Does Faster Loan Growth Lead to Higher Loan Losses?

By William R. Keeton

During the last couple of years, concern has increased that the exceptionally rapid growth in business loans at commercial banks has been due in large part to excessively easy credit standards. Some analysts argue that competition for loan customers has greatly increased, causing banks to reduce loan rates and ease credit standards to obtain new business. Others argue that as the economic expansion has continued and memories of past loan losses have faded, banks have become more willing to take risks. Whichever explanation is correct, the acceleration in loan growth could lead eventually to a surge in loan losses, reducing bank profits and sparking a new round of bank failures. As the experience of the early 1990s made clear, such a slump in banking could not only threaten the deposit insurance fund but also slow the economy by discouraging banks from granting new loans.

The view that faster loan growth leads to higher loan losses should not be dismissed lightly; nor should it be accepted without question. If loan growth increases because banks become more willing to lend, credit standards should fall and loan losses should eventually rise. But loan growth can increase for reasons other than a shift in supply—for example, businesses may decide to shift their financing from the capital markets to banks, or an increase in productivity may boost the returns to investment. In such cases, faster loan growth need not lead to higher loan losses.

This article explains why supply shifts are necessary for faster loan growth to lead to higher loan losses and determines if supply shifts have caused loan growth and loan losses to be positively related in the past. On balance, the article finds limited support for the view that supply shifts have caused loan growth and loan losses to be positively related. Data on business loans and delinquencies show that states experiencing unusually rapid loan growth tended to experience unusually big increases in delinquency rates several years later. This finding is tempered, however, by evidence on business loan growth and business credit standards suggesting that changes in loan growth are not always due to shifts in supply.

The first section of the article explains how loan growth and loan losses might be related. The second section examines the relationship

William R. Keeton is a senior economist at the Federal Reserve Bank of Kansas City. Michelle Holloway, a research associate at the bank, helped prepare the article. This article is on the bank's Website at ***www.kc.frb.org****.*

between business loan growth and business credit standards, drawing on the Federal Reserve's Senior Loan Officer Survey for the periods 1967-83 and 1990-98. The third section investigates the relationship between business loan growth and business loan delinquencies, using statewide data for the period 1982-96.

I. POSSIBLE RELATIONSHIP BETWEEN LOAN GROWTH AND LOAN LOSSES

An obvious reason loan growth and loan losses might be related is the business cycle. Loan growth tends to be high during business expansions, while loan losses tend to be high during business contractions. Thus, as a result of the business cycle, periods of rapid loan growth naturally tend to precede periods of high loan losses. But does faster loan growth lead to higher loan losses even after controlling for the state of the economy? Using a simple model of the market for bank loans, this section identifies when such a relationship between loan growth and loan losses is likely to exist. The section then suggests how data on loan growth, credit standards, and loan losses can be used to test the view that faster loan growth leads to higher loan losses.

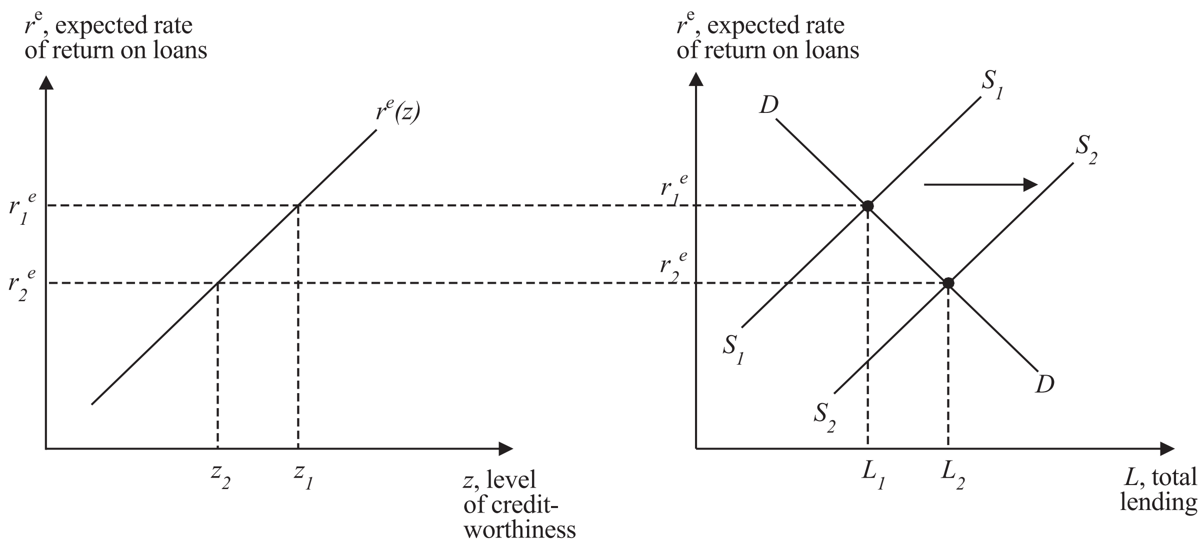
Why faster loan growth might lead to higher loan losses

Most of the reasons usually given for faster loan growth leading to higher loan losses involve *supply shifts*—that is, increases in banks' willingness to lend. When such a shift occurs, banks typically seek to increase their lending in two ways. First, they reduce the interest rate charged on new loans. Second, they lower their minimum credit standards for new loans—for example, they reduce the amount of collateral the borrower must have to back his loan, accept borrowers with weaker credit histories, or require less proof that the borrower will have enough cash flow to service his debts. Such a reduction in credit standards increases the chances that some borrowers will eventually default on their loans. Thus, assuming banks lower credit standards as well as reduce loan rates, increases in lending due to supply shifts will tend to lead to higher loan losses in the future.

Figure 1 shows the effects of such a supply shift on total lending and credit standards. The left-hand panel shows how bank credit standards are related to the expected rate of return on loans. The diagram assumes that the creditworthiness of borrowers can be represented by a single number, z, measured along the horizontal axis. The higher z is, the more likely the borrower will be able to repay his loan—for example, the safer his investment project is or the more collateral he has to back his loan. Banks base the decision to make a loan on the expected rate of return on the loan, r^e. The expected rate of return on a loan depends on both the loan rate and the prospects for repayment. If the borrower were certain to repay his loan on time, the expected rate of return on the loan would be the same as the loan rate. As long as there is some chance of default, however, r^e will be the less than the loan rate. In the diagram, the expected rate of return is measured on the vertical axis.

