
E/A_{-1}			−.0851*	−.1057*
			(.0261)	(.0229)
(INDPRO − 1) × (*E*/*A*)			−.2620*	
			(.0419)	
(*D*20) × (*E*/*A*)				.0150
				(.0537)
(*D*21) × (*E*/*A*)				.0038
				(.0521)
(*D*22) × (*E*/*A*)				.0933
				(.0522)
(*D*23) × (*E*/*A*)				−.0596
				(.0513)
(*D*24) × (*E*/*A*)				.0538
				(.0507)
(*D*25) × (*E*/*A*)				.1048*
				(.0494)
(*D*26) × (*E*/*A*)				−.0112
				(.0493)
(*D*27) × (*E*/*A*)				.0704
				(.0488)
(*D*28) × (*E*/*A*)				.1197*
				(.0488)
(*D*29) × (*E*/*A*)				.3431*
				(.0500)
(*D*30) × (*E*/*A*)				.0831
				(.0519)
(*D*31) × (*E*/*A*)				.2040*
				(.0540)
(*D*32) × (*E*/*A*)				.2971*
				(.0547)
(*D*33) × (*E*/*A*)				.1174*
				(.0575)
(*D*34) × (*E*/*A*)				.0271
				(.0564)
(*D*35) × (*E*/*A*)				.1162
				(.0535)
(*D*36) × (*E*/*A*)				−.0082
				(.0539)

TABLE 4 (*Continued*)

Variable	2SLS (1)	2SLS (2)	OLS (3)	OLS (4)
(*D*37) × (*E*/*A*)				.0696
				(.0576)
(*D*38) × (*E*/*A*)				.0676
				(.0586)
(*D*39) × (*E*/*A*)				.1536*
				(.0547)
Adjusted R^2	.2127	.2153	.6807	.8054

NOTE.—Dependent variable: bank asset volatility (standard deviation of asset returns, s_A). Standard errors are in parentheses. Asset volatility is defined as the standard deviation of asset returns, s_A, where returns equals the log difference of market asset value; *E*/*A* is the ratio of the market value of equity to the market value of assets; NB and TC are bank charter indicator variables for national banks and state-chartered trust companies, respectively; PAR is the ratio of the par value of bank stock (stockholder capital subject to double liability) relative to the market value of assets; SHR (the ratio of the number of shares relative to the market value of assets) is a measure of stockholder concentration; I/MVA is the inverse of the market value of assets; INDPRO_{-1} is the lag of the log difference of the Federal Reserve industrial production index; *D*20 . . . *D*39 are year indicator variables; and 1940 is the omitted year dummy. In both two-stage-least squares (2SLS) regressions, *E*/*A* is treated as an endogenous variable, and the list of instruments includes lagged values of the following variables: (*E*/*A*), s_A, and INDPRO (industrial production).

* Coefficients are significant at below the 5% significance level.

The ratio of the par value of bank stock relative to the market value of bank capital enters positively and significantly in table 4, specifications 3 and 4, for the subperiod 1929–33, and is insignificantly different from zero in the other two subperiods. That finding suggests that the extended liability feature of bank capital permitted banks to expand their asset risk per unit of capital during the period 1929–33, when the implicit put option of extended liability was "in the money."

Ownership concentration enters positively and significantly only in the period 1934–40, suggesting that the diversification effect outweighs the poor stockholder effect in that subperiod. That is not surprising, since with the ending of double liability in 1933, the poor stockholder effect should also have disappeared.

Bank size is positively related to bank risk choice (negatively related to the inverse of bank size), although its significance is not robust to the inclusion of year effects. Size effects were similar to those reported here, or weaker when we measured size using book values of assets, or when we included asset size rather than its inverse in the regressions.

