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Bank Capital and the Credit Crunch: The Roles of Risk-Weighted and Unweighted Capital Regulations

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We investigated whether in recent years banks have increased their holdings of securities at the expense of their holdings of business loans in response to shortfalls of their capital relative to risk-weighted capital standards and relative to a capital standard that made no explicit allowance for credit risk. We estimated that bank credit fell by about $4.50 for each $1 that a bank's capital fell short of the unweighted capital standard. Banks that had less capital than required by the risk-weighted standard appear to have shifted away from assets with low risk weights (securities and single-family mortgages) and to have shifted toward assets with higher risk weights (commercial real estate and commercial and industrial loans). When we included both shortfall variables in a regression, shortfalls relative to the unweighted capital standard significantly affected bank credit, while shortfalls of capital relative to the risk-weighted standard did not. We found no significant effects of capital shortfalls at other, local-competitor banks on bank portfolios. Delinquencies in a given category of a bank's loans generally had significantly negative effects on that bank's holdings of loans in that category. In contrast, banks tended to increase holdings of loans in categories in which local-competitor banks were experiencing higher delinquency rates.

Bank Capital: Regulation and Response

Following the Basle Accord, U.S. regulators in 1989 adopted risk-weighted capital guidelines to assist in the assessment of the capital adequacy of commercial banks. These guidelines were designed to make regulatory requirements involving capital more sensitive to differences in credit-risk profiles among banks, to factor off-balance-sheet exposure into the assessment of capital adequacy, to increase the incentives for holding liquid, low-default-risk assets, and to achieve greater consistency of regu-

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lations across the economies of the largest industrialized nations in the evaluation of the capital adequacy of major banks (Board of Governors of the Federal Reserve System 1989). U.S. banks were required to meet interim standards by the end of 1990 and final standards by the end of 1992. Apparently, because the Basle Accord did not require that capital standards allow for interest rate risk, U.S. bank regulators supplemented the (credit-) risk-weighted standards with standards on banks' ratios of capital to unweighted (i.e., the simple sum of) bank assets. Thus, a U.S. bank may have been affected by a regulatory floor on either its risk-weighted capital ratio or on its unweighted capital ratio.

In addition to regulators having adopted risk-weighted capital standards, it was widely reported in 1990 that regulators had tightened their loan evaluation criteria and thereby effectively raised the required capital-to-asset ratios for banks (Bizer 1993). The primary objective of these policy changes was to produce better-capitalized banks. Unduly low capital ratios had come to be viewed as a major contributor to the S&L debacle of the 1980s. In addition, banks' capital ratios had come to be judged too low when compared with capital ratios of lenders, such as finance companies and insurance companies, that could not avail themselves of federally subsidized deposit insurance.

Though raising bank capital ratios may have reduced the expected costs to taxpayers of future bank failures, moving toward higher and perhaps more appropriate capital ratios may also have imposed costs on taxpayers. Some observers alleged that regulators had effectively raised capital standards so far and so fast in their quest for better-capitalized banks that the aggregate supply of bank credit declined to such an extent that the short-run performance of the macroeconomy was adversely affected.

More stringent public policies may have generated a bank "capital crunch," in that banks restrained the aggregate supply of bank credit in the short run in order to push their capital ratios to levels that were satisfactory to regulators. Support for this view has come from several empirical studies showing a correlation between bank capital and bank credit. Bernanke and Lown (1991), Peek and Rosengren (1992) and Hancock and Wilcox (1993) all reported that unweighted bank credit tended to fall at banks whose capital had declined. Breeden and Isaac (1992) and Hall (1993) attributed much of the slowdown in aggregate bank lending (particularly in business lending) and the concomitant increase in banks' holdings of securities during 1991 to the introduction of risk-weighted capital standards. In contrast, Berger and Udell (1993) concluded that the imposition

of risk-weighted capital requirements had virtually no effect on banks' holdings of loans or securities.

Recent Shifts in Bank Portfolios

The risk-weighted capital standards generally placed greater risk weights on loans than on securities (Basle Supervisors' Committee 1988). Because the aggregate ratio of securities to loans held by banks increased by unusually large amounts soon after the risk-weighted capital standards were promulgated, this shift of bank portfolios has often been attributed to the decrease in the relative amount of capital that banks were required to hold against securities. Figures 1a and 1b display the paths, from 1972 through 1992, of four components of the real volume of bank credit outstanding (including domestic bookings of foreign-related institutions but excluding assets of domestic banks booked abroad).[1] Figure 1a shows the substantial increase since the late 1980s in banks' holdings of securities and the concomitant decline in commercial and industrial (C&I) loans. Figure 1b shows a similar decline in consumer loans and the virtually unchanged volume of banks' real estate loans over the same period.

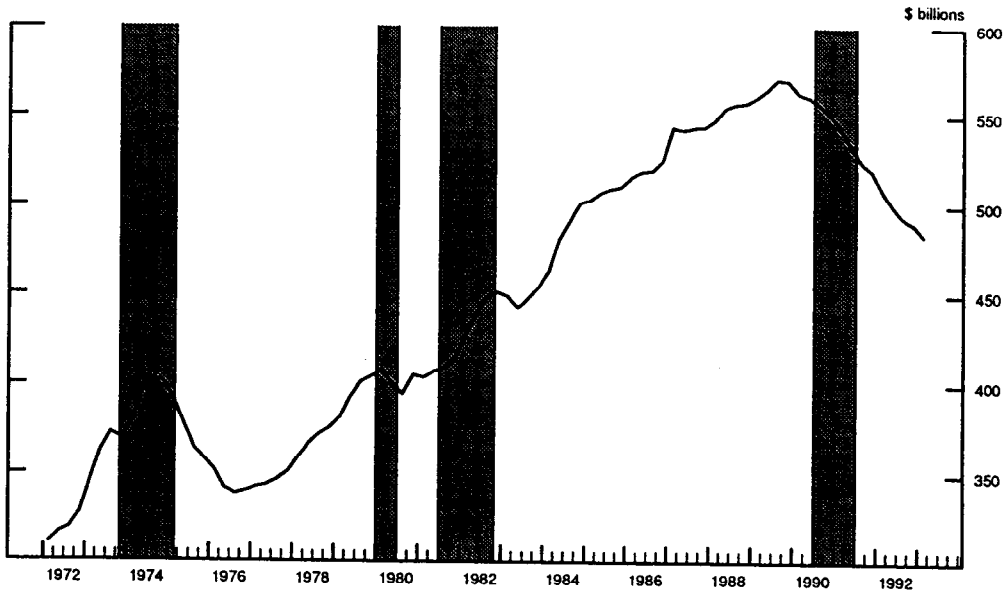
Both consumer loans and real estate loans outstanding apparently behaved during the 1990–91 recession much as they had in earlier recessions. As in earlier recessions, the volume of consumer loans peaked slightly before the business cycle peak and drifted down throughout the most recent recession. Also, the volume of real estate loans rose prior to, and then changed little during, the economy's downturn. If anything, real estate loans rose a bit at the beginning of the 1990–91 recession.

C&I loans and securities holdings, in contrast, behaved differently during the most recent recession than they had during the three earlier recessions plotted in Figure 1. Typically, the volume of C&I loans continued to rise in the early part of those recessions, peaked during the recessions and then declined for a short time even as the economy began to recover. Banks' securities holdings tended to decline before and during those recessions and to begin rising near the economy's trough. During the most recent business cycle, however, C&I loans did not hold to the typical pattern: The volume of loans began to decline before the economy did and continued to slide throughout the recession and well into the recovery. The behavior of securities holdings was equally unusual: Banks held

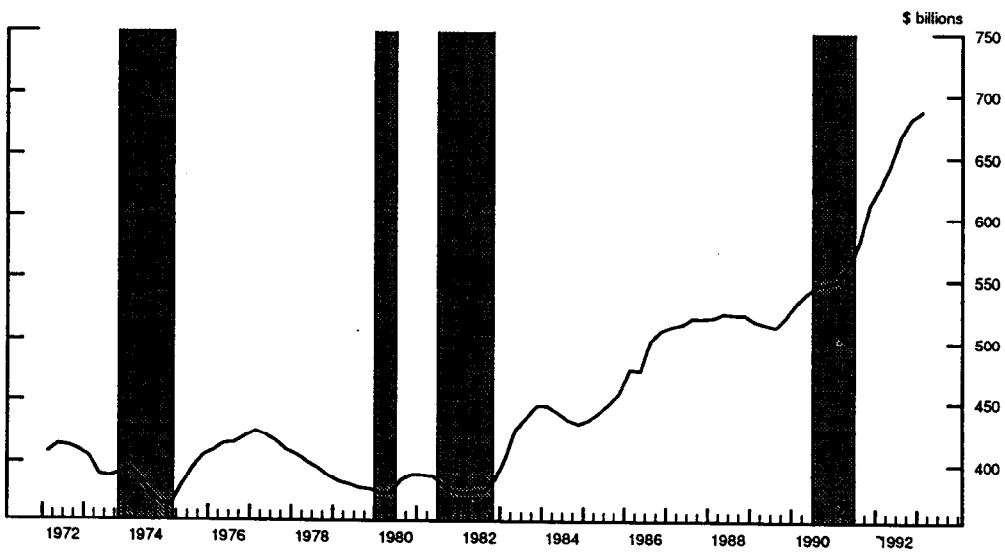
[1] Bank credit is the sum of loans and securities. The data are expressed in constant 1987 dollars, having been deflated by the GDP deflator.