The curve $r^e(z)$ shows the maximum expected rate of return that banks can earn on loans to borrowers of creditworthiness z. Given any value of z, increasing the loan rate will at first raise the bank's expected rate of return. Beyond a point, however, increasing the loan rate will not raise r^e any further—for example, because the borrower will choose a riskier investment project at the higher loan rate, or because the bank will have too high a chance of incurring collection costs at the higher loan rate. Thus, for each value of z, there will exist some upper limit beyond which the bank cannot increase its expected rate of return, no matter how much it increases the loan rate.[1] In Figure 1, this maximum expected rate of return is shown by the curve $r^e(z)$. The higher the borrower's creditworthiness, the greater the expected rate of return the bank can earn by

Figure 1
SUPPLY SHIFT



charging a high loan rate. Thus, the curve $r^e(z)$ slopes upward.

From the curve $r^e(z)$, the minimum level of creditworthiness can be determined for each expected rate of return on loans. Suppose, for example, that banks earn an expected rate of return of r_1^e when the market for bank loans is in equilibrium. Then in Figure 1, banks will be just willing to lend to borrowers with creditworthiness z_1. All borrowers with higher values of z will receive credit and will be charged a loan rate just high enough to yield an expected rate of return of r_1^e. All borrowers with lower values of z will fail to receive credit, because banks will be unable to earn an expected rate of return of r_1^e on such borrowers no matter how high a loan rate they charge. The minimum level of creditworthiness z_1 can be interpreted as a credit standard. The higher the expected rate of return banks require on their loans, the higher they must set this credit standard.

The right-hand panel of Figure 1 shows how the expected rate of return on loans is determined in the market for bank loans. The initial supply of bank credit is represented by the curve S_1S_1 and the demand for bank credit by the curve *DD*. The curve S_1S_1 is upward sloping, indicating that banks are more willing to lend and can attract a greater amount of funds when the expected rate of return on loans is higher. The curve *DD* is downward sloping for two reasons. First, from the left-hand panel, the minimum level of creditworthiness increases with r^e. Thus, the higher the expected rate of return on loans, the fewer borrowers will receive loans. Second, the higher the expected rate of return banks want to earn on their loans, the higher the loan rate they will have to charge each borrower above the cutoff, and thus the less credit each of those borrowers will desire. For the loan market to be in equilibrium, the demand for bank credit must equal the supply. Thus, before the shift in supply, the expected rate of return on bank loans is r_1^e.

Together, the two panels in Figure 1 show that an increase in banks' willingness to lend will raise total lending, reduce the expected rate of return on loans, and lower the minimum level of creditworthiness. In the right-hand panel, the supply curve shifts outward from S_1S_1 to S_2S_2, increasing total lending and reducing the expected rate of return on loans. Because banks do not require as high an expected rate of return on their loans, they not only can reduce loan rates for those borrowers who already qualified for credit, but also can lower the cutoff for creditworthiness. In the left-hand panel, this decline in the credit standard is shown by a movement down the curve $r^e(z)$. The reduction in the credit standard increases the chances that some borrowers will eventually default on their loans. Thus, the outward supply shift not only raises total lending but also increases the likelihood of future loan losses.

In examining the data for evidence of supply shifts, it will prove useful to know not only the likely direction of change in loan growth, credit standards, and loan losses, but also the likely order of change. While Figure 1 does not reveal anything about timing, common sense suggests that when banks become more willing to lend, credit standards will respond first, loan growth second, and loan losses last. In an effort to increase lending, banks will first lower their loan rates and ease their credit standards. As more borrowers qualify for credit and existing borrowers request larger loans, total lending will begin to rise. Loan losses will take much longer to respond, however, because even bad loans do not usually experience repayment problems in the first year.

What factors could increase banks' willingness to lend, leading them to simultaneously reduce credit standards and increase lending? The two factors most often cited in the financial press are euphoria and competition. Some analysts believe banks become excessively optimistic in the later stages of a business expansion, causing them to underestimate the risk of default on new loans. According to this view, banks behave cautiously during and after periods of heavy loan losses but lend more aggressively as the memory of those losses recedes. Other analysts argue that competition for loans increases during periods of prosperity because the high rate of bank profits encourages new entry. With more lenders competing for the same business, loan rates fall and credit standards decline.

A third factor that could cause banks' willingness to lend to vary over time is a myopic concern for short-term reputation. Because the losses on questionable loans may not be realized for several years, a bank may be able to increase short-term profits at the expense of long-term profits by easing credit standards and boosting loan growth. According to one view, banks have a stronger incentive to manipulate earnings in this way when overall bank profitability is high because outsiders are more likely to interpret a bank's low profits as a sign of poor management in such periods than when most banks are performing poorly (Rajan).

Finally, banks could become more willing to lend during certain periods because of an improvement in their underlying financial condition. Among economists, this view of bank behavior has come to be known as the capital constraint model (Bernanke and Gertler). The idea is that a bank's net worth acts as a constraint on its lending because outside investors have highly imperfect information about the quality of the bank's loans. The higher a bank's net worth, the more owners stand to lose if the bank's loans go bad, and thus the more confidence outside investors will have that the bank will make sound loans. During periods of low loan losses and high profits, bank capital tends to improve, enabling banks to attract more funds from outside investors and increase total lending.

Why faster loan growth might not lead to higher loan losses

Faster loan growth need not lead to higher losses, if the source of the increased lending is something other than a shift in supply. Two possibilities will be considered here—an increase in loan demand unrelated to borrowers' underlying creditworthiness, and an increase in the returns to investment that simultaneously boosts the demand for credit and increases each borrower's chances of repaying his loan. For convenience, this article will refer to the first kind of shift as a demand shift and the second as a productivity shift, even though both affect the demand for bank credit.