Deposit Risk, Deposit Outflows, and the Fisher and Bernanke View

Table 4 shows that a key feature of bank behavior during the Depression was the willingness to allow deposit default risk to rise temporarily above its long-run target, rather than suffer the costs from either rapidly liquidating loans or issuing capital (actions necessary to maintain deposit risk at its low long-run level). In the regressions in table 5, we examine the relationship between individual bank deposit outflows and deposit default premiums for New York City banks. We report OLS results, as well as 2SLS results (using charter

TABLE 5 Deposit Growth Regressons

Variable	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	OLS (5)
Constant	9.528*	10.234*	12.526*	14.192*	12.215*
	(1.038)	(1.093)	(2.415)	(2.547)	(4.997)
P	−.0497*	−.1166*	−.0514*	−.1293*	−.032*
	(.0136)	(.0289)	(.0137)	(.0301)	(.013)
Trust Co.			−4.476	−5.275	−3.858
			(2.809)	(2.906)	(2.598)
Nat. Bank			−2.181	−2.995	−2.576
			(2.998)	(3.094)	(2.776)
INDPRO_{-1}			−2.678	−6.689	
			(6.594)	(6.915)	
Year 1920					−5.11
					(6.58)
Year 1921					−3.33
					(6.45)
Year 1922					10.87
					(6.45)
Year 1923					−6.49
					(6.20)
Year 1924					12.91*
					(6.20)
Year 1925					12.43*
					(5.97)
Year 1926					−1.29
					(5.94)
Year 1927					1.48
					(5.97)
Year 1928					16.03*
					(5.97)
Year 1929					2.16
					(6.09)
Year 1930					−17.88*
					(6.04)
Year 1931					−19.42*
					(6.55)
Year 1932					−5.37
					(6.90)
Year 1933					−14.15*
					(6.81)
Year 1934					15.91*
					(6.89)
Year 1935					2.29
					(6.80)
Year 1936					.49
					(6.72)
Year 1937					−16.53*
					(6.72)
Year 1938					−4.31
					(6.72)
Year 1939					5.59
					(6.64)
Adjusted R^2	.021	.026	.021	.028	.169

NOTE.—OLS = ordinary least squares; 2SLS = two-stage least squares. Dependent variable: annual percentage change in deposits. Standard errors are in parentheses; *P* is the (end-of-year) deposit default premium, derived from the data over the last 6 months of the year (see data appendix); Trust Co. and Nat. Bank are indicator variables for state trust companies and national banks; and 1940 is the omitted year dummy. In the two 2SLS regressions, *P* is treated as an endogenous variable, and the list of instruments includes lagged values of the following variables: (E/A) the ratio of the market value of equity to the market value of assets, s_A (standard deviation of asset returns), and INDPRO (industrial production).

* Coefficients are significant at below the 5% significance level.

type indicators; lagged industrial production growth; and lags of the default premium, equity volatility, capital ratio, and the contemporaneous percentage bid-ask spread on bank stock as instruments).

We find a large and statistically significant positive relationship between deposit default risk (P) and deposit outflows. The inclusion of year effects reduces the size of that effect slightly, but the coefficient on deposit risk remains significant. Instrumenting strengthens the effect of P on deposit growth. One interpretation of the larger negative coefficients for the 2SLS results is that deposit contractions promote (or are associated with) endogenous behavior by banks that reduce deposit risk.

These results provide evidence that depositors were able, in some degree, to identify weak banks and penalize them for undesirable increases in default risk. These results do not necessarily imply that depositors "knew" the Black and Scholes (1973) model; more likely, depositors were able to observe the decline in bank stock values easily and make roughly accurate appraisals of the changing risk of deposits by observing changes in market prices (and associated changes in bank leverage). Similar evidence that depositors were able to discriminate across banks during the Depression in their withdrawals is provided in Calomiris and Mason (1997) for Chicago banks. They use interest costs of debt (rather than implied default premiums) to measure cross-sectional differences in bank default risk. Calomiris and Mason (2003) also find evidence (for Fed member banks nationwide) that forecasts of bank default risk based on interest rate costs and other variables predicted which banks suffered closure or deposit contraction the most during the Depression.

The evidence thus far indicates that our theoretical framework fits the facts of bank behavior during the 1920s and 1930s well. During the 1920s, increases in bank lending opportunities prompted banks to accumulate capital and increase asset risk. Asset risk and capital were maintained such that deposit risk remained small. In response to the adverse shocks to bank capital experienced during the 1930s, banks allowed capital to remain low and reduced asset risk by substituting into riskless assets and limiting the riskiness of their loan portfolios.

