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The Credit Crunch: More of a Needed Adjustment than an Overreaction

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Abstract

The credit crunch of the early 1990s in the U.S. was notable in that banks sharply reduced business loans. To infer whether banks overtighten lending standards during a credit crunch, this paper examines how future loan performance was related to loan growth and capital ratios during the credit crunch of the early 1990s. Overtightening of lending standards may occur if banks overreact to increased loan losses, if a high cost of equity financing forces banks to meet capital requirements by reducing loans instead of raising equity, or if regulators excessively constrain banks from making loans. Tighter lending standards should lead to lower loan loss rates later. The main finding is higher loan loss rates in future periods for banks that reduced lending significantly and banks that had insufficient regulatory capital. Based on this finding, there doesn't appear to have been much overtightening either voluntary or forced. Banks that reduced lending were those banks that had suffered high loan losses before the credit crunch. Those banks appear to have tightened lending standards, but not tightened enough. Undercapitalized banks had suffered high loan loss rates too. They also appear to have insufficiently tightened lending standards. It appears that risky banks continued to pursue risky strategies, despite tighter regulation and supervision.

Keywords: *Credit crunch, Capital requirements, Basel accord, Loan performance*

1. Introduction

The credit crunch, which may be defined as a sudden and sharp reduction in the availability of credit, is often blamed for excessively slowing down economic activities, especially the activities of small businesses. Small businesses heavily rely on bank loans because they have very limited access to the stock market and the bond market.

The credit crunch occurred several times in the U.S. and other countries (e.g., in the early 1980s, the early 1990s, and the late 2000s in the U.S.). It usually coincided with an economic downturn, and the economic downturn was deeper when a credit crunch occurred. With many economies around the world staggering due to the COVID-19 pandemic and the war in Ukraine, there is a serious concern about the possibility of another credit crunch.

Since the term credit crunch is largely about its symptoms, rather than causes, many issues are unclear. Just based on the amount of credit, it is even hard to tell whether a credit crunch has occurred. The credit crunch implies undue difficulty in obtaining credit. Thus, if the

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amount of credit decreased due to decreased demand for credit, it should not be regarded as a credit crunch. Provided that a credit crunch has occurred, many questions remain. What are the causes? What are the economic implications? What are optimal policy responses? It is critical to know the causes to understand the economic implications and respond optimally. To be more specific, the credit crunch can be a digression from the equilibrium, a shift of the equilibrium, or a corrective movement from disequilibrium to the equilibrium. If it is a disequilibrium phenomenon, aggressive policy intervention may be desirable. In the last two cases, however, the optimal policy response may be a modest one facilitating the transition.

To assess the relative importance of these possibilities, this paper revisits the credit crunch of the early 1990s in the U.S., which is the most interesting case. Particularly interesting features are that it coincided with the phase-in of new capital requirements and that the loan contraction was most pronounced for commercial and industrial loans (business loans). The latest episode is the one following the 2007-2008 financial crisis. The late-2000s credit crunch, however, was more about home mortgage loans, which can be efficiently provided by non-bank financial institutions. The role of banks is essential for small business loans, which involve private information. In addition, U.S. banking data are very rich. Regulatory filings contain detailed financial information. In the early 1990s, the U.S. banking sector had over ten thousand local banks that made small business loans.

In the early 1990s, many U.S. banks had difficulty meeting capital requirements due to large loan losses and tightened capital requirements (Baer and McElravey [4]). Many banks reduced loans, especially business loans which were subjected to higher capital requirements. The loan contraction was more pronounced among banks with insufficient regulatory capital and also coincided with the 1990-1991 recession (Brinkmann and Horvitz [5], Haubrich and Wachtel [11], and Bernanke and Lown [3]).

These developments present several possibilities: (1) The recession may have reduced the demand for bank loans; (2) Banks with insufficient regulatory capital increased the capital ratio by reducing lending instead of issuing equity; (3) regulators forced undercapitalized banks to reduce risky loans by scrutinizing them more closely; and (4) after suffering larger loan losses, undercapitalized banks voluntarily tightened lending standards more than other banks. (1) Means no credit crunch. (2) Suggests a possible disequilibrium. Undercapitalized banks might reduce lending instead of raising capital if equity financing was unduly expensive due to some market frictions, such as asymmetric information. (3) and (4) can be either good or bad for the economy. Inefficiency would result if regulators forced undercapitalized banks to reduce loans excessively or if undercapitalized banks overreacted to large loan losses. On the other hand, efficiency would improve if the reactions of regulators and banks largely corrected past mistakes.

This paper looks at the relationships among loan growth, regulatory capital, and future loan performance (3-5 years later) to infer whether the credit crunch was a serious disequilibrium phenomenon. Controlled for loan demand, loan contraction means tightened lending standards. Thus, if loan contraction resulted from overtightening, future loan performance would be better (e.g., lower loan loss rates) for banks that reduced lending more (loan-contraction banks). In addition, if banks with insufficient capital (low-capital banks) were forced to overtighten lending standards by regulators or by excessive costs of raising equity capital, there should also exist a negative relation between regulatory capital and future loan performance.

The main finding is poorer future loan performance, as measured by the charge-off rate of business loans in 3 to 5 years, for loan-contraction banks and also for low-capital banks. Based on this finding, the credit crunch of the early 1990s appears to have been more of a needed adjustment than a forced or voluntary overreaction. Many banks may have reduced lending in response to reduced demand. If reduced demand means both a reduced number of creditworthy borrowers and lower average quality of eligible borrowers, future loan performance should be poorer for loan-contraction banks. Poorer future loan performance for low-capital banks suggests insufficient regulatory pressure rather than excessive regulatory pressure. The moral hazard literature shows that riskier banks have stronger incentives to take the risk (e.g., Keeley [12], Merton [14], and Park [17]). The risk-taking incentive may have outweighed regulatory pressure. Another possibility is insufficient voluntary loan contraction by banks that had been overly optimistic before the credit crunch and lost substantial capital due to large loan losses. If their lending standards had been very lax, even a substantial tightening might still be insufficient. Then future loan performance would be poorer for loan-contraction banks and low-capital banks.

The rest of the paper is organized as follows. The next section reviews debates and findings about the causes and economic implications of the credit crunch. Section 3 elaborates on the hypotheses to be tested. Section 4 examines relations among loan growth, capital ratios, and future loan performance. Section 5 discusses the implications of the empirical results. Section 6 concludes.