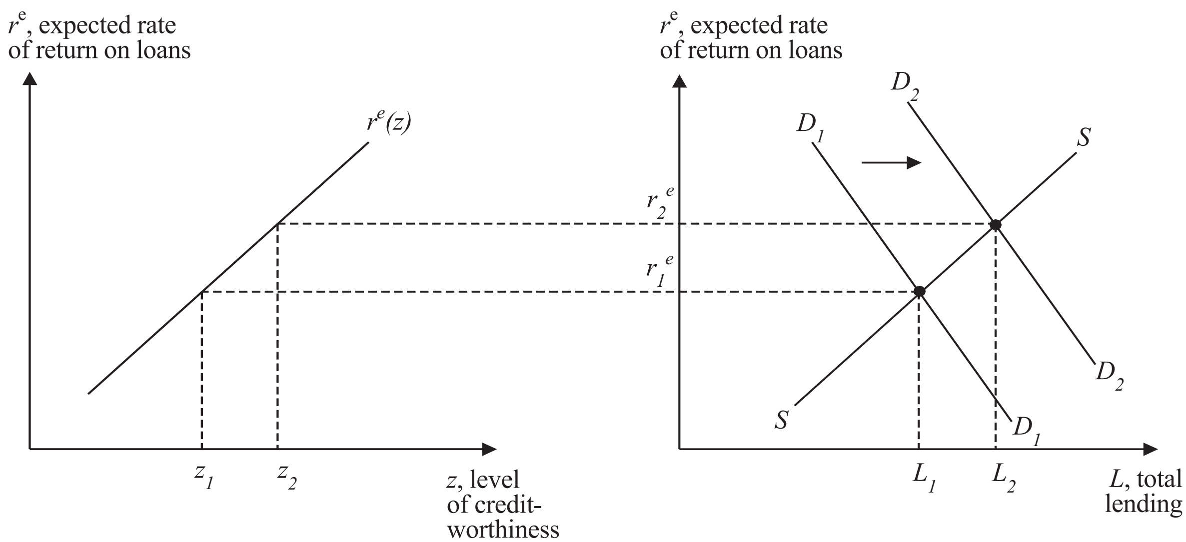
Demand shift. An increased demand for credit unrelated to borrowers' underlying creditworthiness will tend to boost loan growth and raise credit standards, reducing the likelihood of future loan losses. Suppose, for example, that businesses decide to raise a higher proportion of funds from banks—for example, because internal cash flow declines or capital market borrowing becomes more expensive. Faced with increased demand for credit, banks will raise their loan rates and tighten credit standards. Unless the supply of funds to banks is completely inelastic, total bank lending will increase. The likelihood of future loan losses will decline, however, as the tightening in credit standards raises the average creditworthiness of bank loan customers.

The effects of such a demand shift are illustrated in Figure 2. The diagram assumes that at each possible expected rate of return on loans, r^e, the total demand for bank credit increases but the minimum level of creditworthiness remains unchanged. In other words, the demand curve in the right-hand panel shifts out from D_1D_1 to D_2D_2, while the curve $r^e(z)$ in the left-hand panel remains unchanged. As shown in the diagram, the outward shift in *DD* raises total lending and increases the expected rate of return that banks earn on their loans. Seeking a higher expected rate of return on loans, banks not only increase loan rates but also raise their minimum level of creditworthiness. This tightening of credit standards reduces the chances that some borrowers are unable to repay their loans. Thus, at the same time total lending rises, the likelihood of future loan losses declines.

As before, Figure 2 does not reveal anything about the timing of changes in loan growth, credit standards, and loan losses. The most likely outcome, however, is that the increase in loan demand leads first to an increase in loan growth, then to a tightening of credit standards, and finally to a decrease in loan losses. If banks do not realize loan demand has increased, they will at first leave their loan rates and credit standards unchanged. With more borrowers meeting the cutoff for creditworthiness, more loans will be granted and total lending will rise. Once banks realize loan demand has increased, they will begin to increase their loan rates and tighten their credit standards. As before, loan losses will respond last, because repayment problems do not usually show up until a loan is over a year old.

Productivity shift. An overall increase in the productivity of borrowers' investment projects will also tend to boost loan growth and reduce the likelihood of future loan losses, although credit standards may decline in this case. Consider an increase in productivity due, for example, to improved technology or lower oil prices. Such a shock will increase the chances that a borrower of given characteristics can repay his loan, allowing banks to relax their collateral requirements or accept borrowers with poorer credit histories. The productivity shock will also encourage borrowers to undertake larger investments, increasing their demand for credit. The combined effect of the easing in credit standards and the rise in each borrower's demand for credit will be to boost bank loan growth. As in the case of a pure demand shift, the faster loan growth will put upward pressure on loan rates and credit standards, making the net change in credit standards uncertain. Regardless of what happens to credit standards, however, loan losses are likely to fall, because any worsening in the mix of borrowers is likely to be outweighed by the

Figure 2
DEMAND SHIFT



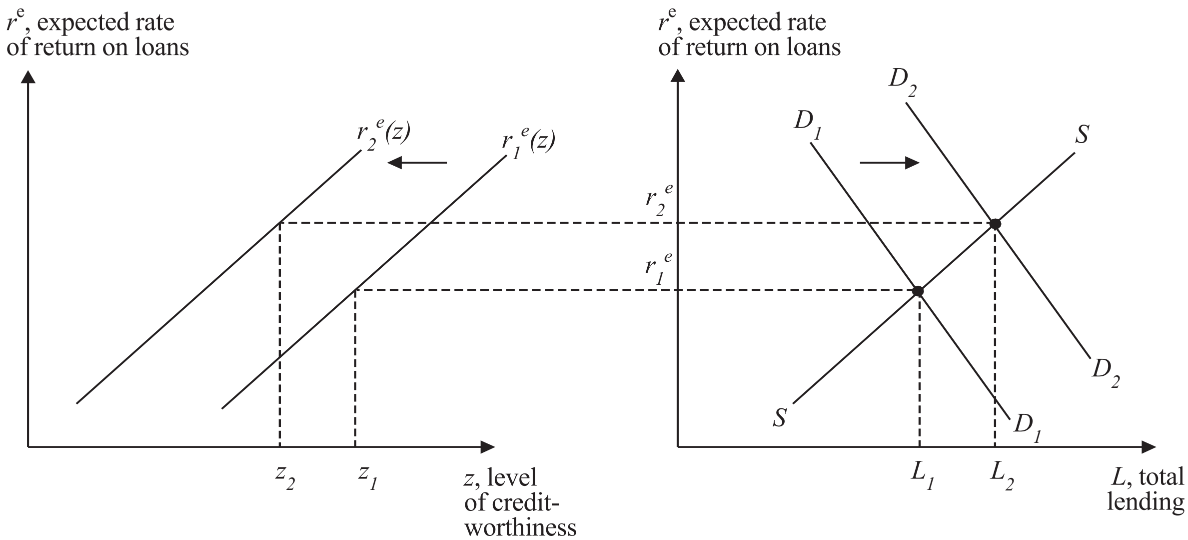
increase in each borrower's creditworthiness due to the productivity shock.

The effects of such a productivity shift are shown in Figure 3. Since the shock increases the chances that a borrower of given characteristics can repay his loan, banks can lower their minimum level of creditworthiness and still earn the same expected rate of return on their loans. In the left-hand panel of the diagram, the curve $r^e(z)$ shifts inward. This reduction in the minimum level of creditworthiness increases the total number of borrowers who receive credit at each expected return, r^e, causing the demand curve *DD* in the right-hand panel to shift outward. The productivity shock also encourages borrowers to undertake larger investments, increasing each borrower's demand for funds and shifting out the curve *DD* still further.