What do our results have to say about the question of whether the decline in bank lending was induced by weak loan demand (falling quasi rents from lending) as opposed to the high costs of supplying loans (the Fisher [1933] and Bernanke [1983] view, which requires both a high lemons premium on new equity and the constraint requiring low risk on deposits)? The fact that increasing the risk of bank deposits was costly for banks—in the form of deposit withdrawals—suggests that the cost of supplying loans was a binding constraint for many banks. Obviously, banks experiencing large deposit outflows faced a strong supply-side incentive to cut lending. Thus, the evidence that default risk on deposits rose and that rises in default risk gave banks a strong incentive to cut lending (to preserve deposits) provides support for the Fisher and Bernanke view that the bank capital crunch contracted the supply of lending and thus likely worsened the severity of the Depression.

TABLE 6 New York City Bank Stock Issues and Acquisitions, 1920–40

Year	New Offerings Unrelated to Acquisitions	Acquisitions Financed by New Stock Issues	Acquisitions Not Financed by New Stock Issues
1920	5	0	6
1921	5	0	6
1922	5	1	5
1923	2	0	3
1924	7	3	1
1925	10	2	2
1926	6	1	7
1927	15	5	4
1928	16	4	5
1929	22	7	8
1930	2	1	10
1931	1	0	9
1932	0	0	0
1933	0	0	0
1934	1	0	0
1935	0	0	0
1936	0	0	0
1937	2	0	0
1938	0	0	0
1939	0	0	0
1940	0	0	0

SOURCE.—*Moody's Manual of Investments: Banks, Insurance Companies, Investment Trusts, Real Estate Finance and Credit Companies* (New York: Moody's Investors Service, various years).

NOTE.—The sample of banks is restricted to those included in our database, as defined in the data appendix.

Dividend Payments, Bid-Ask Spreads, and the Cost of Bank Capital

Another approach to testing the Fisher (1933) and Bernanke (1983) view is to investigate how deposit risk and adverse-selection costs affected bank capital accumulation decisions. Were deposit risk and adverse-selection costs binding constraints on dividend payments and bank stock issues? If banks could have raised stock easily in the 1930s, they could thereby have reduced leverage and the risk of default on their deposits. Doing so would have avoided the binding constraint of depositor discipline and the need to curtail the supply of bank loans and payments of dividends.

Our model predicts that banks with higher adverse-selection costs will choose lower capital and lower asset risk (point X rather than point Z in fig. 2). Here we examine the links between adverse-selection costs and decisions to raise capital and pay dividends.

Table 6 presents data on the timing of stock issues for our sample of banks. Table 7 reports logit results predicting the decision to issue stock. We define the event of a stock issue in two ways: narrowly (issuing stock unrelated to an acquisition of another bank) and broadly (including stock swaps associated with bank acquisitions). We include the lagged bid-ask spread and year indicators in our logit regressions for the period 1921–30. The paucity of stock issues after 1930 makes it impossible to extend our logit sample period beyond 1930.

TABLE 7 Logit Regressions Predicting Stock Issues (1921–30)

Variable	Dependent Variable Is Stock (1)	Dependent Variable Is Any Stock (2)	Offering Unrelated to Acquisition (3)	Offering, including Those Related to Acquisition (4)
Constant	−2.71*	−3.73*	−2.71*	−2.89*
	(.24)	(.75)	(.20)	(.45)
ba_{-1}	−.180*	−.178*	−.089*	−.095*
	(.070)	(.070)	(.048)	(.048)
Year 1922		.79		−.11
		(.85)		(.59)
Year 1923		.55		−.31
		(.87)		(.62)
Year 1924		−.04		−1.14
		(1.01)		(.82)
Year 1925		.87		−.21
		(.85)		(.62)
Year 1926		.83		−.08
		(.85)		(.59)
Year 1927		.68		−.22
		(.87)		(.62)
Year 1928		1.03		.22
		(.83)		(.55)
Year 1929		1.49		.61
		(.79)		(.52)
Year 1930		2.21*		1.47*
		(.76)		(.48)

NOTE.—ba_{-1} is the percent bid-ask spread at the end of the previous year; 1921 is the omitted year dummy.
* Coefficients are significant at below the 5% significance level.