2. Credit crunch debates

The sharp economic downturn caused by the COVID-19 pandemic has rekindled interest in the credit crunch. So far (early 2023), aggressive policy responses by governments around the world have brought the economy back on track and averted a widespread credit crunch. With stimulus policies withdrawn and fights against inflation ongoing, however, many economies face the risks of a recession and a credit crunch. Reinhart [20] questions whether "this time is different." She recognizes that the 2020 economic downturn was different in that it was not preceded by an economic expansion or an asset-price bubble. Nevertheless, she believes that weakened balance sheets of financial institutions make a credit crunch highly likely. To assess the possibility of a credit crunch, it is critical to identify the fundamental causes of the credit crunch.

There are many possible causes of the credit crunch. In the 1930s, threats of bank runs forced many banks to switch out of loans and into more liquid investments [2]. Before the removal of interest-rate ceilings on deposits in the early 1980s, financial disintermediation contributed to credit crunches by limiting banks' ability to raise funds [23]. With deposit insurance and the removal of the interest-rate ceilings, these causes are much less relevant now.

Following the credit crunch of the early 1990s, many studies explored various other possibilities, including reduced loan demand, the difficulty of meeting capital requirements, tightened bank supervision, and voluntary tightening of lending standards in reaction to increased loan losses. In the early 1990s, bank loans decreased, with a particularly sharp decrease in business loans. In addition, the loan contraction was more pronounced among banks with insufficient regulatory capital. A common argument at that time was that tightened capital requirements restrained bank lending. Based on the Basle Accord of 1988, U.S. regulators phased in risk-based capital requirements between 1989 and 1992, which were tighter in general and required larger capital for riskier assets including business loans. Many banks had insufficient regulatory capital due to sharply increased loan losses in the late 1980s and the early 1990s and tightened capital requirements.[2] Since raising capital was costly, banks reduced assets that were subjected to higher capital charges.

A positive relation between loan growth and regulatory capital, however, does not necessarily mean that banks reduced lending because raising capital was costly. There are other possibilities: Undercapitalized banks might be those located in hard-hit regions, where loan demand had decreased sharply; undercapitalized banks might be subjected to tighter scrutiny by regulators; and undercapitalized banks might be those that had overexpanded in the past and needed to tighten lending standards. Gorton and He [10] also show a theoretical possibility that a credit crunch occurs as banks move from a collusive equilibrium to a competitive equilibrium; if some banks skim the cream by investing in costly information production, other banks are forced to produce more information and tighten lending standards.

The empirical results are mixed. Brinkmann and Horvitz [5] and Haubrich and Wachtel [11] show that the shortage of risk-based capital significantly influenced banks' portfolio decisions and loan growth. Bernanke and Lown [3] and Peek and Rosengren [19] attribute the slow loan growth to both capital shortage and decreased loan demand and concede that data limitations make the results inconclusive. Using Japanese data from the late 1990s, Watanabe [22] finds significant negative effects of capital shortage and tight supervision on the supply of bank loans. According to Wall and Peterson [21], it was regulators' scrutiny of banks' asset portfolios that induced banks to reduce risky loans. Berger and Udell [1] find that capital shortage had a minor effect on loan growth relative to other factors such as tightened bank examination and decreased loan demand. Park [18] finds that banks that reduced risky loans had better stock performance in later years, which implies that banks may have reduced lending voluntarily to correct past mistakes.

Previous studies also offer differing economic implications. Bernanke [2] emphasizes the possibility that the credit crunch triggers a vicious cycle. Increases in loan losses following rapid credit expansion in the 1920s and threats of bank runs induced banks to switch out of loans and into more liquid investments by sharply increasing the risk of lending. Resulting in decreases in the prices of risky assets and deflation further increased loan losses by reducing borrowers' ability to repay. The possibility of a vicious cycle implies that the credit crunch can lead to a serious disequilibrium or an undesirable new equilibrium. Even with deposit insurance, fire sales and runs on non-bank financial institutions can trigger a vicious cycle (Brunnermeier [7]).

Wojnilower [23] offers an economic implication at the other extreme. Oftentimes, especially near business cycle peaks, aggregate private credit demand is interest-rate inelastic and far above the supply. On those occasions, downturns in credit use and general business activities occur only after some blockage in the supply of credit, resulting from regulatory constraints or rising default rates. A sharp decrease in credit supply ends a boom and triggers a recession. From this viewpoint, the credit crunch is a necessary process to clean up excesses or a movement from disequilibrium to equilibrium.

The credit crunch was typically preceded by a credit boom and coincided with a recession and an impaired bank balance sheet (a problem in the banking sector). This pattern raises so many possibilities that it is difficult to determine the main cause and the economic implication either at the theoretical or the empirical level. The cause could be rooted in the

[2] Baer and McElravey [4] find that between 1989 and 1991, nearly two-thirds of the assets in their sample (U.S. bank holding companies included in the Compustat database) were controlled by institutions whose growth might have been constrained by capital requirements.

general economy or the banking sector, and the main implication could be a clean-up of excesses or undue contraction of economic activities.

3. Lending standards and future loan performance

As discussed above, the economic implications of the credit crunch critically depend on whether banks overtightened lending standards. Possible causes of overtightening include increased capital requirements, tightened bank supervision, and overreactions to increased loan losses. Since lending standards are not observable, this paper infers lending standards during the credit crunch from loan performance in later years. Controlled for economic conditions, future loan performance should be strongly related to lending standards; tight (loose) lending standards result in low loan (high) loss rates later,

Let's consider a three-period economy, where banks make one-period loans. The first period is the pre-credit crunch period. In the second period, a shock occurs, and banks adjust their lending decisions. The performance of second-period loans becomes known in the third period.

Banks typically deny credit to borrowers who are perceived to be too risky based on observable characteristics and private information, instead of charging a very high-interest rate. In addition, relationship lending resulting from private information limits competition for borrowers (especially business loan customers on which this study focus). Drawing on these characteristics of bank lending, I make the following simplifying assumptions: banks charge the same interest rate (r) to all borrowers; banks lend one unit each to borrowers who meet their lending standards; banks recover nothing from defaulted loans; each bank has a limited pool of borrowers whose creditworthiness it can evaluate; and banks have only two funding sources – deposits (D) and equity capital (K).

Under these assumptions, the expected return on the loan made to borrower i depends only on the default probability for the borrower.

$$E(R_i) = (1 - p_i)(1 + r) \tag{1}$$

Where p_i is the default probability for borrower i. The default probability for the marginal loan (p_m) increases with the amount of the loan, as the bank digs deeper into a limited borrower pool. Thus, the schedule of $E(R_i)$ is analogous to a downward-sloping demand curve with the expected return on the vertical axis and the loan amount on the horizontal axis. Banks face an identical revenue schedule in the first period.