The productivity shock increases both the total volume of lending and the expected rate of return on loans, as banks move up their unchanged supply curve, *SS*. In contrast to the previous case of a pure demand shift, banks may end up setting a lower cutoff for creditworthiness (the case shown in Figure 3).[2] The easing in credit standards need not lead to higher loan losses, however, because the acceptance of loan applicants of below-average creditworthiness may be offset by the increase in each borrower's chance of repaying his loan due to the productivity shock. Indeed, the more likely effect of the productivity shock is to *decrease* future loan losses, because the likelihood of marginal borrowers repaying their loans will generally have to increase for banks to earn a higher expected rate of return on their loans.[3]

With respect to the timing of these changes, less can be said than in the case of a supply shift or demand shift. Once they become aware of the productivity shift, borrowers will begin asking for bigger loans and banks will begin easing

Figure 3
PRODUCTIVITY SHIFT



credit standards. Thus, if banks and borrowers learn of the productivity shift at the same time, loan growth and credit standards could change at the same time instead of one before the other. In any event, loan losses will still respond last because changes in credit standards affect default rates only with a lag.

Empirical tests for whether faster loan growth leads to higher loan losses

The discussion above not only clarifies the circumstances in which faster loan growth will lead to higher loan losses, but also suggests how to empirically test for such a relationship. The first three columns of Table 1 summarize the likely impact of supply shifts, demand shifts, and productivity shifts on three key variables: loan growth, the tightness of credit standards, and loan losses. The second three columns show the order in which the variables are likely to change. As noted above, Figures 1-3 provide information only about the direction of change in the three variables. The results on the order of change are the ones that seem most plausible given the way in which banks set credit standards and make credit decisions.

Table 1 suggests two ways to test the view that faster loan growth leads to higher loan losses. The first is to examine the relationship between loan growth and credit standards. The third column indicates that faster loan growth will lead to higher loan losses only if the source of the faster growth is a supply shift. But if supply shifts are the dominant influence on loan growth, credit standards should be observed to move inversely with loan growth. Specifically, increases in loan growth should be preceded by an easing of credit standards, and decreases in loan growth by a tightening of standards.

At most, this first test can provide only partial support for the view that faster loan growth leads to higher loan losses. A finding that loan growth

Table 1

LIKELY IMPACT OF DIFFERENT SHIFTS ON LOAN GROWTH, CREDIT STANDARDS, AND LOAN LOSSES

	Direction of change			Order of change		
Type of shift	Loan growth	Credit standards	Loan losses	Loan growth	Credit standards	Loan losses
Positive supply shift	Up	Down	Up	Second	First	Third
Positive demand shift	Up	Up	Down	First	Second	Third
Positive productivity shift	Up	?	Down	?	?	Third

and credit standards are negatively related, with increases in loan growth following reductions in credit standards, would help rule out demand shifts as the dominant influence on loan growth. But the finding would not prove that supply shifts are the dominant influence on loan growth, because as the last row of Table 1 indicates, an inverse relationship between loan growth and credit standards can also arise in the presence of productivity shifts. Since the test cannot prove that supply shifts are the dominant influence on loan growth, the test also cannot prove that faster loan growth leads to higher loan losses.

A second way to test whether faster loan growth leads to higher loan losses is to look directly at data on loan growth and loan losses. A finding that loan growth and loan losses have been positively related, with increases in loan growth preceding increases in loan losses, would obviously support the view that faster loan growth leads to higher loan losses. From Table 1, such a finding would also imply that supply shifts have been a more important influence on loan growth than demand shifts or productivity shifts. While more direct, the second test has its own drawback: Because loan losses can take years to show up and depend on many factors besides bank lending policies, the relationship between loan growth and loan losses is likely to contain more "noise" than the relationship between loan growth and credit standards. Accordingly, this article carries out both tests.

II. EMPIRICAL EVIDENCE ON LOAN GROWTH AND CREDIT STANDARDS

Have loan growth and credit standards been negatively related, with increases in loan growth following reductions in credit standards? One of the few sources of information on bank credit standards is the Senior Loan Officer (SLO) Survey conducted by the Federal Reserve since 1967. Every quarter, Federal Reserve staff ask senior loan officers at about 60 large banks a series of questions about their lending policies. Among other questions, loan officers are asked whether they have eased or tightened their credit standards for business firms of different sizes over the past three months. From the answers, the Federal Reserve constructs a measure of net tightening equal to the percentage of banks reporting a tightening of standards minus the percentage of banks reporting an easing of standards. Since 1990, this measure has been available for three size classes—small firms, middle-market firms, and large firms. Similar measures of net credit tightening can be obtained from responses to the SLO survey for the years 1967-83, although the wording of the questions was somewhat different then. Unfortunately, no questions on credit standards were asked from 1984 to 1989, causing a break in the data during that period.[4]

Chart 1 shows that in the 1990s, rapid loan growth has tended to coincide with an easing of credit standards and slow loan growth with a tightening of credit standards, consistent with the view that changes in loan growth reflect shifts in supply. The solid curve shows the net percentage of banks in the SLO survey that reported a tightening of credit standards for middle-market and large businesses.[5] The dotted line shows the growth in commercial and industrial (C&I) loans at all domestic banks. According to the SLO survey, banks tightened credit standards from 1990 to 1992 and then eased them from 1993 to 1997. During the period in which credit standards were being tightened, business loan growth was quite weak, remaining negative most of the time. Conversely, during the period in which credit standards were being eased, business loan growth was very strong. The main exception to this pattern was during the crisis in global capital markets in fall 1998. At that time, banks abruptly tightened their credit standards but loan growth remained strong, a phenomenon most observers attributed to the jump in bond yields and the resulting shift in business financing from the bond market to banks.

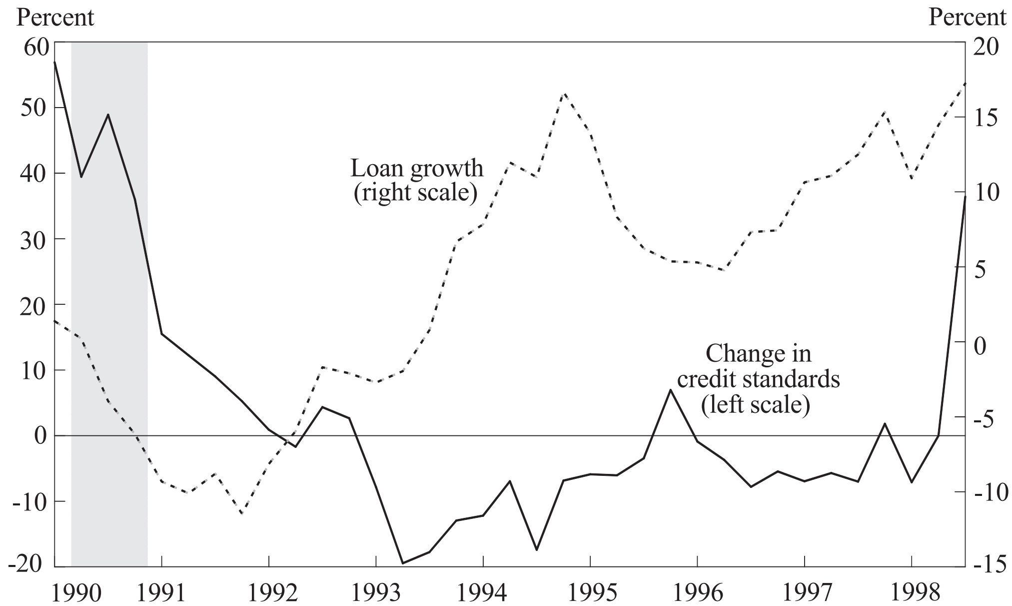
The inverse relationship between loan growth and credit standards during most of the 1990s is consistent with the view that changes in loan growth mainly reflect shifts in supply. As noted in the previous section, however, loan growth and credit standards could also be negatively related due to productivity shifts that increase or decrease each borrower's chance of repaying his loan. Thus, while Chart 1 suggests demand shifts were not the main influence on loan growth during the 1990s, it does not help determine whether supply shifts were more important than productivity shifts during this period.