We find that the lagged bid-ask spread is useful as a predictor of stock issues, even after controlling for time effects. Banks with lower bid-ask spreads were more likely to issue stock than other banks (irrespective of whether the issuing event is defined narrowly or broadly).

While these results do not provide direct evidence on the 1930s, they do show that the bid-ask spread is a useful measure of the adverse-selection costs of issuing equity. The link between bid-ask spreads and issuing costs during the 1920s lends plausibility to the view that the increase in adverse-selection costs during the 1930s—apparent in the doubling of bid-ask spreads—can explain the absence of stock offerings during that period. Stated differently, from the perspective of the panel findings of table 7, and of the growth in bid-ask spreads shown in tables 2 and 3, it is plausible to argue that banks faced much higher costs of issuing equity in the 1930s than in the 1920s and that this can explain the absence of equity offerings (table 6).

In results not reported here, we checked the robustness of table 7's results to alternative explanations for the predictive power of the bid-ask spread. For example, we included the bank share price as a regressor to control for the potential influence of minimum price ticks on the percentage bid-ask spread. While this is generally an important determinant of percentage bid-ask spreads in current markets, there was no share price effect on percentage bid-ask spreads in our sample, partly owing to the fact that the price per share tended to be high during our period.

The bid-ask spread is not only negatively associated with the decision of whether to issue stock, it is also negatively associated with the capital ratio chosen by the bank (E/A), as predicted by our model. Table 8 reports reduced-form regression results for the bank capital ratio. Consistent with our view that bid-ask spreads capture adverse-selection costs that discourage a high-risk–high-equity strategy, we find that the bid-ask spread is negatively associated with the capital ratio chosen by the bank.

While the percentage bid-ask spread is negatively associated with the propensity to raise capital by offering shares on the market (and the average capital ratio of banks during our period), our proxy for adverse-selection costs is positively associated with the tendency to accumulate capital internally during the 1930s—which was accomplished by cutting dividends. Information and agency costs encourage the payment of dividends, and cutting dividends is costly (Miller and Rock 1985; Ofer and Siegel 1987). Indeed, the fact that New York banks were paying dividends while simultaneously raising significant amounts of equity during the 1920s provides prima facie evidence that paying dividends was valuable to our sample firms.

Table 9 reports dividend data retrospectively for 1929 and 1939, for the banks included in our 1939 sample. Dividend reduction was often large during the 1930s, and there is substantial cross-sectional variation in the extent to which banks cut dividends.

In table 10, we report panel OLS results for the annual percentage growth of nominal dividends for banks over the period 1929–39 (the period that saw significant reductions in bank dividends). We include the percentage bid-ask spread and the default risk on deposits as regressors. Both are significant negative predictors of dividend growth. Banks experiencing high deposit default risk or a high bid-ask spread were likely to cut dividends more than other banks. During the adjustment process of the 1930s, the more a bank needed to reduce its deposit risk (the higher was P), and the harder it would be for the bank to float equity to reduce deposit risk in the future if it had to (the higher was the bid-ask spread, ba), the more the bank reduced current dividends. Cutting dividends, in other words, was both a way to restore low default risk and to self-insure against the possibility of having to raise (expensive) equity in the future, and the value of that self-insurance was highest for banks that faced the highest costs of accessing equity in the market.

V. Implications for Arguments about Depression-Era Changes in Bank Risk Preferences

One of the lessons of our study is that when examining bank portfolio or financing changes during the Depression, it is important to look at both sides of the balance sheet at the same time. Previous analysis of the behavior of banks can be criticized for not having done so. For example, Berger et al.