For simplicity, the cost curve is also assumed to be identical for all banks in the first period. Each bank chooses its optimal capital ratio [$K/(D+K)$] based on various factors such as capital requirements, charter value, and the cost of equity capital. When every bank attains its optimal capital ratio, the weighted average cost of capital (WACC = [$D/(D+K)$]C_D + [$K/(D+K)$]C_K, where C_D is the cost of deposits (1 + the interest rate on deposits) and C_K is the cost of equity (1 + the required rate of return on the bank's equity)) is assumed to be the same. The optimal capital structure for banks is beyond the scope of this study. The possibility of a lower WACC for low-capital banks is discussed below. It is also assumed that the WACC does not change with the total amount of capital as long as the capital ratio stays constant and equity can be issued at a fair price reflecting the bank's profitability. These conditions are satisfied in the first period, and the marginal cost of capital does not change with the loan amount (a horizontal line).

There are three types of banks: ordinary banks, moral-hazard banks that take excessive risk to transfer wealth from deposit insurance and reckless banks that overestimate the revenue schedule. Ordinary banks maximize the profit by expanding loans until the expected return on the marginal loan becomes equal to the marginal funding cost. For those banks, the funding cost determines the lending standard, defined here as the default probability for the marginal loan. Holding the cost schedule constant, loan demand determines the loan amount. Ordering p_i from the lowest to the highest, the expected loan loss rate in the second period:

$$E(Loss_2) = \sum_{i=1}^{n_j} \frac{p_i}{n_j} \tag{2}$$

Where n_j is the number of borrowers for a type j bank. This is simply the average default probability for borrowers who meet the lending standard. The expected loss rate increases with n, and n is larger for moral-hazard banks and reckless banks than that for ordinary banks.

A shock in the second period disturbs either the revenue or the cost schedule unevenly across banks. Possible shocks include reduced loan demand, larger-than-expected losses on first-period loans, increased capital requirements, and tightened bank supervision. The nature of the shock and the bank's response to the shock determine the expected loan loss rate in the third period.

Suppose that all banks are ordinary and loan demand decreased for some banks. Then the lending standard remains the same, and the loan amount decreases with loan demand. In this case, the third-period expected loss rate is not necessarily higher for banks that reduced lending, but it is likely to be higher because a negative demand shock may affect most borrowers in the same pool (substantially increased default probabilities for infra-marginal borrowers).

Another possibility is that reckless banks revise the inflated revenue schedule downward after suffering larger loan losses. Reckless banks reduce lending, and the expected loss rate for those banks is lower (higher) than that for other banks if they overreacted (underreacted).

Higher capital requirements may increase the optimal capital ratio for low-capital banks. If increasing the capital ratio raises the WACC, low-capital banks will tighten lending standards and reduce lending. Then the expected loan loss rate should be lower for loan-contraction banks and low-capital banks. This effect should be moderate if banks can raise equity at a fair price. An unduly high cost of equity financing due to asymmetric information (Myer and Majluf [15]), however, can magnify the effect dramatically. In this case, the marginal cost of capital will become discontinuous and jump at the loan level that can be supported by equity capital on hand. Then low-capital banks may reduce lending dramatically, unintentionally tightening lending standards. The result will be much lower expected loan loss rates for loan-contraction banks and low-capital banks.

Alerted by increased loan losses, bank regulators may tighten supervision, especially in low-capital banks. If regulators rightly target reckless banks and moral-hazard banks, the expected loan loss rate should be more equalized across banks. Even with tighter supervision, the expected loan loss rate can be negatively related to the capital ratio and loan growth if moral-hazard banks successfully managed to take more risk than other banks, that is, tightened lending standards but still lower lending standards than other banks' lending standards. If regulators unduly force ordinary banks to tighten lending standards, however, the expected loan loss rate will be lower for loan-contraction banks and low-capital banks.

It is also possible that the cost of capital is lower for low-capital banks thanks to underpricing of deposit insurance. In this case, higher capital requirements would force low-capital banks to tighten lending standards and reduce lending. Still, their lending standards may remain laxer, resulting in a higher expected loan loss rate for loan-contraction banks and low-capital banks. But reduced lending by low-capital banks, in this case, would be a desirable adjustment. The problem is not that the cost of capital is too high for low-capital banks but that it was too low before. The practical implication is similar to that of moral hazard; higher capital requirements reduce risk, but the risk may remain excessive.

In sum, better future loan performance for loan-contraction banks and lower-capital banks during a credit crunch would imply that the credit crunch caused serious inefficiency; banks denied credit to many creditworthy borrowers. Market frictions and sub-optimal behavior that may be responsible for the inefficiency include unduly high costs of equity financing, overzeal of bank examiners, and banks' overreaction to increased loan losses. If all banks optimally responded to well-functioning market forces, future loan performance should be unrelated or positively related (in the case of reduced loan demand) to loan growth and the capital ratio. Poorer future loan performance for loan-contraction banks and low-capital banks might also indicate that needed adjustments were not fast enough or were deterred by some barriers, such as incentives to take excessive risk.

4. Loan growth, regulatory capital, and future loan performance

This section estimates the relationships among business loan growth during the credit crunch of the early 1990s (1991-1993) in the U.S., regulatory capital, and future charge-offs.[3] The growth of business loans was negative for the three years: −3.5 percent in 1991, −3.2 percent in 1992, and −2.2 percent in 1993. I focus on business loans for several reasons: Business loans decreased most dramatically in those years; business loans were affected the most by new capital requirements because of the highest risk weight for those loans, and business loans might have the most significant economic implications because many small businesses heavy rely on banks (relationship lending). Because of their opaqueness, it can be particularly more difficult for small businesses to obtain credit elsewhere. (See Elyasiani and Goldberg, 2004, for a survey of the relationship lending literature.) Relationship lending also affects the welfare of borrowers and firms' capital structure (Boot and Thakor [6] and Leary [13]).

The first thing to be estimated is the effects of regulatory capital ratios and lagged charge-off rates on loan growth. The main purpose of this analysis is to examine whether banks strongly reacted (possibly overreacted) to large loan losses by aggressively cutting back loans. It is also intended to confirm the positive relationship between the capital ratio and loan growth found by previous studies.

In the next subsection, charge-off rates for business loans during years t+3, t+4, and t+5 are regressed on the growth of business loans during year t (t = 1991, 1992, and 1993). These regressions should shed light on whether loan-contraction banks applied tighter lending standards than other banks.

In the last set of regressions, loan growth during year t is replaced by the capital ratio at the beginning of year t. A key question to be answered is whether low-capital banks were forced to tighten lending standards excessively.