Figure 1a ■ Selected Components of Real Bank Credit Outstanding, 1972–92

Panel A: C&I Loans



Panel B: Securities Holdings

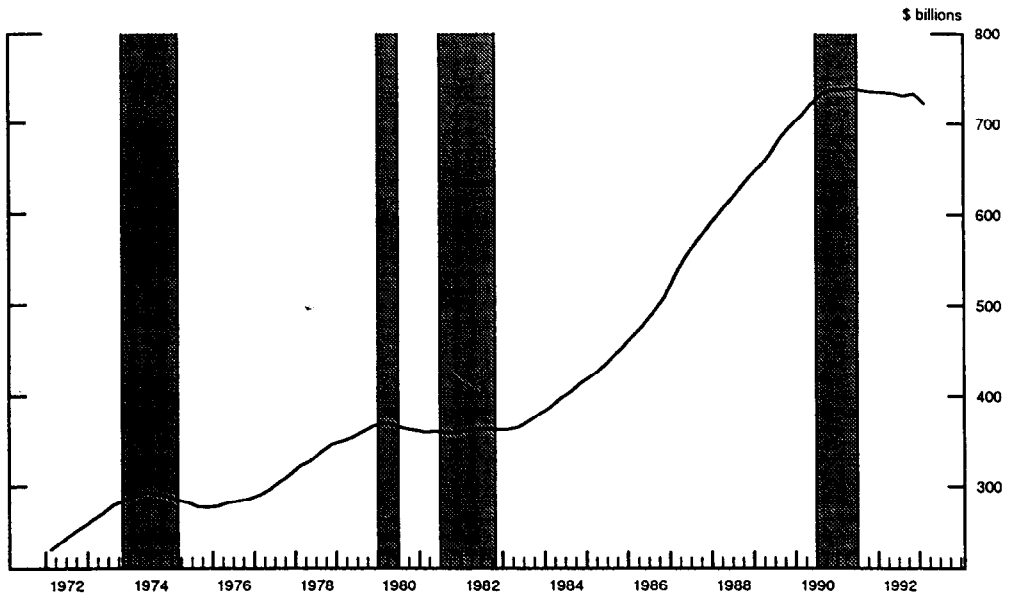


Shading indicates periods of recession as defined by the National Bureau of Economic Research. Included are loans and securities at insured domestically chartered and foreign-related banking institutions (including agencies and branches of foreign banks, Edge Act corporations engaged in banking and New York-chartered foreign inventment company subsidiaries of foreign banks, but excluding international banking facilities).

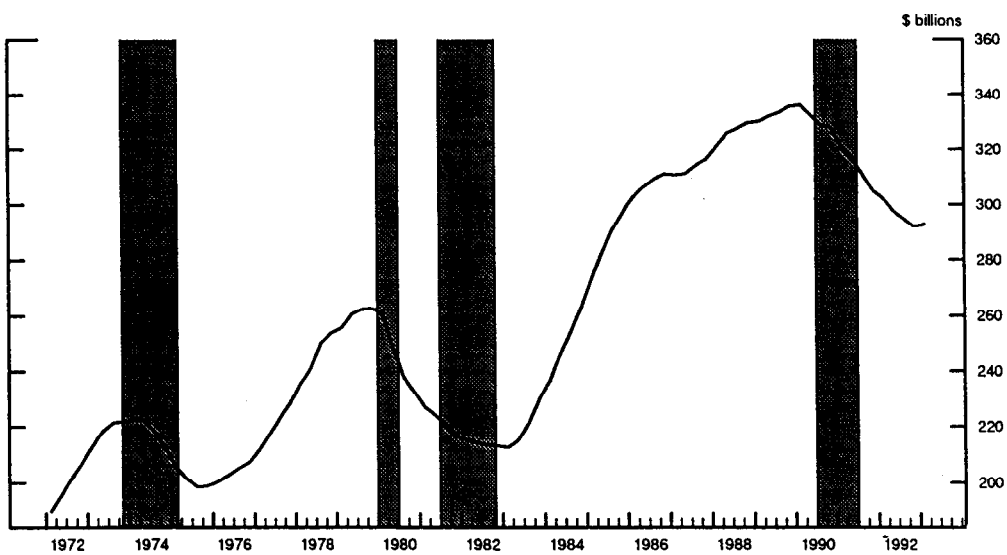
Source: Federal Reserve statistical release H.8.

Figure 1b ■ Selected Components of Real Bank Credit Outstanding, 1972–92

Panel A: Real Estate Loans



Panel B: Consumer Loans



Shading indicates periods of recession as defined by the National Bureau of Economic Research. Included are loans and securities at insured domestically chartered and foreign-related banking institutions (including agencies and branches of foreign banks, Edge Act corporations engaged in banking and New York-chartered foreign inventment company subsidiaries of foreign banks, but excluding international banking facilities).

Source: Federal Reserve statistical release H.8.

increasing amounts of securities before the 1990–91 recession and continued to increase their holdings during and after the downturn. The extent to which regulatory capital pressures on commercial banks accounted for these recent patterns, and for the sluggish growth of total bank credit, is the focus of this paper.

Effects of Capital Pressures

At the same time capital regulations were being stiffened, changes in other conditions may have contributed to the recent shifts in banks' portfolios. Deteriorating conditions in the macroeconomy generally, and in real estate markets in particular, for example, likely had sizable effects on total bank credit and on its composition. We attempted to separate the effects of capital pressures from the effects of other conditions on banks' holdings of loans and securities during 1991. To do so, we first calculated the extent to which banks' capital at the end of 1991 fell short of two proxies for regulators' standards. We then used those shortfall amounts to estimate whether banks altered either the total amount of credit they had outstanding or the composition of that credit in response to pressures on their capital positions.

Our estimates suggest that banks' portfolios shrank when their capital fell short of the proxy for the unweighted capital standard but that estimated bank credit was little affected by also considering shortfalls from the proxy for risk-weighted capital standards. In addition, banks' shifts in the composition of their portfolios in response to shortfalls from the risk-weighted standards seemed inconsistent with the Basle Accord's risk weights. In response to risk-weighted shortfalls, banks primarily reduced their holdings of securities and single-family mortgages, which carry low risk weights, at the expense of commercial real estate and business loans, which carry high risk weights. This pattern of portfolio adjustments points toward the unweighted capital standard as having had a greater influence on bank portfolios than the risk-weighted standard during 1991.

To the extent that capital shortfalls deterred local-competitor banks from lending to creditworthy borrowers, other banks in the local market that had capital surpluses might have been expected to increase their lending, effectively "capitalizing" on the adverse conditions at competing banks. Our estimates uncovered no such spillover effects.

In the next section, we discuss the risk-weighted standards for bank capital and the unweighted capital standard we used to approximate regu-

lators' two capital standards. Shortfalls and surpluses of regulatory capital for each bank were calculated relative to each of the two standards. We then lay out the model and data used to derive estimates of the responses of bank assets to capital pressures and to other conditions faced by individual banks. Following that, we present the results of the regressions. The last section of the paper contains concluding remarks.

Regulators' Standards for Bank Capital

We constructed a proxy for each of the regulatory capital standards, the unweighted- and the risk-weighted standard, that a U.S. commercial bank faced during 1991.[2]

The Unweighted Capital Standard

The proxy for the unweighted capital standard was tier 1 capital equal to 4.75% of bank assets. Tier 1 capital includes common stockholders' equity, qualifying noncumulative perpetual preferred stock (including related surplus) and minority interest in the equity accounts of consolidated subsidiaries. Goodwill is generally excluded, but exceptions were sometimes made when goodwill was acquired in connection with regulator-assisted mergers with troubled or failed depository institutions.

The 4.75% tier 1 capital ratio is a simple approximation to the minimum capital-to-total assets ratio (or equivalently, the maximum leverage ratio) that was required by regulators in 1991. Of course, regulators did not impose the same capital-to-total assets floor on all commercial banks during that year. Rather, they used a rating system based on asset and management quality, earnings patterns and liquidity to assess the current and expected condition of a bank and thus, to determine whether the bank's capital was sufficient. In practice, such an approach could produce a wide range of values across banks for minimally acceptable capital ratios.