While loan growth was negatively related to the tightness of credit standards in the 1990s, Chart 2 shows that such a relationship was less evident during the period 1967-83.[6] Loan growth sometimes increased without any coincident or prior easing of credit standards. And in several instances, increases in loan growth were followed within a quarter or two by a *tightening* of credit standards. This behavior suggests that a significant portion of the variation in loan growth in the earlier period may have been due to demand shifts rather than supply or productivity shifts. For example, some increases in loan growth may have resulted from a shift toward bank financing from other sources of funds. As noted earlier, such a demand shift would lead not only to faster loan growth but also to tighter credit standards, helping explain why loan growth and credit standards often moved in the same direction during the period.

Charts 1 and 2 are suggestive but cannot provide definitive evidence on the relationship between loan growth and credit standards. First, the substantial volatility in loan growth and credit standards during the two periods makes it difficult to detect the precise relationship between the two variables. Second, the charts do not reveal whether loan growth and credit standards were related even after controlling for the state of the economy. For example, loan growth may have been weak in the early 1990s because the economy was just emerging from a recession and firms had little demand for credit. Conversely, loan growth may have been strong in the rest of the decade because the economy was booming and demand for credit was high. In other words, the change in loan growth over the period may have been due entirely to changes in the economy, and the inverse relationship between loan growth and credit standards a coincidence.

Regression analysis was used to determine the relationship between loan growth and credit standards more precisely and control for the state of the economy. Specifically, a vector auto-

Chart 1
C&I LOAN GROWTH AND CREDIT STANDARDS, 1990-98

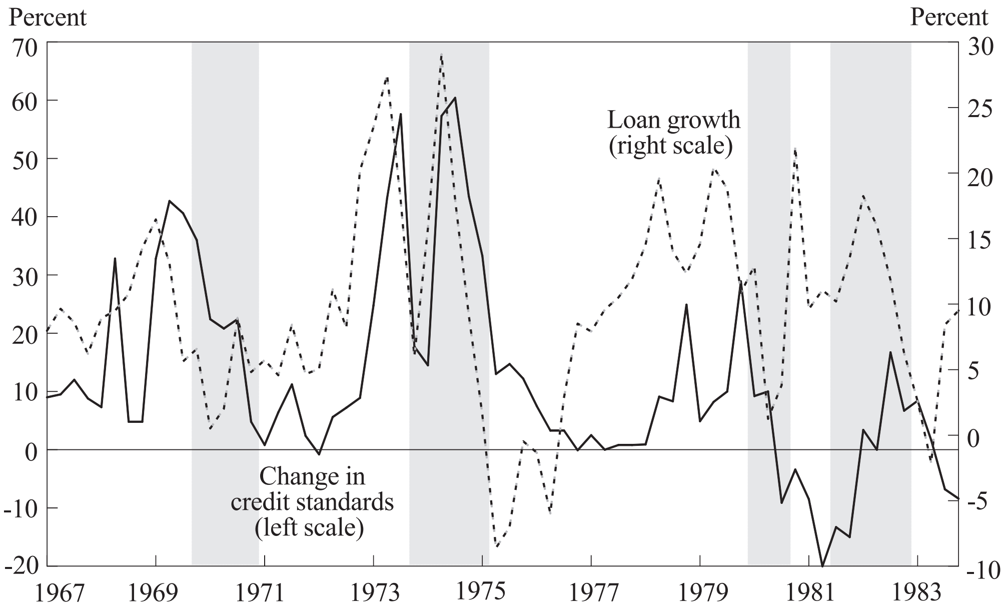


Notes: Loan growth is seasonally adjusted and annualized. Shaded area represents recession.
Source: Senior Loan Officer Survey and Federal Reserve Statistical Release H8.

regression (VAR) was estimated for each period with real loan growth, the change in credit standards, and the GDP gap (the percent deviation of actual GDP from potential GDP).[7] In a VAR, each variable is regressed on its own lags and the lags of each other variable in the model. Such an approach has two major advantages. First, it allows for feedback among the variables. And second, because all variables are included in each regression equation, fewer arbitrary decisions are made as to the structure of the model.[8]

The results of these regressions are reported in Table 2. Each column in the table corresponds to a different regression equation. For example, the first column shows the results of regressing real loan growth during the 1990-98 period against real loan growth in the previous two quarters, the change in credit standards in the previous two quarters, and the GDP gap in the two previous quarters. For each of these variables, two results are reported—the sum of the estimated coefficients on the variable, and the result of a statistical test of the ability of the variable to predict loan growth. In each case, the table also indicates whether the sum of estimated coefficients is statistically significant, in the sense of being too large to be attributed to chance. For example, the first row in the first column shows that when the loan growth equation is estimated for 1990-98, the sum of coefficients on the GDP gap is 1.99, an amount that is statistically significant. The second row shows that these coefficients were also large enough for the GDP gap to pass the statistical test for helping predict loan growth.

Chart 2
C&I LOAN GROWTH AND CREDIT STANDARDS, 1967-83



Notes: Loan growth is seasonally adjusted and annualized. Shaded areas represent recessions.
Source: Senior Loan Officer Survey, Federal Reserve Statistical Release G.7, and *Federal Reserve Bulletin* (various issues).