[3] It may also be worthwhile to consider the delinquency rate as an alternative measure of loan performance. While the charge-off rate better reflects ultimate loan performance, the timing of charge-offs is at the discretion of banks, to a certain extent. Loan delinquencies, however, were classified as confidential and excluded from publicly available databases for years before 2001. Choosing one over the other should not make a material difference.

4.1. Data

Bank balance sheet and income-statement data are from the Consolidated Reports of Condition and Income (Call Reports) that banks file to regulators each quarter. The sample includes all commercial banks that were insured by the Federal Deposit Insurance Corporation (FDIC) and in business between 1991 and 1993. For each of the three years (year t), business loan growth and the capital ratio are matched with the charge-off rate in years t+3, t+4, and t+5. Many mergers took place in those years. For merged banks, combined figures are used. For example, if Bank A belonging to the 1991 sample acquired Bank B belonging to the same sample in 1993, the charge-off rates in 1994, 1995, and 1996 for Bank A are matched with the combined loan growth and capital ratio in 1991 for Bank A and Bank B. The same control for mergers is applied to lagged variables. After the merger combinations and the eliminations due to failures and missing variables, there remain 26,868 observations for regressions using the charge-off rate in year t+3 as the dependent variable. The sample size decreases when the charge-off rate in year t+4 is used, and further decreases when the charge-off rate in t+5 is used due to more mergers and failures.

4.2. Loan growth and capital ratios

Loan growth is regressed on capital ratios and lagged charge-off rates to infer whether banks overreacted to large loan losses by aggressively cutting back loans.

$$LonGrh_t = \alpha_1 Intcpt + \alpha_2 CptRto_t + \alpha_3 CptRto_t^2 + \alpha_4 CptRto_t^3 + \alpha_5 ChrOff_{t-1} + \alpha_6 DptGrh_t$$

$$+ \alpha_7 SteEcn_t + \alpha_8 Size_t + \alpha_9 Yr1991 + \alpha_{10} Yr1992 + u \qquad (3)$$

Where $LonGrh_t$ is the log of business loans at the end of year t minus the log of business loans at the end of year t−1; Intcpt is the intercept term; $CptRto_t$ is a regulatory capital ratio at the beginning of year t; $ChrOff_{t-1}$ is business loans charged offs divided by business loans in year t−1; $DptGrh_t$ is the log of transaction deposits at the end of year t minus the log of transaction deposits at the end of year t−1; $SteEcn_t$ is the log of payroll jobs in the state where the headquarter of the bank is located in year t minus the log of payroll jobs in the state in year t−1; $Size_t$ is the log of total assets in year t; Yrxxxx's are year dummies (1 if year t is xxxx and 0 otherwise); u is the error term; and α_i's are coefficients to be estimated.

The log growth rate is used for all growth variables to avoid skewed distributions. During the sample period, there were three regulatory capital ratios: the total risk-weighted capital ratio (ratio of tier 1 plus tier 2 capital to risk-weighted assets), the tier-1 capital ratio (the ratio of tier-1 capital to risk-weighted assets), and the leverage ratio (the ratio of tier-1 capital to total assets).[4] This analysis primarily uses the total risk-weighted capital ratio because it was the most binding capital requirement.[5] Using other capital ratios produced similar results

[4] Tier 1 capital consists mainly of common stock and some perpetual preferred stock. Tier 2 capital includes preferred stock, subordinated debt, and allowance for loan losses. The risk-weighted asset is the weighted average of four asset categories: 0-, 20-, 50-, and 100-percent risk-weight categories. Most government securities fall into the 0-percent risk-weight category, claims guaranteed by depository institutions belong in the 20-percent risk-weight category, loans fully secured by first liens on residential properties are included in the 50-percent risk-weight category, and most other loans fall into the 100-percent risk-weight category. Risk weights are also applied to the credit-equivalent amount of off-balance-sheet items. Risk-weighted capital ratios used here are those estimated by FDIC.

[5] The required minimum was 8 percent for the total risk-weighted capital ratio, 4 percent for the tier 1 capital ratio, and 3 percent for the leverage ratio. Between 1991 and 1993, the total risk-weighted capital was below 8 percent for 2.33 percent of banks and below 10 percent for 8.61 percent of banks, while the tier-1 capital ratio was below 4 percent for 0.60 percent of banks and

with moderately lower statistical significance.[6] The leverage ratio is less relevant; it does not discourage lending because it treats all assets, including safe securities, equally to calculate the capital ratio. The square and cube terms of CptRto were included because the relationship is likely to be nonlinear; the capital ratio may not matter much for well-capitalized banks.

The calculation of ratios and growth rates for a large sample typically produces some outliers, some of which may arise from data collection errors. To mitigate the effects of outliers, some ratios, and growth rates are censored at appropriate levels. For example, the total risk-weighted capital ratio is censored at 0.03 (0.03 for all banks with a capital ratio of 0.03 or below) and 0.3 (0.3 for all banks with a capital ratio of 0.3 or above). Once a bank is critically undercapitalized or has huge buffer capital, the capital ratio should cease making a difference. Table 1 presents descriptive statistics and the range after censoring.

Table 1: Descriptive Statistics

	1st Pctl	5th Pctl	Median	95th Pctl	99th Pctl	Censored Range
Total CptRto	0.0447	0.0771	0.1356	0.3343	0.7048	0.03 - 0.30
Tier 1 CptRto	0.0600	0.0907	0.1473	0.3454	0.7119	0.01 - 0.25
ChrOff	0.0000	0.0000	0.0043	0.0847	0.2500	0.00 - 0.30
LonGrh	-1.1935	-0.5669	0.0077	0.5607	1.2341	-1.39 - 1.39
Size	8.7762	9.4255	10.9708	13.1618	15.2117	No Censoring
DptGrh	-0.4980	-0.1507	0.0597	0.3450	0.7854	-1.39 - 1.39
SteEcn	-0.0183	-0.0044	0.0229	0.0408	0.0499	No Censoring
AgLShr	0.0000	0.0000	0.1544	0.8430	0.9261	No Censoring

If banks tightened lending standards in reaction to large loan losses, lagged charge-offs should be negatively related to loan growth. For banks with less than $300 million in total assets (small banks), the Call Reports categorize charge-offs more broadly and combine business loan charge-offs with charge-offs of some agricultural loans. In cases where ChrOff is used as an explanatory variable, the variable is adjusted for the effect of agricultural loans. For small banks, ChrOff is regressed on the share of relevant agricultural loans (agricultural loans / (agricultural loans + business loans)), and the estimated effect of the share is filtered out. In later regressions using ChrOffs as the dependent variable, the share of agricultural loans for small banks (0 for large banks) is included as an explanatory variable.