In 1991, U.S. banks were required to maintain a ratio of tier 1 capital to balance sheet assets of at least 3% (Federal Reserve Regulatory Service 1993; Baer and McElravey 1992). It seems that, in practice, minimal acceptable capital ratios were somewhat above 3%, and therefore, few banks with capital ratios of around 3% were likely to be free of regulatory pressure to increase their capital ratios. For example, banks with opera-

[2] Throughout this study, we used the reported accounting values of capital, though they could differ considerably from the economic values.

tional weaknesses, or with significant credit or interest rate risk, were expected to have capital ratios at least 100 to 200 basis points above this minimum (Federal Reserve Regulatory Service 1993). Baer and McElravey (1992) argued that 5% or higher capital ratios might be required for most banks. Former FDIC Chairman William Seidman estimated that 99% of all U.S. banks would have to maintain tier 1 capital in excess of 4.5% (Garsson 1990). We experimented with several ratios as candidates for the uniform minimum unweighted capital ratio. Our empirical results proved relatively insensitive to choices of a minimum uniform capital standard between 4% and 6%. The results also proved insensitive to substituting equity capital for tier 1 capital in calculation of capital shortfalls.[3] Below, we report estimates based on a uniform minimum tier 1 capital standard of 4.75%.

The Risk-Weighted Capital Standard

The proxy for the risk-weighted capital standard was based on the Basle Accord.[4] That agreement specified a floor for tier 1 capital plus eligible tier 2 capital minus deductions of 7.25% of risk-weighted assets as of the end of 1990, rising to 8% by the end of 1992.[5] We assumed that banks acted during 1991 as if the relevant risk-weighted capital standard equaled 8% of risk-weighted assets, a standard that was binding as of year-end 1992 but had been announced in 1989. The risk weight assigned to each category of assets was related to the perceived relative credit risk of that type of asset. Broadly, risk-weighted assets were calculated as follows:[6] A zero weight was assigned to U.S. Treasury and agency securities, government-backed mortgages and mortgage-backed securities guaranteed by the Government National Mortgage Association (GNMA); 20% weight to

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[3] Equity capital consists of perpetual preferred stock, common stock, surplus, undivided profits and capital reserves and cumulative amounts of foreign currency translations. The principal difference between equity capital and tier 1 capital is that the former does not include the minority interest in equity accounts of consolidated subsidiaries.

[4] The framework for the risk-based capital standards was developed jointly by supervisory authorities from countries represented on the Basle Committee on Banking Regulations and Supervisory Practices. See Basle Supervisors' Committee (1988).

[5] Tier 2 capital includes other types of preferred stock, subordinated debt, loan loss reserves (up to 1.25% of risk-based assets), and mandatory convertible debt. Eligible tier 2 capital cannot exceed tier 1 capital.

[6] The formulas for evaluating compliance with the Basle capital standards were quite detailed. We calculated weighted risk assets according to Board of Governors of the Federal Reserve System (1989).

most other mortgage-backed securities; 50% weight to qualifying conventional mortgages on one- to four-family homes; and 100% weight to most other loans, including C&I, consumer and commercial real estate loans.

Thus, the total capital required under the risk-weighted standard depends not only on a bank's size but also on the composition of its portfolio. As a consequence, a bank finding itself short of tier 1 capital by the risk-weighted standard might not raise its ratio of capital to unweighted assets to achieve compliance but rather might replace business loans in its portfolio with government securities.

Bank Capital Shortfalls and Surpluses

The extent to which a bank's actual level of capital fell short of our proxies for the regulatory minima was termed the bank's capital "shortfall." If a bank's tier 1 capital exceeded 4.75% of its assets, the value of the shortfall was set at zero. Because we sought a shortfall measure that indicated the extent to which assets were adjusted when capital was under pressure, we calculated the bank's capital shortfall relative to the amount of bank capital required under the unweighted 4.75% standard as

$$K^T - K = k^T * A_{-1} - K, \tag{1}$$

where K^T is the minimum amount of tier 1 capital required by the standard and K is the actual amount of tier 1 capital. Thus, a bank's assets at time $t - 1$ (December 1990), A_{-1}, were multiplied by 4.75%. The actual (reported) level of capital at time t (December 1991) was used as a proxy for the amount of capital that the bank, at time $t - 1$, expected to have at time t. Analogously, the extent to which a bank's capital fell short of the risk-weighted capital standard was calculated by subtracting the bank's tier 1 capital plus eligible tier 2 capital minus deductions at the end of 1991 from 8% of the bank's risk-weighted assets as of the end of 1990. Throughout, capital shortfalls and surpluses were calculated as the amount of capital a bank had at the end of 1991 relative to the amount of capital each standard would have required on the basis of the bank's 1990 assets.

Equation (1) implies that a bank that expected to have, at the end of 1991, tier 1 capital equal to 4.75% of its end-of-1990 assets would have a calculated capital discrepancy of zero. A bank having less capital than that was said to have a "shortfall;" such a bank would have had to reduce its assets during 1991 to satisfy the unweighted capital ratio requirement at

the end of 1991, given the capital it expected, at the end of 1990, to have at the end of 1991. A bank having more capital than required, given its assets at the end of 1990, was said to have a "surplus;" such a bank would have been able to increase its asset holdings and still meet that capital standard. By construction, each bank was calculated to have either a surplus or a shortfall of capital (both measured positively), unless actual capital precisely equaled required capital. Capital surplus banks were assigned shortfalls equal to zero, and capital shortfall banks were assigned surpluses equal to zero.

The Extent of Capital Shortfalls

Only "large" banks, those with at least $300 million of assets in 1991, were included in this study. Together, these banks held more than 75% of total U.S. bank assets in 1991. Smaller banks, though far more numerous, were excluded because they accounted for a relatively small proportion of bank assets and because they were required to report less detailed information than were larger banks. Also excluded from the sample were the one bank that had capital in excess of 20% of its assets and the banks with more than $300 million in assets in 1991 that had no delinquent loans. (These banks were excluded on the grounds that they were likely to be relatively new banks with very different behavior, with respect to both their asset portfolios and capital accounts, than more established banks.) The final sample size was 788 banks.

Table 1 shows the number of banks in our sample that recorded capital surpluses or shortfalls at the end of 1991, as measured by the proxy for each capital standard. All but 62 of the 788 banks in our sample had unweighted capital ratios above the unweighted 4.75% standard, and all but 74 satisfied the 8% risk-weighted standard. Forty-eight banks had shortfalls by both standards, and 40 banks had a shortfall by one standard but not by the other. This implies that only 88 banks had a shortfall by one standard or the other. Thus, bank capital shortfalls may not have affected a large number of banks. On the other hand, the larger the bank the more likely that it had a capital shortfall. Thus, the total bank credit extended by capital shortfall banks as a proportion of total U.S. bank credit was greater than the proportion of U.S. banks that had capital shortfalls.

The share of aggregate bank credit that was in banks having capital shortfalls may understate the effects of regulatory capital standards. Banks whose capital levels were close to their perceived regulatory minima may

Table 1 ■ Number of banks having capital shortfalls and surpluses.

	Relative to the Unweighted 4.75% Standard		
	Shortfall	Surplus	Total
Relative to the Risk-Weighted 8% Standard			
Shortfall	48	26	74
Surplus	14	700	714
Total	62	726	788

have altered their credit supply so as to reduce the risk of violating the standards in the event of adverse shocks. And to the extent that banks having shortfalls were concentrated regionally, such as in New England, borrowers there may have been more than proportionately affected as compared with regions where capital shortfalls were less prevalent. Widespread capital shortfalls within a region may have restricted the lending of most, if not all, banks in a borrower's region. In that case, a very large fraction of creditworthy borrowers may not have been able to secure credit. On the other hand, if a relatively small fraction of banks in a region reduced their supplies of credit because of capital considerations, most would-be borrowers may have been able to obtain financing from the other lenders in their regions.

Which Constraint Was More Binding?

A bank could fall short of either, both or neither capital standard. At any point in time, some banks found themselves with a capital surplus by one standard and a shortfall by the other. Over time, the capital "constraint" that effectively "bound" a given bank might have changed as conditions external and internal to the bank changed. Table 2 shows the number of banks, categorized by tier 1 capital ratio, that were bound during 1991 by each of the capital standards, as measured by equation (1). For each bank, the larger capital shortfall (or smaller surplus, if a bank's capital fell short of neither standard) by these two standards was considered the one that bound the bank. For only 24 of the 62 banks that fell short of the unweighted 4.75% capital standard was the dollar shortfall larger relative to the unweighted standard than the dollar shortfall relative to the risk-weighted capital standard. Of the 74 banks that fell short of the risk-

Table 2 ■ Which capital constraint was binding?