Table 2 leads to two main conclusions. First, tighter credit standards tended to lead to slower loan growth in both periods. This conclusion follows from the first and third columns of the table, which show that changes in credit standards helped predict loan growth in both periods and that the total effect of loan growth on credit standards was negative and statistically significant. Second, increases in loan growth had no appreciable effect on credit standards in the 1990-98 period but tended to lead to tighter credit standards in the 1967-83 period. This conclusion follows from the second and fourth columns, which show that loan growth helped predict credit standards only in the 1967-83 period, having a total effect on credit standards during those years that was positive and statistically significant. Like Charts 1 and 2, these results suggest that either supply shifts or productivity shifts were the main influence on loan growth in the 1990-98 period, but that demand shifts played an important role along with supply or productivity shifts in the 1967-83 period.[9]

To summarize, the behavior of loan growth and credit standards in the 1990s provides partial support for the view that faster loan growth leads to higher loan losses, because loan growth and credit standards behaved just as one would expect if supply shifts were driving the change in loan growth. The different behavior of loan growth and credit standards in the 1970s and 1980s suggests, however, that loan growth need not always be associated with easier credit standards and can fluctuate due to demand shifts as well as supply shifts. Furthermore, faster loan

Table 2

RELATIONSHIP BETWEEN REAL LOAN GROWTH AND CHANGE IN CREDIT STANDARDS

Results of VAR

	Dependent variable			
	1990-98		1967-83	
Independent variable	Loan growth	Credit standards	Loan growth	Credit standards
Lagged GDP gap				
Sum of coefficients	1.99**	2.96	.80**	.78
Helps predict dependent variable?	Yes	No	Yes	No
Lagged change in credit standards				
Sum of coefficients	-.22**	.84**	-.21**	.72**
Helps predict dependent variable?	Yes	Yes	Yes	Yes
Lagged loan growth				
Sum of coefficients	.47**	-.14	.56**	.58*
Helps predict dependent variable?	Yes	No	Yes	Yes

*Significant at 5 percent level.
** Significant at 1 percent level.
Note: An independent variable helps predict a dependent variable if the hypothesis that each coefficient is zero can be rejected at the 5 percent level. Two lags are included for each variable, and loans are deflated by the chain-weighted price index for GDP.

growth could have been associated with easier credit standards during the 1990s not because of a shift in supply but because of a shift in productivity that simultaneously increased businesses' demand for credit and reduced banks' minimum level of creditworthiness. As noted in the previous section, such a productivity shock need not increase the chance of future loan losses, even if it causes a relaxation of credit standards. Thus, while an inverse relationship between loan growth and credit standards may be a necessary condition for faster loan growth to lead to higher loan losses, it is by no means a sufficient condition.

III. EMPIRICAL EVIDENCE ON LOAN GROWTH AND LOAN LOSSES

A more direct test of the view that faster loan growth leads to higher loan losses can be carried out using data from bank call reports on business loan growth and business loan delinquencies. Commercial banks are required to file financial reports at the end of each quarter. These call reports have always included information on the volume of loans outstanding in each major category. Since the end of 1982, call reports have also included information by category on the amount of delinquent loans, making it possible to examine the link between loan growth and loan delinquencies.[10] Loan delinquencies are a good proxy for loan losses because loans usually become overdue before they are written off as uncollectible. As a measure of loan losses, delinquencies also have two advantages over chargeoffs of bad loans. First, delinquencies tend to be less volatile than chargeoffs, which can fluctuate widely due to bank discretion in deciding when to write off problem loans. Second, delinquencies capture losses on loans that are not repaid on time but do not have to be written off because they are eventually collected in full.

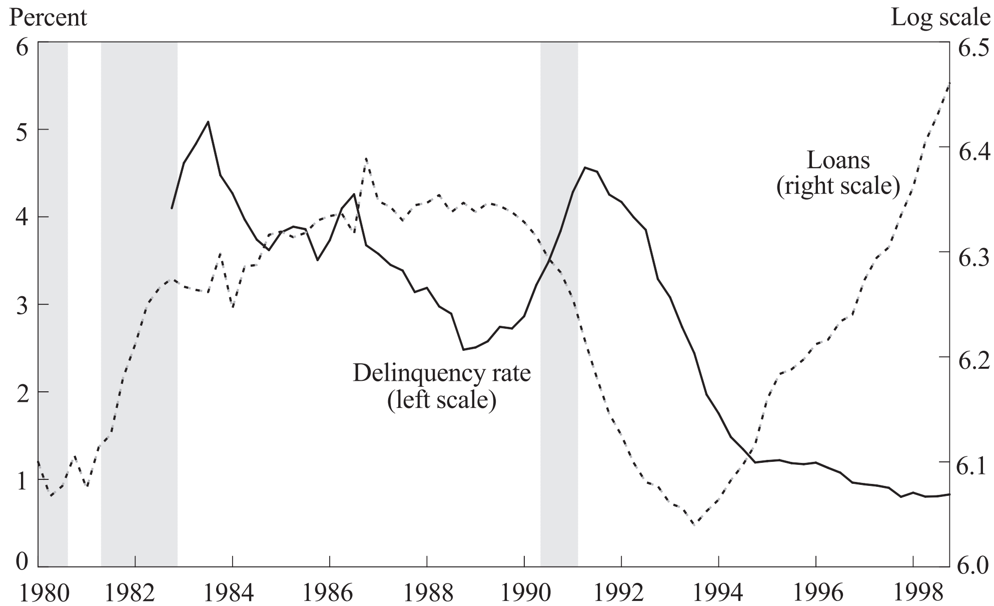
Using the bank call report data, Chart 3 shows the relationship between the volume of business loans and the average delinquency rate on business loans for the United States as a whole. The solid line in the chart shows the average delinquency rate, defined as the percent of C&I loans that are delinquent. The dotted line shows the volume of real C&I loans measured on a log scale.[11] Although the same data are available for other loan categories, there are two reasons for focusing on C&I loans. First, since there are well-developed secondary markets for consumer loans and real estate loans, the volume of such loans on banks' books can fluctuate solely due to loan sales. Secondary markets for business loans are not nearly as developed, making sales of such loans less common. Second, bank holdings of real estate loans were artificially boosted in the 1990s by takeovers of both failed and healthy thrifts. Growth in bank holdings of business loans was much less affected by these acquisitions, because most thrifts made few business loans.

Two periods shown in Chart 3 appear to support the view that loan growth is positively related to future loan losses—the early 1980s and the early 1990s. C&I loans grew rapidly during the 1981-82 recession, and when banks began reporting delinquencies shortly thereafter, the delinquency rate started out relatively high at 4 to 5 percent. After 1989, the process appeared to work in reverse—C&I loans began to decline, and within a year and a half, the delinquency rate also headed down. For the rest of the period, however, the relationship between loan growth and the delinquency rate is less clear. For example, the delinquency rate declined in the late 1980s following a period of moderate loan growth, and the delinquency rate remained unchanged in the late 1990s following a period of very strong loan growth.