To confirm the robustness of the results, I also use a subsample containing only large banks with clean ChrOff. In addition to removing the measurement error, the large bank sample has an important advantage. Loan performance at large banks should be less influenced by bank-specific factors, such as borrower characteristics and information advantages, which are hard to control.

below 6 percent for 1.68 percent of banks. To be classified as "well-capitalized" by regulators, the total risk-weighted capital ratio and the tier 1 capital ratio respectively had to be at least 10 percent and 6 percent.

[6] Two measures of the most binding capital ratio have been considered: the smaller of the tier 1 capital ratio minus the required ratio and the total risk-based capital ratio minus the required capital ratio used in Park [18] and the log of the minimum of total risk-based capital ratio, the tier 1 capital ratio, and the leverage ratio, respectively divided by 10, 6, and 5 percent (thresholds to be classified as well-capitalized) used in Calomiris and Nissim [8]. While these measures may better reflect the degree of undercapitalization, they cause some inconsistency for well-capitalized banks.

Transaction deposits, which are relatively insensitive to interest rates, are determined largely by exogenous factors, such as liquidity preference and economic conditions. Thus, DptGrh should capture the effects of fund availability and local economic conditions. SteEcn is an additional measure of local economic conditions. Size is relevant because large banks may mostly lend to large corporations and engage in more diverse activities.

[Table 2] presents the results of Ordinary Least Squares (OLS) estimations. OLS is appropriate for estimating most cross-sectional relations. A common problem in cross-sectional OLS estimations is heteroscedasticity. To address heteroscedasticity, I calculate all t-values using the heteroscedasticity-consistent covariance matrix. Models 13 and 14 use a subsample consisting of large banks with clean charge-off data.

As expected, CptRto shows a highly non-linear relationship with LonGrh. [Figure 1] plots the relationship based on the coefficients of the three capital-ratio terms in Model 11. The relationship is strongly positive for banks with a total risk-weighted capital ratio under 10 percent, beyond which it quickly weakens. An increase in the capital ratio from 8 percent to 9 percent is associated with an increase in a log loan growth rate of 0.015. Model 12 using the tier 1 capital ratio produces similar results. The qualitative results are the same in Models 13 and 14.

The lagged charge-off rate has a moderately negative effect on loan growth. In Models 11 and 12, the log growth rate decreases by 0.0025 when the lagged charge-off rate increases by 1 percentage point. In Models 13 and 14, the coefficients are larger in magnitude but fail to be statistically significant at the 95 percent level. Inferring from this moderate effect, banks do not appear to have overreacted to loan losses.

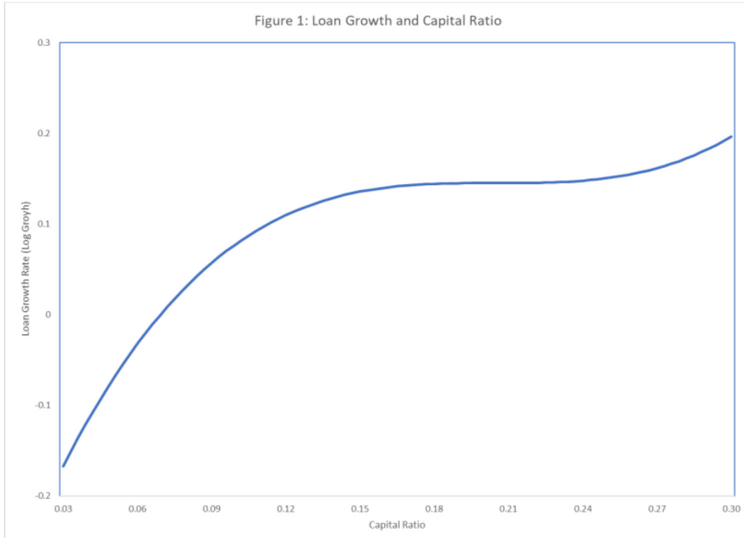
DptGrh and SteEcn are statistically significant with expected signs. Size is statistically significant, but it has inconsistent signs across samples, suggesting that its effect may not be monotonic.

Table 2: Loan Growth and Capital Ratios

Dependent Variable: $LonGrh_t$

	Model 11	Model 12	Model 13	Model 14
Intcpt	-0.3578	-0.2711	-0.8882	-0.7514
	(-6.91)	(-5.85)	(-5.29)	(-5.07)
$CptRto_t$ (Total)	7.381		11.3456	
	(8.87)		(4.06)	
$CptRto_t^2$	-36.0975		-63.5575	
	(-7.61)		(-3.52)	
$CptRto_t^3$	58.8349		114.9363	
	(6.95)		(3.22)	
$CptRto_t$ (Tier-1)		6.6624		9.4258
		(7.83)		(4.07)
$CptRto_t^2$		-36.9551		-61.7414
		(-6.40)		(-3.43)
$CptRto_t^3$		70.0259		133.1355
		(5.70)		(3.02)
$ChrOff_{t-1}$	-0.2536	-0.2518	-0.7296	-0.7679
	(-4.39)	(-4.36)	(-1.76)	(-1.85)
$DptGrh_t$	0.4064	0.4068	0.3213	0.3241
	(24.19)	(24.14)	(6.08)	(6.14)
$SteEcn_t$	0.6337	0.6408	1.0574	1.0474
	(3.83)	(3.87)	(2.46)	(2.42)
$Size_t$	-0.0120	-0.0115	0.0137	0.0169
	(-6.89)	(-6.59)	(2.31)	(2.69)
Yr1991	-0.0472	-0.0478	-0.0385	-0.0433
	(-7.57)	(-7.67)	(-1.90)	(-2.16)
Yr1992	-0.0724	-0.0726	-0.0283	-0.0313
	(-13.80)	(-13.83)	(-1.74)	(-1.93)
Adjtd R^2	0.0701	0.0700	0.1153	0.1131
No. Obs.	32,223	32,223	2,285	2,285

Note: Numbers in parentheses are t-values calculated based on the heteroscedasticity-consistent covariance matrix.



4.3. Future charge-off rates and loan growth

The following regression estimates the relationship between future charge-off rates and loan growth.

$$ChrOff_{t+i} = \beta_1 Intcpt + \beta_2 LonGrh_t + \beta_3 LGDmmy_t + \beta_4 DptGrh_{t+i-1} + \beta_5 DptGrh_{t+i} + \beta_6 SteEcn_{t+i-1}$$

$$+ \beta_7 SteEcn_{t+i} + \beta_8 Size_{t+i} + \beta_9 AgLShr_{t+i} \quad + \beta_{10} Yr1991 + \beta_{11} Yr1992 + u \qquad (4)$$

where $ChrOff_{t+i}$ is the charge-off rate in year t+i (i = 3, 4, or 5);[7] LGDmmy is LonGrh if LonGrh is negative and 0 otherwise; AgLShr is relevant agricultural loans divided by the sum of those agricultural loans and business loans.