Tier 1 Capital Ratio	Number of Banks				
	Relative to the Unweighted 4.75% Standard		Relative to the Risk-Weighted 8% Standard		
	Shortfall	Surplus	Shortfall	Surplus	Total
<4%	5	4	13	2	24
4–5	12	36	17	22	87
5–6	5	89	23	56	173
6–7	1	102	8	105	216
7–8	1	89	3	61	154
≥8	0	93	0	41	134
Total	24	413	64	287	788

Tier 1 capital ratios are ratios of tier 1 capital to total assets (both at book value as of December 31, 1990). Capital shortfalls and surpluses were calculated as the deviations of capital a bank had at the end of 1991 from its capital standard based on its assets at the end of 1990. For each bank, the larger capital shortfall (or smaller surplus, if a bank's capital fell short of neither standard) by these two standards was considered the binding constraint.

weighted standard, nearly 90% (64 out of 74 banks) had either smaller shortfalls (or larger surpluses) with respect to the unweighted 4.75% standard than they did relative to the risk-weighted standard. Thus, according to our estimates, nearly three times as many (64 versus 24) banks faced capital pressure from the risk-weighted standard as faced pressure from the unweighted standard. Further, not all banks that were under capital pressure by the risk-weighted measure had low unweighted capital ratios. Table 2 shows that, of the 64 banks bound by the 8% risk-weighted capital standard, 17% of them (11 banks) had unweighted capital ratios of at least 6%.

The higher the minimum unweighted capital ratio, the larger the number of banks that fall short of that minimum and the larger the number of banks that are constrained by the unweighted ratio. Though only 62 banks fell short of the 4.75% minimum unweighted capital standard, 217 fell short of a 6% unweighted standard. The number of banks constrained more by the 6% unweighted standard than by the risk-weighted standard rose, from 24 banks more constrained by the 4.75% standard, to 202. Only 16 banks had larger risk-weighted capital shortfalls than they had

shortfalls relative to a 6% unweighted capital ratio. When we re-estimated the model discussed below with capital discrepancies calculated relative to a minimum unweighted capital standard of 6% in place of discrepancies calculated relative to the unweighted 4.75% capital standard, the estimates and their implications changed little.

Bank Asset Adjustments

This section addresses a bank's short-run adjustments of portfolio holdings to changes in economic conditions generally and to discrepancies in the bank's capital account in particular.

The Supply of and Demand for Bank Credit

Various models suggest that a bank's decisions about what volume of each asset to hold in its portfolio will reflect the variability of its deposits, imperfections in the primary and secondary markets for credit and for factors of production, the bank's capital position, owners' and managers' risk aversion, default and interest rate risks, the structure of interest rates and government regulations (Hester and Pierce 1975). We approximated the bank's long-run, target, stock supply of each financial asset (A^S) and therefore the sum of those stocks, bank credit, by:

$$A^S = s_1 + s_2 * R - s_3 * Z + s_4 * K. \tag{2}$$

A bank's loan supply was posited to depend positively on R, the contract interest rate for each category of assets, and negatively on Z, the perceived risks associated with holding each category of assets. K, the bank's holding of capital, was posited to affect loan supply positively. We took each bank's actual capital to be determined exogenously to its asset decisions. Certainly capital is not completely exogenous to a bank: A bank can use its dividend and equity issuance and retirement policies to change its capital. A bank may be reluctant to alter these policies, however, for fear of adversely affecting existing shareholders (Asquith and Mullins 1986). According to Baer and McElravey (1993), "(b)anks manage their asset growth as if there are significant costs associated with issuing new equity and selling existing assets."

Borrowers' long-run demands for credit were also posited to depend on the loan contract interest rate, R, and on perceived risks, Z, though not on a bank's capital condition:

$$A^D = d_1 - d_2 * R - d_3 * Z. \tag{3}$$

Loan demand was posited to depend negatively on the contract interest rate and on the bank's assessments of the risks of the projects to be financed. To the extent that banks require that borrowers have equity in loan-financed projects, we expected that greater perceived risk reduced loan demand. If borrowers could obtain loans from banks without substantial equity investment, loan demand might be positively related to risk. Though some loans funded at selected S&L's during the 1980s likely did not require borrowers to have consequential equity stakes, demand for bank loans during our sample period was likely reduced by perceived risk.

The general economic vitality in its market is likely to affect a bank's perception of the risks of and rewards from lending and also to affect borrowers' demand for credit: Strong economic activity in the market likely increases both the demand for credit and the bank's willingness to lend. To allow for these effects, we included in Z two measures of general economic conditions—the local unemployment rate and a personal income variable. Although some borrowers might have been willing to pay higher interest rates for credit from a bank that was well capitalized, and therefore more likely to remain solvent and able to provide credit in the future, we did not include a bank capital term in the loan demand equation (3) that would capture the effect on loan demand of borrowers who regarded themselves as stakeholders in the financial health of the bank.

Equating long-run supply and demand ($A^T = A^S = A^D$) and eliminating the market interest rate produces the following expression for the long-run stock of assets:

$$A^T = b * [(d_1 s_2 + s_1 d_2) - (d_3 s_2 + s_3 d_2) * Z + (d_2 s_4) * K], \tag{4}$$

where $b = [1/(s_2 + d_2)]$. The lack of cross-section data for R, the terms and conditions on bank credit, precluded our estimating the demand function, whose parameters are identified. Though parameters of the supply function are unidentified in the model consisting of equations (2) and (3), estimating the reduced forms for the components of A^T may shed light on whether changes in bank capital influenced the supply of banks' financial assets. If the demand for bank credit fell when terms or conditions were tightened, i.e. if d_2 in equation (4) was positive, a positive estimate of the reduced-form coefficient on K in equation (4) implies that the supply of bank credit was reduced by declines in bank capital, i.e. that s_4 was also positive. In contrast, reduced-form responses to Z cannot be used to determine whether the effects of Z worked through the supply of bank credit, through the demand for bank credit, or both.

Short-Run Adjustments to Asset and Capital Discrepancies

Hester and Pierce (1975) concluded that "studies of aggregate bank portfolio behavior have generally found long lags in portfolio adjustments" (Goldfeld 1986; Hendershott 1968; DeLeeuw 1965). They argued that banks were likely to adjust their portfolios with a pronounced lag as a result both of information imperfections and of costs of adjusting bank assets, particularly loans. The development of secondary markets since then may have changed the relative speeds of adjustment and generally reduced lags in portfolio adjustment.

We approximated an individual bank's adjustments of its assets by

$$\mathbf{A} - \mathbf{A}_{-1} = \theta_1 * (\mathbf{A}^T - A_{-1}) + \theta_2 * (K^T - K), \tag{5}$$

where $\mathbf{A}$ and $\mathbf{A}_{-1}$ are the $N \times 1$ vectors that contain the actual current and one-period-lagged values of the volume of assets in each of N categories held by a bank. $\mathbf{A} - \mathbf{A}_{-1}$ is the $N \times 1$ vector of dollar changes in a bank's holdings of assets in each category from time $t - 1$ to time t, and $\mathbf{A}^T$ is the $N \times 1$ vector that contains the target volume of assets in each category, as given by equation (4). In equation (4), capital was among the factors affecting A^T. In equation (5), $\mathbf{A}^T$ is redefined to exclude the capital discrepancy, $(K^T - K)$, which is now included separately as the final term. K^T is the bank's target stock of capital, the amount required by the capital standard, and K is the bank's actual capital. The $N \times N$ matrix of adjustment coefficients, θ_1, allows for different speeds of adjustment across assets.

Equation (5) allows the gradual adjustment of the volume of assets in each category to be a function of the discrepancy in that and every other asset category, and also to be a function of the discrepancy between the expected actual and target capital positions of the bank. Both the asset and capital holdings could, in principle, be disaggregated further, with banks adjusting different components of their total capital with different speeds. The specification in equation (5), however, treats equity capital as homogeneous.

Equation (5) indicates that capital shortfalls, like many other discrepancies in a bank's holdings, may produce changes in the volume of holdings of each of the assets that the bank holds. Unexpected shocks to the bank's capital account—for example, shocks from unanticipated loan losses or regulatory changes—produce a discrepancy between actual and standard (minimum) levels of capital. In response, the bank is likely to adjust not

only its capital but also its holdings of each of its assets and liabilities. Taking into consideration the costs associated with raising capital, we adopted a specification that allowed for the possibility that a bank would not adjust its level of capital so quickly as to, in effect, preclude the emergence of a discrepancy between its actual and required capital.

Data

Bank Assets

Data for individual banks came from the quarterly Reports of Condition and Income (Call Reports) for insured, domestically chartered, commercial banks.[7] We used Call Report data for the period December 31, 1990 to December 31, 1991. We adjusted the bank data for mergers and acquisitions during 1991 by "force merging," that is, adding the balance sheets of banks that merged into or were acquired by other banks into the balance sheets of the surviving banks. Thus, if Bank A acquired Bank B during 1991, we added the data for Bank B for December 31, 1990 to the data for Bank A. Bank B did not otherwise appear in our sample. Changes in asset holdings were measured as the difference between their end of 1991 and end of 1990 values. Use of year-end data mitigated the seasonality of bank data, which can be surprisingly strong. Year-end Call Report data are also the most comprehensive.

Bank credit included bank holdings of securities, loans and leases, but excluded such assets as the book value of buildings, cash and balances due from other depository institutions. Tier 1 capital was used to calculate discrepancies from the unweighted capital target. Both the capital and the asset data were for individual banks, not for the bank's holding company.