TABLE 8 Reduced-Form Regressions for Bank Capital Ratio

Variable	1920–40 (1)	1920–40 (2)	1920–28 (3)	1920–28 (3′)	1929–40 (4)	1929–40 (4′)
Constant	.178*	.076*	.254*	.039*	.087*	.023
	(.010)	(.018)	(.017)	(.012)	(.020)	(.017)
Trust Co.	.029*	.039*	.056*	.005	.019	.010
	(.010)	(.008)	(.012)	(.007)	(.012)	(.010)
Nat. Bank	.009	.016	.021	.004	.009	.008
	(.010)	(.009)	(.012)	(.007)	(.014)	(.011)
ba	−.005*	−.0023*	−.0030	.0002	−.0023*	−.0023*
	(.001)	(.0009)	(.0019)	(.0018)	(.0010)	(.0009)
E/A_{-1}				.0095		.0062*
				(.0003)		(.0004)
Year 1920		.049*	−.136*	−.043*		
		(.022)	(.020)	(.011)		
Year 1921		.063*	−.123*	−.023*		
		(.022)	(.020)	(.011)		
Year 1922		.058*	−.128*	−.035*		
		(.020)	(.018)	(.011)		
Year 1923		.060*	−.125*	−.029*		
		(.020)	(.018)	(.010)		
Year 1924		.073*	−.112*	−.027*		
		(.020)	(.018)	(.010)		
Year 1925		.098*	−.085*	−.009		
		(.019)	(.017)	(.010)		
Year 1926		.102*	−.082*	−.026*		
		(.020)	(.017)	(.009)		
Year 1927		.159*	−.026	.010		
		(.019)	(.017)	(.009)		
Year 1928		.186*				
		(.020)				
Year 1929		.180*			.181*	.066*
		(.020)			(.020)	(.019)
Year 1930		.122*			.123*	.022
		(.019)			(.019)	(.018)
Year 1931		.069*			.070*	−.001
		(.021)			(.021)	(.018)
Year 1932		.081*			.083*	.055*
		(.023)			(.023)	(.019)
Year 1933		.036*			.038	.007
		(.023)			(.022)	(.019)
Year 1934		.028			.030	.022
		(.023)			(.023)	(.019)
Year 1935		.051*			.053*	.051*
		(.023)			(.023)	(.019)
Year 1936		.046*			.048*	.029
		(.023)			(.023)	(.019)
Year 1937		.017			.019	.002
		(.023)			(.023)	(.019)
Year 1938		.012			.014	.018
		(.023)			(.023)	(.019)
Year 1939		.024			.025	.031
		(.023)			(.022)	(.018)
Adjusted R^2	.052	.318	.266	.851	.332	.595

NOTE.—The dependent variable is market capital-to-asset ratio (E/A). Standard errors are in parentheses; *ba* is the contemporaneous percent bid-ask spread for bank stock; Trust Co. and Nat. Bank are indicator variables for state trust companies and national banks; 1940 is the omitted year dummy in cols. 2, 4, and 4′; and 1928 is the omitted year dummy in cols. 3 and 3′.

* Coefficients are significant at below the 5% significance level.

TABLE 9 New York City Bank Dividend Changes, 1929–39

Bank	Dividend 1929 ($million)	Dividend 1939 ($million)
Bankers Trust Company	30.0	2.0
Bank of New York & Trust	20.0	14.0
Brooklyn Trust Company	30.0	4.0
Central Trust Company	3.0	4.0
Chase National Bank	10.5	1.4
Chemical National Bank	12.0	1.8
National City Bank	7.0	4.0
Commercial National Bank & Trust	.0	8.0
Continental Bank & Trust	8.8	.8
Corn Exchange Bank & Trust	12.0	3.0
Empire Trust Company	16.0	.6
Fifth Avenue Bank	59.0	24.0
First National Bank	20.0	15.0
Guaranty Trust Company	14.0	7.0
Irving Trust Company	7.0	3.6
Bank of the Manhattan Company	16.0	.9
Manufacturers Trust Company	5.8	2.0
New York Trust Company	20.0	4.0
Public Bank of New York	4.0	1.5
Title Guarantee & Trust Company	36.0	.0
United States Trust Company	60.0	60.0

SOURCE.—*Moody's Manual of Investments: Banks, Insurance Companies, Investment Trusts, Real Estate Finance and Credit Companies* (New York: Moody's Investors Service, various years).

NOTE.—The sample of banks included in this table is restricted to banks in our database (as defined in the data appendix) that were in existence both in 1929 and in 1939.