Since a lower charge-off rate means better loan performance, a positive β_2 would mean a negative relationship between loan growth and loan performance, which would imply that loan contraction might have resulted from excessively tight lending standards. LGDmmy is included because the relation between loan growth and loan performance for banks that contracted loans can differ from that for banks that expanded loans. Since there can be a substantial lag between financial difficulties experienced by borrowers and loan charge-offs, I include lagged values of deposit growth and state-level payroll growth, as well as their contemporary values to capture local economic conditions. AgLShr is to control for the portion of charge-offs attributable to agricultural loans.

In [Table 3], Models 21, 22, and 23 use the full sample, and Models 24, 25, and 26 uses the large-bank sample. The key result is that for banks that reduced lending, loan growth is negatively related to charge-offs in 3, 4, and 5 years. Although β_2 is positive, β_3 is negative and larger in magnitude in all 6 models. Since this result suggests a U-shaped curve, Model 27 pools $ChrOff_{t+3}$, $ChrOff_{t+4}$, and $ChrOff_{t+5}$, and replaces $LGDmmy_t$ with square and cube terms of $LonGrh_t$. Figure 2 depicts the relationship between the future charge-off rate and the loan growth rate based on the coefficients of loan growth terms in Model 27. The future

[7] Looking at three future years (t+3, t+4, and t+5) should safely capture landing standards in year t. The outcome of a risky project is usually realized in a few years. Thus, lending standards in years before year t should not significantly affect loan performance in years t+4 and t+5, and lending standards in years after year t should not significantly affect loan performance in years t+3 and t+4.

charge-off rate is minimized at a loan growth rate of 0.08. In the mid-range of loan growth, the effect of ChrOff on LonGrh is quite modest. A change in LonGrh by 0.1 is associated with a change in ChrOff by less than 5 basis points. However, ChrOff increases by 15 basis points when LonGrh decreases from −0.9 to −1. It is a fairly large change. During the sample period, ChrOff was less than 1 percent for 71 percent of banks and less than 2 percent for 82 percent of banks.[8] Looking at large banks, whose business loan charge-off rates were not inflated by charge-offs of some agricultural loans, ChrOff was less than 1 percent for 81 percent of banks and less than 2 percent for 92 percent of banks. For those banks, ChrOff increases by 24 basis points between the 40th percentile and the 60th percentile.

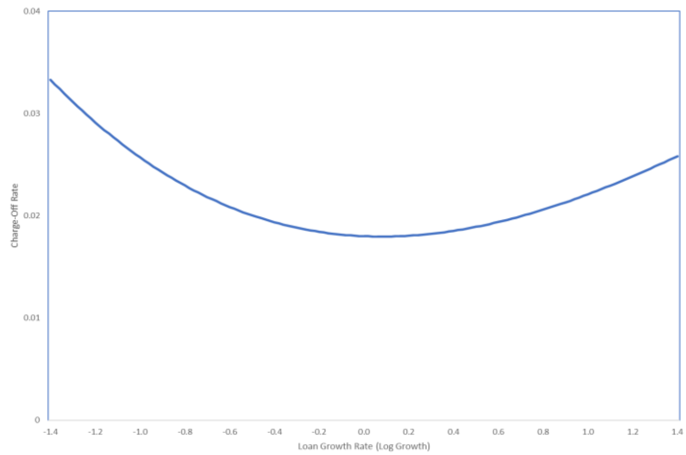
Table 3: Future Charge-Offs and Loan Growth

Dependent Variable	$ChrOff_{t+3}$	$ChrOff_{t+4}$	$ChrOff_{t+5}$	$ChrOff_{t+3}$	$ChrOff_{t+4}$	$ChrOff_{t+5}$	Pooled
	Model 21	Model 22	Model 23	Model 24	Model 25	Model 26	Model 27
Intcpt	0.0209	0.012	0.0136	0.0186	0.0084	0.0095	0.018
	(7.74)	(4.38)	(4.40)	(2.97)	(1.21)	(1.42)	(11.08)
$LonGrh_t$	0.0045	0.0052	0.0057	0.0028	0.0078	0.0002	-0.0009
	(3.71)	(4.18)	(4.40)	(0.75)	(1.22)	(0.11)	(-1.45)
LGDmmyt	-0.0144	-0.0142	-0.0111	-0.0074	-0.0112	-0.0068	
	(-6.40)	(-6.23)	(-4.96)	(-1.54)	(-1.44)	(-1.12)	
$LonGrh_t^2$							0.0059
							(9.14)
$LonGrh_t^3$							-0.0009
							(-1.30)
$DptGrh_{t+i-1}$	-0.007	-0.0069	-0.0067	0.0001	0.0015	0.0008	-0.0073
	(-5.12)	(-4.70)	(-4.65)	(0.07)	(0.82)	(0.91)	(-8.83)
$DptGrh_{t+i}$	-0.0119	-0.0097	-0.009	-0.0037	-0.0024	0.0003	-0.0097
	(-8.00)	(-7.24)	(-6.77)	(-2.33)	(-1.82)	(0.32)	(-12.23)
$SteEcn_{t+i-1}$	-0.2454	-0.2129	-0.0146	-0.3549	-0.2227	-0.0486	-0.0875
	(-5.84)	(-5.34)	(-0.36)	(-5.49)	(-4.15)	(-1.12)	(-4.83)
$SteEcn_{t+i}$	0.1964	0.2625	0.1949	0.2559	0.2409	0.0989	0.1162
	(4.33)	(6.08)	(4.60)	(3.90)	(3.42)	(1.63)	(6.19)
$Size_{t+i}$	-0.0009	-0.0007	-0.0009	-0.0006	-0.0003	-0.0003	-0.0009
	(-4.54)	(-3.48)	(-4.11)	(-1.53)	(-0.83)	(-0.82)	(-7.51)
$AgLShr_{t+i}$	0.0205	0.023	0.0224				0.0217
	(18.79)	(20.27)	(18.52)				(32.98)
Adjtd R^2	0.0486	0.0643	0.0508	0.0317	0.0176	0.0056	0.0498
No. Obs.	26,868	25,176	23,612	2,240	2,153	2,043	75,656

Notes: Numbers in parentheses are t-values calculated based on the heteroscedasticity-consistent covariance matrix; the coefficients of year dummies in all models and sample dummies in Model 27 are not reported for the sake of space.