We disaggregated bank credit into bank holdings of securities and of loans and leases. The Call Report included in the securities category the following assets: U.S. Treasury and federal agency securities [including agency-related collateralized mortgage obligations (CMO's)]; obligations of corporations, state and local governments and political subdivisions; domestic and foreign debt securities; and equity securities such as mutual funds.[8]

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[7] The data were consolidated, in that they pertained to both the domestic and foreign offices of domestic banks. Data limitations prevent including agencies and branches of foreign banks in our sample.

[8] CMO's and other real estate-based securities have some of the features of real estate loans. We judged CMO's and other real estate-based securities to be closer

Loan Categories

Loans and lease financing receivables were disaggregated into five loan categories, namely, individual, single-family real estate, commercial real estate, commercial and industrial (C&I) and "other." Individual, or consumer, loans included credit card, check credit, installment and other loans to individuals, households and families for personal expenditures. Loans secured by one- to four-family residential properties made up the single-family real estate category. Commercial real estate loans were comprised of loans to finance the purchase of commercial real estate, loans secured by real estate to finance construction and land-development activities and loans secured by multi-family properties (five or more units). C&I loans were loans to businesses, both U.S. and foreign addressees. "Other" loans (the "loans not elsewhere classified" category in the Call Report) included obligations (other than securities) of states and political subdivisions in the United States, loans to foreign governments, loans for the purchase of securities, agricultural loans not secured by farmland, loans to depository institutions and lease financing receivables.[9]

We were unable to calculate the flows of new bank loans extended, either in the aggregate or by loan category, for several reasons. First, data for loan repayments at individual banks were not available. In addition, loan sales by banks reduce the volume of loans on banks' books relative to the volume of credit extended directly by banks. Further, the flow of loans originated in a given loan category will exceed the change in banks' holdings of that loan category to the extent that the bank charges off loans in that category. Therefore, the net change in asset holdings over a given interval cannot be used to accurately calculate the flow of new loans extended.

It is also worth noting that differences across banks in the timing of their loan loss provisioning and charging off of bad loans can alter the sample correlations in cross-section data between bank credit and the variables that drive it. Banks in regions with weaker economies are more likely to suffer loan losses, and charging off bad loans is likely to bring banks in those regions closer to regulatory capital minimums. On the other hand, if those banks charge off bad loans less readily than stronger banks (so as to preserve their reported capital positions), the observed positive cor-

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substitutes for the other components of the securities category as defined by the Call Report than for real estate loans.

[9] Excluded from the "other" category was unearned income on loans held by the bank.

relation between bank credit and regional economic conditions will be lower than might have been expected.

Specification of Proxy Variables

Estimation of equation (5) required observable proxy variables for the perceived risks, Z, associated with holding assets in each category. The elements of Z were specified to pertain to conditions in a bank's relevant "local" market (e.g., the state unemployment rate), to conditions of the bank's own portfolio (e.g., the delinquency rate on its own loans) or to some combination thereof. Banks that had assets of less than $5 billion were assumed to have as their relevant local banking market the state in which they were incorporated; larger banks were assumed to operate regionally, and their local market was deemed to be the region that contained the bank's head office.[10]

Economic Activity

The first measure of activity we included was the unemployment rate. For banks that had less than $5 billion of assets, the relevant local rate was the unemployment rate of the state in which the bank was headquartered. A regional unemployment rate was relevant to the larger banks. We calculated the regional unemployment rate for each larger bank by dividing the total number of unemployed in the states in the bank's region by the labor force in its region.

Although a higher unemployment rate in a bank's market likely will adversely affect the risks and returns associated with lending, this measure of economic conditions is unlikely to capture all the information necessary to determine the impact of macroeconomic conditions on lending, for several reasons. First, the unemployment rate may not unambiguously signal economic strength; the local unemployment rate may fall because local economic conditions improve, but it may also decline because of a reduction in the measured labor force because of "discouraged worker" effects or out-migration. Second, personal income in a market area may or may not improve as unemployment decreases; workers may accept

[10] The regions were those used by the National Council of Real Estate Investment Fiduciaries (1992): Northeast, Mideast, Southeast, Southwest, East North Central, West North Central, Mountain and Pacific. These multi-state market regions are not likely to encompass large enough areas for banks that conduct a substantial portion of their operations on an inter-regional, national or even global scale.

positions at reduced wages or for fewer hours of employment. Demand for consumer loans is more than likely determined by the level and distribution of personal income rather than the level of employment. In addition, loan demand is likely to be affected importantly by accelerator-like forces associated with real growth of the area's economy. In that case, not only the level, but also the growth rate, of an area's economy might be relevant to loan demand.

Inclusion of a measure of economic conditions based on personal income allowed for these considerations. Regional income was calculated by summing the personal incomes for the states in each region. The personal income variable for each state or region was calculated as the ratio of 1990 to 1977 constant-dollar personal income. This variable not only measures the rate of longer-term economic growth in an area but also may serve as a proxy for the relative levels of economic vitality and loan market conditions across states and regions. States and regions whose economies have grown rapidly since 1977 would have relatively higher levels of personal income than areas that have grown more slowly.

The local growth rate and the unemployment rate were each expressed as decimals, not percentage points. To convert the local growth rate variable to the same scale as the dependent variable, the rate was multiplied by bank credit at each bank as of December 31, 1990. The local unemployment rate was scaled the same way. The estimated coefficients on the local growth rate and the unemployment rate reported in Tables 3 through 5 have been multiplied by 100.

Conditions in Real Estate Markets

We included three variables, each expressed as decimals, that quantified conditions in real estate markets. Two of the three—vacancy rates for commercial real estate and for homeowner housing in each region—were included to allow for their influence on the assessments by banks and their customers of the risks of and returns from real estate lending.[11] For commercial real estate, statewide vacancy rates were calculated using vacancy rates in metropolitan areas during 1990.[12] The third variable—in-

[11] Regional homeowner vacancy rates were obtained from the U.S. Department of Commerce (1991). These rates apply to single-family residences.

[12] Metropolitan area vacancy rates were aggregated to form state vacancy rates. Because regional vacancy rates were not available, banks were assigned the vacancy rate for their state. For states that had no city in the Coldwell Banker (1992) data base, rates were assigned on the basis of rates for similar, typically neighboring, states.

tended to reflect expectations about the profitability of commercial real estate lending—was the total percentage return on commercial real estate by region, as recorded by the Russell-NCREIF index from the first quarter of 1991 to the first quarter of 1992 (National Council of Real Estate Investment Fiduciaries 1992).

The dollar volumes of delinquent loans held by each bank in March 1991—delinquent commercial real estate loans, single-family real estate loans, C&I loans and consumer loans—were included to capture the outlook for the risks of and returns on lending in these categories. Delinquent loans were defined as the total dollar amount of loans that were past due more than 30 days but still accruing interest and loans in nonaccrual status. Beginning with the March 1991 Call Report, dollar amounts of past-due and nonaccrual-status loans have been available separately for loans secured by one- to four-family residential properties, for loans secured by commercial real estate, for C&I loans and for loans to individuals.[13] These data were available for each bank in our sample. In addition to each bank's own delinquencies, we included the delinquency rate for loans in each category experienced by the other banks in each bank's relevant local market.

The commercial and single-family real estate vacancy rates and the return on commercial real estate were each multiplied by a dollar scalar for each bank. The commercial real estate vacancy rate and return were multiplied by the bank's holdings of commercial real estate loans. Analogously, the single-family real estate vacancy rate was multiplied by the bank's holdings of single-family real estate loans. The delinquency rates in the market, by category, were multiplied by the dollar volume of such loans held at each bank.

Specification and Estimation

Substituting its determinants for $\mathbf{A}^T$ and then rearranging equation (5) produces:

$$\mathbf{A} = b_1 * \mathbf{Z} + b_2 * (\mathbf{K}^T - \mathbf{K}) + b_3 * (\mathbf{A}_{-1}), \tag{6}$$

[13] The commercial real estate delinquency data incorporate delinquencies on all loans where real estate was used as collateral. These data also include delinquencies on loans to finance commercial real estate, construction and land development activities that were included in the categories of commercial and industrial loans and of "other" loans.

where $\mathbf{Z}$ is the vector of proxy variables, $(\mathbf{K}^T - \mathbf{K})$ is a vector of capital discrepancies for each bank and $\mathbf{A}_{-1}$ is the vector of the volume of assets in each of the categories of bank credit, lagged one period. For each bank, we also calculated the dollar sum of the capital shortfalls and the sum of the capital surpluses at the banks in the state or region of the bank's headquarters. We included in the vector $(\mathbf{K}^T - \mathbf{K})$, in addition to the capital shortfall and surplus variables for each bank, measures of the capital shortfalls and surpluses of the banks in each bank's local market, that is, in its state or region.

In order to reduce the potential biases associated with having omitted variables, we also experimented with regional dummy variables. Owing partly to our inclusion of other variables that measured conditions across regions, the regional dummy variables were always statistically insignificant and had little effect on the other coefficient estimates. Thus, we omitted them from the specifications reported below.