(1995, p. 403) conclude that the precipitous decline in bank (book) capital-to-asset ratios after 1933 reflected the effects of government deposit insurance, which relieved banks from having to satisfy depositor discipline.

Friedman and Schwartz (1963), examining the asset side of the banks' balance sheets, arrive at the opposite conclusion. They argue that banks felt obliged to increase their holdings of cash and Treasury securities because of the increased risk faced by banks. Friedman and Schwartz argue that the failure of the Fed to act as a lender of last resort made banks realize that they were more vulnerable than they had previously thought.

An implication of the Friedman and Schwartz (1963) view is that bankers and depositors would have targeted lower default risk for any given lending risk than they did prior to the Depression. Berger et al.'s (1995) view implies the opposite—that is, greater tolerance for bank default risk after 1933 than during the 1920s.

Our data do not support either implication. The targeted default risk of deposits in the late 1930s—like that of the 1920s—was very low. Depositors' tolerance for default risk neither rose (as argued by Berger et al. [1995]) nor fell (as implied by our interpretation of the Friedman-Schwartz [1963] view). Once one considers bank capital ratios and asset risk together, New York City banks behaved as if they were responding to the same depositor preferences in the 1920s and the 1930s. Lower capital ratios in the 1930s did not reflect an absence of discipline, and neither did lower asset risk reflect an increase

TABLE 10 **Dividend Growth Regressions (1929–39)**

Variable	(1)	(2)	(3)
Constant	3.77	6.75	7.85
	(4.13)	(8.91)	(9.21)
ba	−1.91*	−1.78*	−1.81*
	(.65)	(.67)	(.75)
P	−.115*	−.131*	−.131
	(.055)	(.057)	(.061)
ba_{-1}			−.225
			(.684)
P_{-1}			.02
			(.08)
Year 1929		11.31	11.42
		(11.01)	(11.15)
Year 1930		−22.31*	−22.38*
		(10.75)	(11.00)
Year 1931		−1.16	−1.35
		(11.12)	(11.27)
Year 1932		−9.70	−9.74
		(11.76)	(11.90)
Year 1933		−11.12	−11.16
		(11.75)	(11.87)
Year 1934		−2.12	−2.55
		(11.81)	(12.00)
Year 1935		−2.86	−3.09
		(11.81)	(11.91)
Year 1936		−.74	−.65
		(11.69)	(11.81)
Year 1937		1.89	2.27
		(11.66)	(11.83)
Year 1938		.36	.26
		(11.66)	(11.76)
Adjusted R^2	.05	.06	.05

NOTE.—The dependent variable is annual percentage change in dividends. Standard errors are in parentheses; *ba* and *P* are the end-of-year percent bid-ask spread and deposit default premium; and 1939 is the omitted year dummy.

* Coefficients are significant at below the 5% significance level.

in risk aversion. Rather, the level of discipline was unchanged, but banks chose to substitute lower asset risk for lost capital because the cost of issuing new capital had risen. We also note that the fact that New York City banks reduced their capital during the Depression is prima facie evidence against the view that deposit insurance caused that decline more generally, since New York City banks enjoyed very little benefit from federal deposit insurance owing to the large deposits held in those banks (Saunders and Wilson 1995).

VI. Conclusion

Recent theoretical work in banking and corporate finance under asymmetric information emphasizes that depositors may be intolerant of default risk on their deposits and may reward banks for keeping default risk low. Information problems also make it more costly for banks to issue stock. Other related work on banking sees bankers as information producers and managers who earn quasi rents through risky lending, based on possessing scarce information. Our theoretical framework combines these insights (along with standard contingent claims pricing) to solve for the equilibrium asset risk choices, and financing choices, of banks.

We apply this framework to New York City banks during the period 1920–40. Our findings support the key theoretical propositions developed in Sections II and III. Capital ratios and asset risk are alternative means that banks use to limit deposit default risk. Normally, banks strive to keep default risk low to avoid withdrawals by risk-intolerant depositors. In response to the capital losses of the Depression, banks substituted into low-risk assets as quickly as possible and cut dividends. Still, they were forced to let their default risk rise temporarily. Over time, as loan liquidation proceeded, default risk returned to its low long-run equilibrium levels.