[8] Due to many extreme values, the mean and the standard deviation are not meaningful in this case.

Figure 2: Future Charge-Off Rate and Loan Growth



ChrOff is positively related to LonGrh for those banks that increased business loans substantially. It is not surprising that lending standards were lower at banks that expanded loans rapidly. A more interesting result is a higher charge off rates for banks that reduced lending during the credit crunch period, which suggests that those banks faced sharply reduced loan demand and/or that they did not tighten lending standards enough. Holding the lending standard (creditworthiness of marginal borrowers) constant, reduced loan demand can lead to poor future loan performance by lowering the creditworthiness of infra-marginal borrowers. Poor future loan performance for banks that expanded loans rapidly might reflect a failure to recognize reduced demand or resistance to correct past mistakes.

In models using the full sample, both lagged and contemporary deposit growth, which may reflect local economic conditions, show negative effects on the charge-off rate. The two variables are statistically insignificant in models using the large-bank sample, probably because large banks are less affected by local economic conditions. Somewhat surprisingly, state payroll growth shows mixed effects; while β_6 is negative, as expected, β_7 is positive. Other state-level variables, such as state-level deposit growth and state-level banking asset growth, did not behave much better. However, the key results of these regressions are quite robust; excluding all variables reflecting local economic conditions ($DptGrh_{t-1}$, $DptGrh_t$, $SteEcn_{t-1}$, and $SteEcn_t$) and including various combinations of those and other related variables had very marginal effects on the coefficients of loan growth variables.

Size has a negative sign, suggesting that loan performance was better for larger banks during the sample period. The regressions also include year dummies, and Model 7 also includes a 3-year dummy (1 if i =3 and 0 otherwise) and a 4-year dummy (1 if i =4 and 0 otherwise). Their coefficients, which are not particularly notable, are not reported for the sake of space.

4.4. Future charge-off rates and capital ratios

The equation below replaces loan growth variables with capital ratio variables to examine a more specific possibility that tightened capital requirements and bank supervision forced low-capital banks to overtighten lending standards.

$$ChrOff_{t+i} = \gamma_1 Intcpt + \gamma_2 CptRto_t + \gamma_3 CptRto_t^2 + \gamma_3 CptRto_t^3 + \gamma_4 DptGrh_{t+i-1} + \gamma_5 DptGrh_{t+i}$$

$$+ \gamma_6 SteEcn_{t+i-1} + \gamma_7 SteEcn_{t+i} + \gamma_8 Size_{t+i} + \gamma_9 AgLShr_{t+i} + \gamma_{10} Yr1991 + \gamma_{11} Yr1992 + u \qquad (5)$$

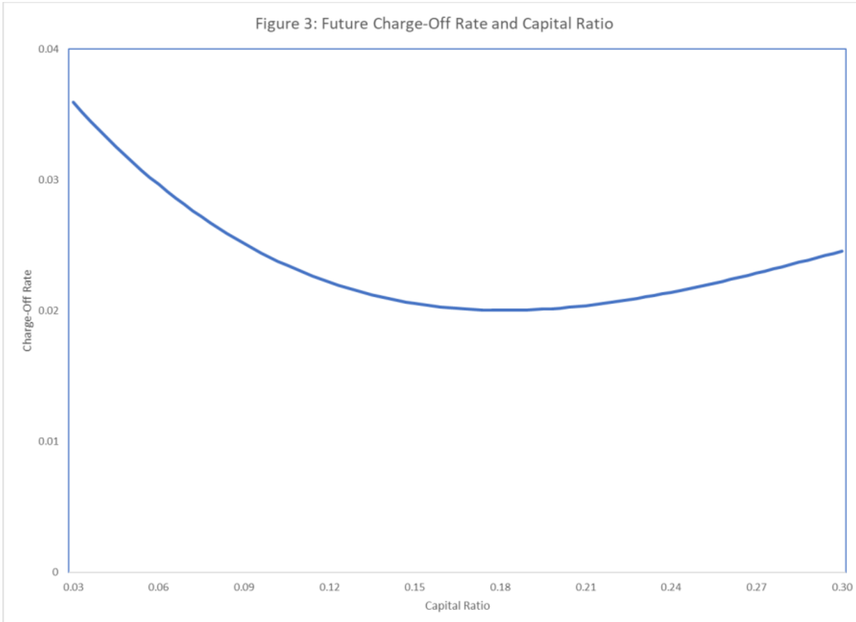
If low-capital banks were forced to overtighten lending standards, γ_2 should be positive. In addition, γ_3 should be negative because the capital ratio should not matter much for well-capitalized banks. The opposite results would imply that stronger risk-taking incentives for lower-capital banks might have outweighed regulatory pressure.

Across all specifications, γ_2 is negative, and γ_3 is positive [Table 4]. The coefficients of capital ratio terms produce U-shaped curves. In [Figure 3], which is based on the coefficients in Model 37, the future charge-off rate decreases with the capital ratio at a decreasing pace up to a capital ratio of about 0.18 and increases at a moderate pace beyond that point. The effect is fairly large for seriously undercapitalized banks; the future charge-off rate decreases by 17, 15, and 13 basis points when the capital ratio increases from 6 to 7 percent, from 7 to 8 percent, and 8 to 9 percent. Based on this result, lending standards may have been still lower at low-capital banks during the credit crunch period. Under regulatory pressure, they may have tightened lending standards somewhat, but not sufficiently.