Estimation Issues

On the assumption that the disturbance terms implicitly attached to equation (4) were not autocorrelated, ordinary least squares (OLS) provides consistent estimates of the coefficients in equation (6). (It was not possible with our cross-section data to test whether the disturbance terms were autocorrelated.) Since the equation for each portfolio item contains the same explanatory variables, OLS estimates were as efficient as those achieved by the seemingly unrelated regression technique.

For two reasons, each regression reported below was performed by weighted least squares, with the weights equal to the inverse of the square root of the bank's assets. First, this weighting scheme placed more importance on larger banks than on smaller banks while it prevented a few very large banks from dominating the results. Second, weighting reduced heteroskedasticity related to bank size that would otherwise be expected in an unweighted regression on our cross-sectional bank data. Tests indicated that residuals from unweighted regressions were much more heteroskedastic than were residuals from the weighted regressions. Since weighted least squares may not have completely eliminated heteroskedasticity, t-statistics, which are reported one row below the coefficient estimates in the tables below, were calculated as the ratio of the coefficient estimates to White-corrected standard errors (White 1980) in order to render them heteroskedasticity consistent.

Empirical Results

Effects on the Size of Bank Portfolios

Table 3 presents estimates of equation (6) when bank credit was used as the dependent variable. (The coefficients on the six lagged bank credit categories were not reported in the tables.) The columns in Table 3 differ by which capital discrepancy measure was included in the regression. The estimates in column 1 are based on tier 1 capital discrepancies relative to the unweighted capital ratio standard of 4.75%; column 2 is based on the discrepancies between total eligible capital (tier 1 capital plus qualifying tier 2 capital less deductions) and the risk-weighted capital standard; and column 3 is based on both sets of capital discrepancies.

The estimates in column (4) were produced when we included measures of capital discrepancies from the "most-binding" capital standard. (Table 2 shows that 24 banks were most tightly bound by the unweighted capital standard, while 64 banks were most tightly bound by the risk-weighted standard.) For a bank with a capital shortfall by either the unweighted or the risk-weighted standard, the larger dollar amount (in absolute value) of the shortfall by either standard was assigned to the maximum shortfall variable. A bank with a shortfall by neither standard was assigned a value of zero for this variable. For banks with a zero capital shortfall by both measures, the smaller surplus by either capital standard was entered as the minimum surplus. A bank with a shortfall by either capital standard was assigned a value of zero for the minimum surplus variable.

Effects of Noncapital Variables

Though the point estimates indicated that bank credit fell as the economy weakened, neither of the economic activity variables was statistically significant in Table 3. Higher single-family real estate vacancy rates had the expected negative effect on bank credit. On the other hand, commercial real estate vacancy rates had significant, positive effects on bank credit. Higher returns on commercial real estate also had the counterintuitive effect of reducing bank credit, though insignificantly. One possible explanation for the unexpected effects of commercial real estate returns and vacancy rates is that weaker conditions in commercial real estate markets effectively forced banks to extend more credit on troubled but not completed projects, made it impossible for banks to close out loans as the original maturity dates passed, or made it excessively costly for banks to place commercial real estate loans with insurance companies or other ultimate holders of these loans (Fergus and Goodman 1993). In that regard,

the commercial real estate indicators may have served as proxies for disequilibria during the sample period.

The conclusion that banks involuntarily held commercial real estate loans is weakened, however, by banks' estimated responses to delinquency rates. Bank credit generally fell in response to higher delinquency rates for business loans, though it rose insignificantly when delinquency rates for loans to households rose. Had banks, in effect, been forced by deteriorated real estate market conditions to hold more commercial real estate than they would have otherwise chosen, we would have expected bank credit to have responded positively to delinquency rates on their own loans. On the other hand, higher delinquency rates at other, neighboring banks for commercial and industrial loans and on commercial real estate loans tended to increase the size of a bank's portfolio. Interpretations of these effects are presented below. The estimated effects of most of the noncapital variables were little affected by varying the measure of capital discrepancy included in the regressions.

Effects of Capital Discrepancies

The bottom rows of Table 3 show the effects of the capital discrepancy measures on bank credit. Regardless of which standard was used, capital shortfalls reduced, and capital surpluses increased, bank credit significantly. Discrepancies from the unweighted capital standard, discrepancies from the risk-weighted standard and discrepancies from the most-binding capital standard each affected bank credit. Once allowance was made for shortfalls from the unweighted standard, however, bank credit was insignificantly affected by a shortfall from the risk-weighted standard: The effect of shortfalls from the risk-weighted standard shriveled to economic and statistical insignificance in the presence of the discrepancies from the unweighted capital standard. By contrast, the estimated magnitude and statistical significance of the capital shortfall from the unweighted standard, on the other hand, were little affected by adding the risk-weighted discrepancy.

The estimated effects on bank credit during 1991 of a shortfall from the unweighted capital standard were not substantially different from those reported by Hancock and Wilcox (1993) for 1990. On the other hand, the estimated effects during 1991 of unweighted capital shortfalls were considerably larger than Hancock and Wilcox (1993) reported for the years before 1990. Whereas the estimated 1991 own-shortfall coefficient was 4.63 in Table 3, the estimated effects on bank credit of capital shortfalls

Table 3 ■ 1991 Bank credit, market conditions, and capital discrepancies.

Explanatory Variables	Dependent Variable = Bank Credit			
	(1)	(2)	(3)	(4)
Economic Activity				
Personal Income	0.06	−0.90	0.40	0.73
	(0.02)	(−0.26)	(0.12)	(0.23)
Unemployment Rate	−115.99	−114.38	−111.26	−99.21
	(−1.32)	(−1.30)	(−1.31)	(−1.14)
Real Estate Market Indicators				
Commercial Vacancy Rate	2.80	2.31	2.44	2.36
	(2.25)	(1.87)	(1.99)	(1.99)
Commercial Returns	−1.90	−1.61	−1.70	−2.77
	(−0.91)	(−0.69)	(−1.02)	(−1.46)
Single-Family Vacancy Rate	−17.85	−14.88	−18.41	−16.14
	(−2.12)	(−1.85)	(−2.30)	(−1.99)
Own-Loan Delinquency Rates				
Commercial and Industrial	−1.02	−1.23	−1.11	−1.01
	(−1.25)	(−1.40)	(−1.30)	(−1.18)
Commercial Real Estate	−1.93	−2.07	−2.00	−2.04
	(−3.44)	(−3.75)	(−3.59)	(−3.75)
Single-Family Real Estate	1.82	1.75	1.74	2.29
	(0.89)	(0.84)	(0.87)	(1.11)
Consumer	0.67	1.44	0.41	1.19
	(0.53)	(1.10)	(0.35)	(0.93)
Market Delinquency Rates				
Commercial and Industrial	4.05	3.57	3.41	3.83
	(2.61)	(2.14)	(2.08)	(2.37)
Commercial Real Estate	0.61	1.19	0.90	0.75
	(0.60)	(1.07)	(0.96)	(0.80)
Single-Family Real Estate	−3.56	−1.80	−0.52	−3.60
	(−0.67)	(−0.36)	(−0.10)	(−0.70)
Consumer	−0.08	0.86	−0.13	0.63
	(−0.05)	(0.51)	(−0.08)	(0.36)

Table 3 (continued)

Explanatory Variables	Dependent Variable = Bank Credit			
	(1)	(2)	(3)	(4)
Capital Discrepancies				
Unweighted 4.75% Standard				
Own Surplus	2.49		0.74	
	(3.30)		(0.99)	
Own Shortfall	−4.63		−5.26	
	(−3.74)		(−2.09)	
Surplus in Local Market	−0.58			
	(−0.88)			
Shortfall in Local Market	−0.15			
	(−0.05)			
Risk-Weighted 8% Standard				
Own Surplus		2.44	1.85	
		(3.75)	(2.88)	
Own Shortfall		−2.80	0.49	
		(−2.91)	(0.28)	
Surplus in Local Market		−0.56		
		(−1.01)		
Shortfall in Local Market		−4.07		
		(−1.47)		
Own Minimum Surplus				3.11
				(3.73)
Own Maximum Shortfall				−2.75
				(−2.74)
Goodness-of-Fit Measures				
R-Square	0.36	0.37	0.38	0.38
Root-Mean-Square Error	5319.3	5295.2	5255.0	5234.1

Based on the sample of 788 commercial banks with more than $300 million in assets on December 31, 1990. Bank credit includes holdings of securities, loans and leases but excludes such assets as the book value of buildings. Data are from Reports of Condition. Reported t-statistics (in parentheses below each coefficient estimate) are heteroskedasticity-consistent.

were less than one both in the boom year of 1972 and in the recession year of 1982. Thus, banks did react differently in the early years of the 1990s than they had in earlier years.

One repercussion of a capital shortfall at some of the banks in a given local market might be an increase in lending by less-capital-constrained banks in that area. Creditworthy borrowers whose loan requests were denied by a capital-shortfall bank might have been expected to obtain credit at a nearby bank that had a capital surplus. Table 3 offers little support for this hypothesis. Given the other control variables, no effect of other local-competitor banks' capital conditions on bank credit was detected.