Deposit outflows were the inevitable cost of choosing not to liquidate loans faster or issue new capital. Banks that suffered larger increases in default risk during the Depression suffered greater percentage shrinkage in their deposit base and made larger cuts to dividends. The reason that banks did not issue new capital in the 1930s was the higher adverse-selection costs (reflected in wider bid-ask spreads) associated with bank stock in the wake of the Depression.

Our findings indicate no long-run change in the tolerance for deposit risk following the Great Depression. We find that banks in the mid-1930s achieved the same level of default risk on deposits via a different combination of capital and asset risk.

Our findings have general implications for the literature on "capital crunches," and for the Fisher (1933) and Bernanke (1983) interpretation of bank credit reduction during the Depression. We have argued that New York City banks faced binding financing constraints that reduced the supply of bank loans. Loans did not decline solely because of the reduced opportunities for profitable lending. Banks scrambled to shed asset risk during this period, to restore their default risk to the low long-run desired level, and to avoid the high cost of issuing capital as an alternative means to reduce default risk. Avoiding the prohibitive cost of issuing capital entailed a costly adjustment process—banks balanced the costs of forgone lending opportunities, disruptive deposit withdrawals, and stockholder displeasure at draconian reductions in dividends.

Despite the support we provide for the Fisher (1933) and Bernanke (1983) view, our analysis also contains a cautionary note. While we have shown that bank lending was constrained in the early 1930s by the capital losses of the Great Depression, we have not shown how much higher bank lending would have been in the absence of those constraints. Our model of bank risk and financing choices (depicted in fig. 2) illustrates why it is difficult to determine the precise extent to which a collapse of lending is caused by lost bank capital. A movement from X to Z in figure 2 reflects some combination of a higher cost of capital and reduced lending opportunities (lower bank quasi rents from lending). While we have argued that financing constraints were important binding constraints during the 1930s, we cannot address empirically the counterfactual question of how much lending would have declined simply due to the decline in lending opportunities because we lack a good measure of the quasi rents from bank lending.

Finally, our evidence—that (1) markets and depositors discriminate across banks when measuring risk, (2) depositors apply market discipline selectively to reward prudence, and (3) the threat of discipline leads banks to reduce asset risk following capital losses—suggests potential gains from reintroducing market discipline into banking. Government safety nets can eliminate the incentive to reduce asset risk in the wake of losses. Indeed, protected banks may increase risk after capital losses (to maximize the value of the safety net subsidy). Requiring banks to meet market standards for prudence could mitigate such moral hazard problems and reduce the vulnerability of banking systems to collapse (see also Calomiris 1997; and Shadow Financial Regulatory Committee 2000).

Data Appendix

The data sample comprises an annual bank balance sheet, dividend, and stock issuance data and weekly stock price data for a sample of New York City banks whose bid and ask quotes were reported in the *Commercial and Financial Chronicle* and whose stock was actively traded over the period 1920–39. In 1920 (1939), this sample included approximately 55 (32) banks, with the largest decline in sample bank numbers during the early 1930s. The sample consists of national banks, state banks, and trust companies, ranging in size from large-money-center banks to smaller borough and suburban banks.

Annual bank-specific balance sheet data, including capital, surplus, deposits, cash, securities, loans, and total assets, were collected from *Rand McNally Bankers Directory*. The balance sheet data were also cross-checked for accuracy with *Moody's Manual of Investments,* which began publication in 1928. This latter resource also allowed us to collect detailed historical accounts of bank capital levels, new capital issues, dividends, and stock dividends and splits.

Bid-ask spreads, market values of capital, and equity returns volatility were calculated from stock prices reported weekly in the *Commercial and Financial Chronicle*. Specifically, the average of reported bid and ask quotes was used to develop a weekly stock series for each bank, which was then adjusted for stock splits and stock dividends. The standard deviation of equity returns was then calculated, based on the 6 months of weekly stock prices preceding the report date, for the bank's (year-end) balance sheet data. The Black and Scholes (1973) model, and a double-liability variant of that model used for the period through 1933, were used to derive implied asset volatility s_A (the standard deviation of asset returns) and deposit default premiums from our measures of market capital values, book values of debt, and equity returns volatility.

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