The fact that delinquencies have been reported only since 1982 makes it difficult to determine the relationship between loan growth and delinquencies for the nation as a whole. Most analysts believe it can take as long as three years for delinquencies to show up on a bad loan. As a result, a relatively long sample period is required to statistically test the view that faster loan growth leads to higher delinquency rates. One way around this problem is to use bank call report data aggregated by state. Because the number of states is large, the relationship between loan growth and the delinquency rate can then be identified using a much shorter time period.[12]

Although call report data were available to the end of 1998, this article uses only data through the end of 1996 because subsequent data are distorted by interstate mergers. Loans and delinquencies are reported only for the bank as a whole, and not by location of the bank's branches. Before 1997, bank holding companies were allowed to own banks in different states but branching across states lines was severely restricted.[13] As a result, statewide data on business loans and business loan delinquencies were fairly reliable. In June 1997, the Reigle-Neal Act authorized the creation of out-of-state branches through interstate bank mergers. Since then, it has become much more common for banks to be acquired by banks in other states and converted to out-of-state branches—for example, as large interstate holding companies have consolidated their banks under one charter to reduce expenses. Such transactions cause an artificial decline in loans and delinquencies in the state in which the

Chart 3
REAL C&I LOANS AND C&I DELINQUENCY RATE



Notes: The range of 6.0 to 6.5 for the log of real C&I loans corresponds to a range of $400 to $670 billion in 1992 dollars. Shaded areas represent recessions.
Source: Reports of Income and Condition for Insured Commercial Banks.

acquired bank was headquartered, and an artificial increase in loans and delinquencies in the state in which the acquiring bank is headquartered. Thus, statewide data can be used to test the relationship between loan growth and loan losses only if the analysis is confined to the period before Reigle-Neal.

To investigate the relationship between loan growth and loan losses over the period 1982-96, a VAR was estimated with quarterly data on each of the 50 states and the District of Columbia. The question of interest is whether loan growth and loan losses are related even after controlling for the state of the local economy. Accordingly, nonfarm earnings were included as a variable in the VAR along with the volume of business loans outstanding and the fraction of business loans that were delinquent.[14] Because delinquencies can take as long as three years to show up on a bad loan, 12 quarterly lags were included for each variable in the regression. All variables were measured in logs, and dummy variables were included for each state. Seasonal dummies were also included for each quarter, because income, loans, and delinquencies all display substantial seasonal variation.

The regression results are summarized in Table 3. As before, each column in the table corresponds to a different regression equation. For example, the first column shows the results of regressing the delinquency rate against nonfarm earnings in the previous 12 quarters, the volume of business loans outstanding in the previous 12 quarters, and the delinquency rate in the previous

Table 3

RELATIONSHIP BETWEEN LOANS AND DELINQUENCY RATE

Results of VAR for all 50 states and D.C. (1982-96)

	Dependent variable	
Independent variable	Delinquency rate	Loans
Lagged earnings		
Sum of coefficients	-.32**	-.03
Helps predict dependent variable?	Yes	Yes
Lagged loans		
Sum of coefficients	.24**	.98**
Helps predict dependent variable?	Yes	Yes
Lagged delinquency rate		
Sum of coefficients	.86**	-.02**
Helps predict dependent variable?	Yes	Yes

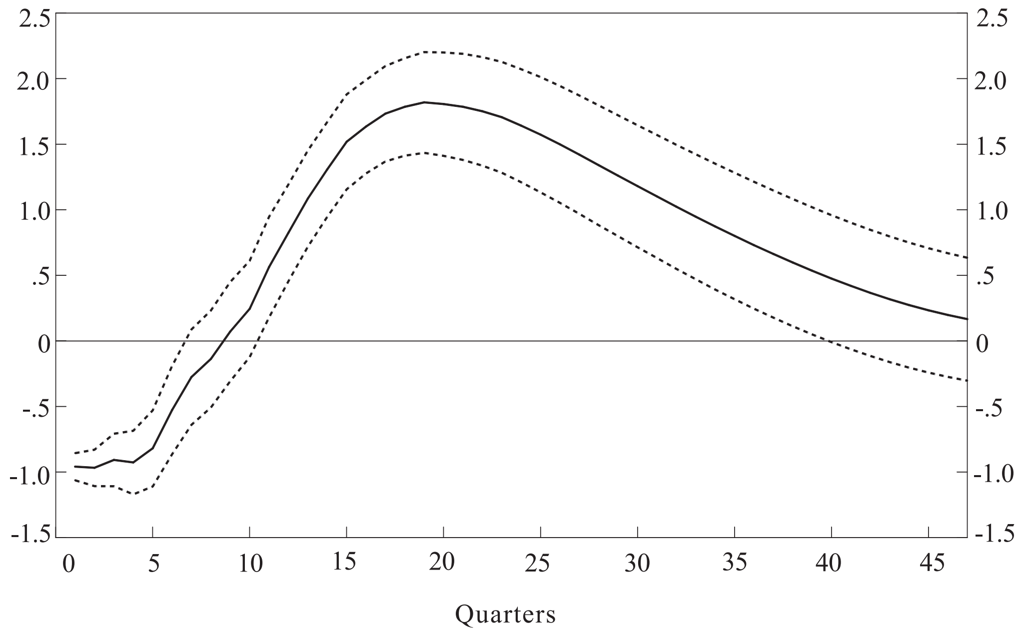
* Significant at 5 percent level.
** Significant at 1 percent level.
Note: An independent variable helps predict a dependent variable if the hypothesis that each coefficient is zero can be rejected at the 5 percent level. Twelve lags are included for each variable.

12 quarters. As before, two results are reported for each variable—the sum of the estimated coefficients on the variable, and the result of a statistical test of the ability of the variable to predict the delinquency rate.

The main conclusion from Table 3 is that increases in business loans in a state tended to lead to increases in the delinquency rate in that state, even after controlling for local economic growth. The fourth row in the first column shows that loans helped predict the delinquency rate. By itself, such a finding would not be surprising. Since it takes some time for delinquencies to show up, the initial effect of an increase in loans should be to *decrease* the ratio of delinquent loans to total loans. The third row shows, however, that the sum of coefficients on loans is positive, implying that the long-run effect of an increase in loans is to increase the delinquency rate. Most of the other results in the table are as expected. From the first column, increases in earnings lead to a reduction in the delinquency rate, indicating that borrowers are better able to repay their loans when the local economy is strong. And from the second column, increases in the delinquency rate lead to a decrease in loans, suggesting that repayment problems either discourage businesses from taking on additional debt or dissuade banks from making new loans.