Effects on the Components of Bank Credit

Even if the risk-weighted capital standards did not materially affect total bank credit, they may have affected its composition. Hall (1993) estimated that the imposition of the risk-weighted capital standards induced a shift of bank portfolios toward lower-risk-weighted assets, such as government bonds, and away from higher-risk-weighted assets, such as business loans. He estimated that, by the end of 1991, banks had curtailed their lending by about $150 billion in response to the imposition of risk-weighted capital standards. Estimates of the effects of capital discrepancies on the composition of bank portfolios are given in Tables 4 and 5. These tables follow a format similar to that of Table 3, except that bank credit is replaced with the six components of bank credit, each in turn serving as the dependent variable. Table 4 is based on discrepancies from the unweighted 4.75% standard, and Table 5 is based on discrepancies from the risk-weighted standard.

Because the same explanatory variables are used for each category of bank credit, the sum across categories of the coefficients for each explanatory variable in Tables 4 and 5 equals the effect of that variable on bank credit in columns 1 and 2, respectively, in Table 3.

Effects of Real Estate Conditions

Just as the estimated effects on bank credit of the noncapital variables were little affected by the choice of capital standards, the effects on the components of bank credit were robust to the choice of capital standards. None of the individual components of bank credit responded significantly to the income or employment variables. Single-family real estate loans,

"other" loans and securities did respond procyclically, however, in the sense that they responded positively to stronger economic activity: The higher income and the lower the unemployment rate, the greater were holdings of these categories. C&I loans, in contrast, appeared to react countercyclically in the short run.

Vacancies on commercial and single-family real estate had negative but insignificant effects on banks' holdings of loans in those categories, respectively, and generally insignificant effects on the other components of bank credit. (Table 3 shows that the net effect on bank credit of those two vacancy variables was positive on commercial real estate and negative on single-family real estate.) Somewhat inexplicably, the higher commercial real estate returns were, the lower the volumes of bank holdings of C&I and commercial real estate loans were, though commercial real estate returns did not have significant effects on banks' holdings of any category of loans.

Effects of Own-Loan and Market Loan Delinquencies

In general, delinquencies on loans to households tended to depress holdings of all categories of loans to households; delinquencies on loans to the business sector tended to depress holdings of all categories of loans to the business sector. For example, delinquencies on C&I loans and on commercial real estate loans had significant, negative effects on banks' holdings of both C&I and commercial real estate loans. Similarly, banks' holdings of single-family real estate loans were restrained by delinquencies on consumer loans and on single-family mortgages (though the latter effect was statistically insignificant). In contrast, delinquencies on a bank's own consumer loans had a strong, positive effect on holdings of consumer loans. The within-portfolio "cross effects" of loan delinquencies, that is, the effects of delinquencies on a bank's loans in one category on its own holdings of loans in another category, were of mixed signs, though the dominant pattern was for business loan delinquencies to spur lending to households and for delinquencies on loans to households to spur business lending.

The effects on a bank's portfolio of loan delinquencies at other banks in its local market were surprising. In contrast to the effects of delinquencies in its own portfolio, a bank whose local-competitor banks had higher delinquency rates in a given loan category tended to increase its holdings of loans in that category. For example, higher delinquency rates on C&I

Table 4 ■ 1991 portfolio composition, market conditions and capital discrepancies relative to the unweighted 4.75% standard.

	Loans					
Explanatory Variables	Consumer	Commercial and Industrial	Commercial Real Estate	Single-Family Real Estate	Other	Securities
Economic Activity						
Personal Income	−0.82	−2.15	−1.16	0.40	2.16	1.63
	(−0.72)	(−1.89)	(−1.58)	(0.22)	(1.73)	(0.82)
Unemployment Rate	−4.40	10.86	−9.26	−46.26	−49.30	−17.64
	(−0.14)	(0.48)	(−0.53)	(−1.53)	(−1.71)	(−0.30)
Real Estate Market Indicators						
Commercial Vacancy Rate	0.26	−0.22	−0.46	−0.23	1.44	2.01
	(0.84)	(−0.58)	(−1.68)	(−0.59)	(1.52)	(1.97)
Commercial Returns	−0.38	−1.18	−0.15	0.51	0.29	−0.99
	(−0.71)	(−1.36)	(−0.21)	(0.84)	(0.37)	(−0.89)
Single-Family Vacancy Rate	2.54	0.86	−1.63	−7.86	−3.55	−8.20
	(1.11)	(0.31)	(−1.12)	(−1.78)	(−1.23)	(−1.37)
Own-Loan Deliquency Rates						
Commercial and Industrial	−0.52	−1.29	−0.54	−0.02	0.73	0.63
	(−1.95)	(−4.98)	(−2.69)	(−0.09)	(1.48)	(1.30)
Commercial Real Estate	0.07	−0.38	0.73	0.14	−0.48	−0.56
	(0.46)	(−2.60)	(−4.30)	(0.66)	(−1.94)	(−1.69)
Single-Family Real Estate	−0.56	1.30	0.47	−0.71	0.60	0.72
	(−1.17)	(2.30)	(1.14)	(−0.71)	(1.14)	(0.70)
Consumer	3.05	0.45	0.22	−1.16	−0.60	1.29
	(4.86)	(1.21)	(0.80)	(−2.46)	(−0.83)	(−1.96)

Table 4 (continued)

Market Delinquency Rates						
Commercial and Industrial	−0.11	2.92	−0.03	−0.43	1.38	0.33
	(−0.23)	(4.68)	(−0.10)	(−0.82)	(1.54)	(0.34)
Commercial Real Estate	−0.31	−0.91	0.62	0.26	0.43	0.52
	(−1.20)	(−2.69)	(1.70)	(0.77)	(0.97)	(1.00)
Single-Family Real Estate	−2.39	−0.36	−1.23	6.14	−3.61	−2.10
	(−2.37)	(−0.25)	(−1.58)	(2.56)	(−2.61)	(−0.68)
Consumer	2.83	−0.27	0.05	−1.30	−0.64	−0.75
	(3.01)	(−0.55)	(0.16)	(−2.44)	(−0.79)	(−0.96)
Capital Discrepancies						
Own Surplus	0.24	0.28	0.23	0.28	0.51	0.95
	(2.38)	(2.41)	(2.43)	(1.75)	(1.61)	(2.08)
Own Shortfall	−1.14	−0.23	0.18	−0.74	−1.02	−1.68
	(−1.42)	(−0.78)	(0.84)	(−1.65)	(−2.04)	(−2.17)
Surplus in Local Market	0.10	0.01	−0.13	0.15	−0.42	−0.28
	(0.43)	(0.03)	(−1.07)	(0.77)	(−1.66)	(−0.79)
Shortfall in Local Market	0.46	1.16	−0.48	−1.22	−1.90	1.83
	(0.61)	(1.11)	(−0.56)	(−0.94)	(−1.44)	(0.97)
Goodness-of-Fit Measures						
R-square	0.27	0.51	0.33	0.20	0.20	0.20
Root-Mean-Square Error	1626.7	1504.4	1244.0	1840.3	1913.5	3423.5

Based on the sample of 788 commercial banks with more than $300 million in assets on December 31, 1990. Data are from Reports of Condition. Reported t-statistics (in parentheses below each coefficient estimate) are heteroskedasticity-consistent.

Table 5 ■ 1991 portfolio composition, market conditions and capital discrepancies relative to the risk-weighted 8% standard.

	Loans					
Explanatory Variables	Consumer	Commercial and Industrial	Commercial Real Estate	Single-Family Real Estate	Other	Securities
Economic Activity						
Personal Income	−1.17	−1.87	−1.19	−0.15	2.47	1.02
	(−1.01)	(−1.65)	(−1.61)	(−0.09)	(1.92)	(0.51)
Unemployment Rate	−3.70	8.43	−9.56	−46.77	−50.06	−12.70
	(−0.11)	(0.37)	(−0.55)	(−1.57)	(−1.60)	(−0.22)
Real Estate Market Indicators						
Commercial Vacancy Rate	0.21	−0.27	−0.48	−0.28	1.32	1.80
	(0.70)	(−0.74)	(−1.74)	(−0.70)	(1.42)	(1.88)
Commercial Returns	−0.52	−0.75	0.06	0.47	0.69	−1.56
	(−0.83)	(−0.87)	(0.09)	(0.68)	(0.58)	(−1.47)
Single-Family Vacancy Rate	3.56	0.48	−1.73	−6.95	−4.04	−6.21
	(1.52)	(0.18)	(−1.20)	(−1.64)	(−1.30)	(−1.08)
Own-Loan Delinquency Rates						
Commercial and Industrial	−0.58	−1.42	−0.55	0.11	0.57	0.65
	(−2.19)	(−5.28)	(−2.60)	(0.45)	(1.19)	(1.30)
Commercial Real Estate	0.07	−0.43	−0.73	0.19	−0.58	−0.59
	(0.41)	(−2.80)	(−4.48)	(0.88)	(−2.09)	(−1.83)
Single-Family Real Estate	−0.57	1.29	0.46	−0.71	0.56	0.72
	(−1.16)	(2.33)	(1.12)	(−0.71)	(1.06)	(0.71)
Consumer	3.19	0.60	0.19	−1.11	−0.28	−1.14
	(4.25)	(1.61)	(0.74)	(−2.49)	(−0.44)	(−1.81)