Table 4: Future Charge-Offs and Capital Ratios

Dependent Variable	$ChrOff_{t+3}$	$ChrOff_{t+4}$	$ChrOff_{t+5}$	$ChrOff_{t+3}$	$ChrOff_{t+4}$	$ChrOff_{t+5}$	Pooled
	Model 31	Model 32	Model 33	Model 34	Model 35	Model 36	Model 37
Intcpt	0.0547	0.0377	0.0335	0.0545	0.0406	0.0371	0.0442
	(9.57)	(7.56)	(5.60)	(5.58)	(3.53)	(3.26)	(13.65)
$CptRto_t$	-0.3678	-0.2319	-0.2655	-0.4797	-0.4537	-0.419	-0.3115
	(-4.30)	(-3.01)	(-2.90)	(-3.41)	(-2.18)	(-2.15)	(-6.34)
$CptRto_t^2$	1.3919	0.7994	1.2011	2.4753	2.4602	2.3181	1.2316
	(2.85)	(1.77)	(2.28)	(3.06)	(2.00)	(2.05)	(4.35)
$CptRto_t^3$	-1.5042	-0.6286	-1.5597	-4.1696	-4.2297	-3.9759	-1.3721
	(-1.72)	(-0.76)	(-1.65)	(-2.86)	(-1.89)	(-1.94)	(-2.69)
$DptGrh_{t+i-1}$	-0.0070	-0.0071	-0.0061	-0.0001	0.0008	-0.0009	-0.0070
	(-4.96)	(-4.74)	(-4.12)	(-0.03)	(0.28)	(-0.52)	(-8.28)
$DptGrh_{t+i}$	-0.0110	-0.0094	-0.0085	-0.0014	-0.0017	0.0001	-0.0090
	(-7.31)	(-7.21)	(-6.65)	(-0.62)	(-1.34)	(0.09)	(-11.63)
$SteEcn_{t+i-1}$	-0.2158	-0.1915	-0.0024	-0.3465	-0.2393	-0.0764	-0.0775
	(-5.16)	(-4.82)	(-0.06)	(-4.61)	(-3.60)	(-1.31)	(-4.28)
$SteEcn_{t+i}$	0.1650	0.2389	0.1707	0.2574	0.2674	0.1340	0.0986
	(3.61)	(5.51)	(3.98)	(3.18)	(3.20)	(1.72)	(5.21)
$Size_{t+i}$	-0.0013	-0.0012	-0.001	-0.001	-0.0007	-0.0006	-0.0011
	(-6.27)	(-5.61)	(-4.47)	(-2.35)	(-1.82)	(-1.45)	(-9.16)
$AgLShr_{t+i}$	0.0209	0.0209	0.0220				0.0217
	(19.42)	(19.39)	(18.34)				(33.33)
Adjtd R^2	0.0489	0.0499	0.0512	0.0334	0.0171	0.0033	0.0498
No. Obs.	27,038	25,331	23,795	2,265	2,179	2,068	76,191

Notes: Numbers in parentheses are t-values calculated based on the heteroscedasticity-consistent covariance matrix; the coefficients of year dummies in all models and sample dummies in Model 37 are not reported for the sake of space.



This result is consistent with the moral hazard hypothesis: Since low-capital banks can easily transfer losses to the deposit insurer (put option value), they have greater incentives to take the risk. Moral hazard models can also explain the moderately positive relationship between the capital ratio and the future charge-off rate at very high capital ratios. Once the put option value becomes negligible, banks that take more risk should be those that can absorb more risk because their main concern should be protecting the charter value (Keeley [12] and Park [16]). Given the positive relationship between the capital ratio and loan growth, this result is also consistent with reduced loan demand and underreactions to increased loan losses.

5. Implications

A clear implication of the empirical results is that banks were not excessively forced to reduce lending during the credit crunch of the early 1990s. Regulatory pressure matters largely to low-capital banks. An excessive cost of equity financing would mostly constrain low-capital banks because high-capital banks did not need to raise equity to expand loans. Bank examiners would scrutinize low-capital banks more closely. Thus, higher future charge-off rates for low-capital banks tell that the difficulties of meeting increased capital requirements and dealing with tighter supervision were not severe enough to cause overtightening of lending standards. Although charge-off rates in year t+i may partly reflect lending standards in years before year t, future charge-off rates should not be significantly higher for low-capital banks if their lending standards during year t and later were substantially tighter than those of high-capital banks.

It is also unlikely that banks overreacted voluntarily, although the evidence is not complete enough to rule it out. Controlled for capital ratios, loan losses had a moderately negative effect on lending. Inferring from this finding, banks reacted to loan losses, but they don't seem to have overreacted. A more important finding is higher future charge-off rates for loan-contraction banks. Overreactions would normally be translated into significant loan contraction. Thus, if overreaction were the main cause of the credit crunch, future charge-off rates should be lower for loan-contraction banks.

It is still possible that banks collectively overtightened lending standards, without systematic cross-sectional variations. This hypothesis is much harder to test. One can control for macroeconomic and other factors affecting time-series variations in loan performance to a reasonable extent. What are relevant for lending decisions; however, are forecasts for those variables. Collective overreactions would mean that most banks were unreasonably pessimistic about economic prospects, which is hard to judge from *ex*-post-loan performance. Furthermore, given that lending standards may have been too tight in some years and too lax in some other years, it is hard to establish a benchmark to compare against. Intuitively, it is implausible that banks expanding loans and those contracting loans were equally and unreasonably pessimistic about economic prospects.

The key results of this paper are generally consistent with reduced loan demand and the moral hazard hypothesis. If reduced loan demand was accompanied by deterioration of overall credit quality (higher default probabilities for many infra-marginal borrowers), future loan performance should be worse for banks that faced lower loan demand. Another possibility is that risk-taking incentives outweighed external forces; risky banks tightened lending standards, but their lending standards remained laxer than those of safer banks. In either case, a credit crunch is not a good excuse for regulatory complacency. Regulatory pressure is unlikely to cause excessive loan contraction.

In sum, the credit crunch is more likely to be a correction process (movement toward equilibrium) than a serious disequilibrium phenomenon, at least at the bank level. Drawing a more definitive conclusion would require further research, such as international comparisons based on the same method and analyses of time-series variations in aggregate loan performance. At the minimum, however, it is quite clear that banks make some needed adjustments during a credit crunch. Given this finding, leniency with lenders can be ineffective and inefficient. Promoting loan demand and the overall stability of the financial market may be safer and more effective in preventing a vicious cycle and excessive economic contraction.

6. Conclusion

Although the credit crunch exacerbates an economic downturn, one should not simply assume that it is a disequilibrium phenomenon that unnecessarily damages the economy. It can be a process of restoring the equilibrium that is painful but necessary. A key question is whether banks overtighten lending standards during a credit crunch. If they do, the credit crunch may be a disequilibrium phenomenon that should be avoided. If they don't, it may be a needed adjustment.

This paper has inferred lending standards during the U.S. credit crunch of the early 1990s from loan performance in future years. Tighter lending standards should lead to lower loan loss rates later. The main finding is higher future loan loss rates for banks that reduced lending significantly. Based on this finding, there doesn't appear to have been much overtightening either voluntary or forced. Most banks that reduced lending had suffered heavy loan losses before the credit crunch and/or had insufficient regulatory capital during the credit crunch. Given that those banks reduced lending, they probably tightened lending standards. Given that loan loss rates were still higher for those banks than for other banks several years later, they probably did not tighten lending standards enough. It appears that risky banks continued to pursue risky strategies, despite increased regulatory pressure.

The fundamental problem seems to be the overexpansion of credit in the years preceding a credit crunch. The credit crunch may be more of a needed adjustment than an overreaction. The best policy is to prevent the overexpansion of credit during normal times. Once a credit crunch occurs, policymakers should focus on mitigating the economic effects of reduced credit and preventing overtightening rather than increasing credit.

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