Table 5 (continued)

Market Delinquency Rates						
Commercial and Industrial	−0.17	3.08	−0.05	−0.66	1.69	−0.33
	(−0.35)	(4.95)	(−0.13)	(−1.19)	(1.65)	(−0.34)
Commercial Real Estate	−0.32	−0.68	0.71	0.26	0.77	0.46
	(−1.18)	(−1.89)	(1.92)	(0.81)	(1.14)	(0.85)
Single-Family Real Estate	−2.54	0.07	−0.80	6.00	−2.97	−1.57
	(−2.42)	(0.05)	(−1.06)	(2.49)	(−2.07)	(−0.55)
Consumer	3.03	−0.12	0.08	−1.31	−0.28	−0.54
	(2.94)	(−0.26)	(0.26)	(−2.45)	(−0.38)	(−0.72)
Capital Discrepancies						
Own Surplus	0.36	0.22	0.26	0.31	0.31	0.99
	(3.57)	(1.91)	(2.98)	(2.19)	(1.38)	(2.50)
Own Shortfall	−0.50	0.16	0.12	−0.96	−0.38	−1.23
	(−1.10)	(0.54)	(0.65)	(−2.57)	(−0.89)	(−2.01)
Surplus in Local Market	−0.03	0.16	−0.12	−0.13	−0.20	−0.24
	(−0.17)	(0.83)	(−1.03)	(−0.70)	(−0.92)	(−0.72)
Shortfall in Local Market	−0.30	−0.59	−0.74	−1.15	−3.10	1.82
	(−0.49)	(−0.63)	(−1.09)	(−0.93)	(−1.44)	(1.04)
Goodness-of-Fit Measures						
R-Square	0.27	0.51	0.34	0.23	0.17	0.22
Root-Mean-Square Error	1624.4	1508.0	1237.9	1815.0	1942.3	3383.5

Based on the sample of 788 commercial banks with more than $300 million in assets on December 31, 1990. Data are from Reports of Condition. Reported *t*-statistics (in parentheses below each coefficient estimate) are heteroskedasticity-consistent.

loans at other banks in the local market led a bank to increase its own holdings of C&I loans. The same pattern held for the other three delinquency rates: The higher the delinquency rate on a given category of loans in a bank's market area, the more loans of that category the bank held. Tables 4 and 5 imply that banks tended to hold smaller amounts of a given loan category the higher the delinquency rates on their competitor banks' other loan categories. For example, in response to higher delinquencies on single-family mortgages at other banks in their local markets, banks tended to hold a larger volume of single-family mortgages but a smaller volume of every other component of bank credit. As a result, total credit extended by a bank generally was little affected by delinquency rates at neighboring banks.

Capital Standards and Business Lending

Effects of Own-Capital Discrepancies

The results given in Table 3 indicate that for every dollar that a bank's capital fell short of the 4.75% standard, the bank reduced its credit outstanding by about $4.50. The results in Table 4 indicate how they achieved that reduction. Securities and "other" loans were the two categories where significant reductions took place. Holdings in each of these categories fell by over $1. Noticeable but not quite significant declines were also registered in consumer and single-family real estate loans.

In contrast, the declines in C&I loans were relatively small and statistically insignificant, and commercial real estate loans were estimated to rise to about the same extent that C&I loans declined. As noted above, the positive but insignificant estimated effect on commercial real estate may reflect disequilibria in that sector during 1991; banks may have effectively been forced to hold loans that they had originated with the intention of selling to insurance companies or to pension funds. The increase in commercial real estate loans may have also come at the expense of loans classified as C&I loans: When business loans became collateralized by real estate, the Call Report called for them to be reclassified from the C&I to the commercial real estate loan category.

Capital surpluses increased significantly lending in three out of five loan categories and raised holdings of securities by an especially large amount. These results would be expected if banks with capital surpluses increased their assets in an attempt to maintain relatively steady capital ratios. In the short run, securities holdings may have increased until profitable loan opportunities could be developed.

Effects of Other Banks' Capital Discrepancies

One signal of banks' having faced a capital crunch would be that, when their local-competitor banks were so "capital-constrained" that they turned away creditworthy business loan customers, banks increased their own holdings of business loans in order to take advantage of the business loan demand that had been deflected toward the better-capitalized bank. As an alternative to increasing their deposits or capital, banks could fund increased business loan volume by reducing their holdings of single-family real estate loans or securities, which likely were relatively liquid. This would have been profitable to the extent that C&I loans typically provided lenders with larger economic rents than did single-family real estate loans or securities.

We detected no effects of other banks' capital shortfalls on bank portfolios. Given a bank's economic environment and its own capital condition, the capital conditions of the other banks in its local market area did not appreciably affect its lending. The estimates in Table 4 do, however, point to banks' having reduced their holdings of single-family mortgages by about the same amounts by which they increased their holdings of C&I loans when their local-competitor banks faced capital shortfalls. In no case in either Table 4 or 5, however, did greater capital surpluses or shortfalls at local-competitor banks significantly affect securities holdings or any of the loan categories.

Risk-Weighted Capital Discrepancies and Portfolio Shifts

As Figure 1a clearly shows, banks shifted their holdings away from business loans and toward securities during 1991. We found little evidence, however, consistent with risk-weighted capital standards having driven those shifts. In fact, Table 5 shows that, in response to risk-weighted own-capital shortfalls, banks significantly reduced their securities holdings (which generally are considered 0% or 20% risk-weighted assets) and their holdings of single-family loans (generally 50% risk-weighted assets)—an effect opposite from what would be expected if the risk-weighted regulations drove banks' portfolio allocations during 1991. Also contrary to the hypothesis that risk-weighted capital regulations importantly affected bank portfolios, C&I loans and commercial real estate loans (which generally were assigned 100% risk weights) tended to rise, but not statistically significantly so, in the presence of capital shortfalls relative to the risk-weighted standard. Thus, risk-weighted capital shortfalls, once other conditions were allowed for, apparently did not lead banks to

shift away from the higher-risk-weighted assets into assets with lower risk weights.

Table 5 indicates that risk-weighted capital surpluses tended to lead banks to raise their holdings of each category of bank credit in much the same way that unweighted surpluses did. The effects of risk-weighted capital surpluses or shortfalls at local banks were also small and statistically insignificant. Contrary to the hypothesis that other banks' risk-weighted capital shortfalls may have deflected demand for business loans toward better-capitalized banks, the estimates suggest that, in response to capital shortfalls at local-competitor banks, banks acquired securities at the expense of loans.

Conclusions

Our results suggest that banks contracted their portfolios in response to shortfalls relative to either an unweighted 4.75% capital standard or a risk-weighted 8% capital standard. The estimated effects of capital shortfalls relative to the unweighted capital standard were somewhat larger than those based on 1990 data: Compared with responses during 1990 that were about three times as large as the capital shortfalls, during 1991 bank credit fell by over $4.50 for each $1 of capital shortfall. Contrary to widely held perceptions, in response to shortfalls relative to the unweighted capital standard, the largest and most significant declines in banks' portfolios took place in securities and not in business lending.

The estimated effects of the risk-weighted capital standards provide little, if any, support for the hypothesis that risk-weighted capital standards led to increased bank holdings of securities at the expense of C&I loans. On the contrary, banks that had less capital than required by the risk-weighted standard appear to have shifted away from assets with low risk weights (securities and single-family mortgages) and to have shifted toward assets with higher risk weights (commercial real estate and business loans). When we included both shortfall variables in a regression, shortfalls relative to the unweighted capital standard significantly affected bank credit, while shortfalls of capital relative to the risk-weighted standard did not.

To the extent that creditworthy customers were denied loans by capital-constrained banks, we expected bank portfolios to respond positively when other banks in a bank's local market experienced capital shortfalls. The estimated responses to capital shortfalls at local-competitor banks, however, were generally small and insignificant. The estimates provided only

weak evidence that banks shed single-family real estate loans and acquired C&I loans when other banks in their market were short of capital.

Banks' responses to delinquencies on their own loans were very different from their responses to loan delinquencies at other banks in their local markets. Delinquencies in a given category of a bank's loans generally had significantly negative effects on that bank's holdings of loans in that category. In contrast, banks tended to increase holdings of loans in categories in which nearby banks were experiencing delinquencies.

Thus, we detected little evidence that bank lending to businesses was importantly affected by the imposition of risk-based capital standards. Nor did we detect much evidence that shortfalls relative to the unweighted capital standards restrained banks' lending to businesses. Instead, bank holdings of securities and loans to households appear to have been restrained more by capital considerations during 1991.

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