While Table 3 shows that an increase in loans eventually leads to an increase in the delinquency rate, it does not reveal how long the effect takes to show up. Furthermore, the table shows only the partial effect of an increase in loans with all other variables held constant—that is, it ignores any feedback among earnings, loans, and delinquencies. Suppose, for example, that the delinquency rate increases due to an increase in loans. The increase in the delinquency rate will lead to some decrease in loans in subsequent

Chart 4
RESPONSE OF DELINQUENCY RATE TO SHOCK IN LOANS



Note: Curve shows the change in the log of the delinquency rate due to a one-unit change in the log of loans.

periods, keeping the delinquency rate from rising as much as it otherwise would. The total effect of an increase in loans on the delinquency rate is still likely to be positive, but the magnitude of the effect is unclear.

To get a more accurate picture of the effect of an increase in loans on the delinquency rate, the regression results were used to compute "impulse responses." The impulse response curve in Chart 4 shows the estimated effect on the delinquency rate of a shock to loans—that is, a change in loans that could not be predicted from the past values of earnings, loans, and delinquencies.[15] The curve not only shows how the impact of the shock varies over time but also has the advantage of accounting for all feedback effects among earnings, loans, and delinquencies. Since all variables are measured in logs, the impulse response is approximately equal to the percentage change in the delinquency rate due to a one percent change in loans. Also shown in the chart is a two standard-error confidence band. Roughly speaking, the true response has a 5 percent chance of falling outside this band. Thus, when the confidence band lies above zero, the true impulse response is highly likely to be positive, and when the confidence band lies below zero, the true response is highly likely to be negative.[16]

Chart 4 confirms that a positive shock to loans reduces the delinquency rate at first but raises the delinquency rate later on. The initial effect of the increase in loans is to reduce the delinquency rate by 1 percent, the same proportion by which loans go up. After a year, however, the delinquency rate begins to rise sharply. By the end of two years, the delinquency rate is back to its initial level. The delinquency rate continues rising for another three years, peaking at about 1.8 percent above its initial level. The rate then gradually declines, returning close to its initial value by the end of 12 years.[17]

Taken together, Table 3 and Chart 4 suggest that when loans grew rapidly relative to income in a particular state, the amount of delinquent loans ultimately rose by an even greater proportion, boosting the delinquency rate. A plausible explanation is that some states experienced significant shifts in the supply of bank credit, leading to changes in credit standards and in the likelihood of future loan losses. For example, the net worth of banks may have fluctuated in some states due to boom-and-bust conditions in local real estate markets. According to proponents of the capital constraint model, such fluctuations in net worth would tend to cause big swings in the amount of funds banks could attract from outside investors and, thus, big changes in the amount of new loans banks were willing to extend. The capital constraint model is, however, only one of several possible supply-side explanations for the fact that faster loan growth in a state tended to lead to a higher delinquency rate in that state. Thus, the results in Table 3 and Chart 4 provide some indication that supply shifts were the main factor driving changes in loans and delinquencies at the state level, but do not reveal the source of those supply shifts.

IV. SUMMARY AND CONCLUSIONS

Concern has risen recently that the rapid growth in business loans may be a sign that banks have eased their credit standards excessively, increasing the chances they will suffer heavy loan losses if the economy slows. This article points out that an increase in loan growth is likely to lead to higher loan losses only if the source of the faster loan growth is a shift in the supply of bank credit. The article then examines the data for evidence that supply shifts have caused loan growth and loan losses to be positively related in the past. Two forms of evidence are considered—evidence from the Federal Reserve's Senior Loan Officer Survey on the link between loan growth and changes in credit standards, and evidence from bank call reports on the link between loan growth and delinquencies.

On balance, the data provide some support for the view that faster loan growth leads to higher loan losses. The strongest support comes from the bank call report data, which show that states experiencing unusually rapid loan growth over the period 1982-96 tended to experience unusually big increases in delinquencies several years later. This finding is tempered, however, by evidence from the Senior Loan Officer Survey suggesting that changes in loan growth have not always been due to shifts in supply. Loan growth moved inversely with credit standards in the 1990s, consistent with the view that changes in loan growth were being driven by shifts in supply. But loan growth and credit standards often moved together in the 1970s and early 1980s, suggesting that some of the fluctuation in loan growth during that period was due to demand shifts. Thus, supply shifts appear to account for much of the variation in loan growth, explaining why faster loan growth has often been followed by higher loan losses. But supply shifts have not been the only factor driving loan growth, causing the link between loan growth and loan losses to be far from airtight.

ENDNOTES

[1] There are two basic reasons why there might exist an upper limit on r^e for each value of *z*. First, beyond some point, increases in the loan rate may actually decrease r^e by exacerbating the asymmetry of information between lenders and borrowers. Specifically, increases in the loan rate may increase the expected costs of verifying loan defaults (Williamson); induce borrowers to choose riskier investment projects (Keeton, Stiglitz and Weiss); or worsen the mix of borrowers for a given set of observable characteristics (Stiglitz and Weiss). Second, at a loan rate high enough for the bank to earn an expected rate of return of r^e, the borrower may prefer to use other financing or forego the investment entirely (Weinberg). Although both reasons have been offered as an explanation for minimum credit standards, the first seems the more plausible.

2 The productivity shift has two opposing effects on the cutoff for *z*—it reduces the cutoff by shifting the curve $r^e(z)$ inward, and it raises the cutoff by boosting r^e. If the only effect of the productivity shock on *DD* were to increase the number of borrowers who qualify for credit at each value of r^e, the cutoff for *z* would have to fall because that would be the only way for total lending to increase. If the productivity shock also increased each borrower's desired loan size, however, the cutoff for *z* could rise, just as in the case of a pure demand shift.

[3] Weinberg presents a model in which a positive productivity shock *does* lead to an increase in expected loan losses. The main effect of a productivity shock in his model is to increase project returns in those states of the world in which the borrower is already able to repay his loan. This shift in returns induces banks to raise loan rates and ease credit standards but does not make it any easier for borrowers to meet loan payments in unfavorable states of the world. Thus, he obtains his result by ignoring the favorable effect of a productivity shock on the ability of borrowers to repay their loans.

[4] For further details on the SLO Survey, see Hamdani and others and Schreft and Owens.

[5] The change in credit standards for middle-market and large businesses was used because these firms account for the bulk of C&I lending.

[6] The question on credit standards was changed somewhat in 1977. As a result, the change in credit standards is for new loans for 1967-77 and for loans made at the prime rate for 1978-83.

[7] Loans were deflated by the chain-weighted price index for GDP. The GDP gap was used to control for the state of the economy instead of the growth of real GDP, because the GDP gap did a better job of predicting loan growth.

[8] Hamdani and others also examined the relationship between business loan growth and the change in credit standards. They first estimated the change in credit standards that could not be explained by overall economic growth or changes in interest rates. They then included this measure in a regression equation for business loan growth along with variables such as inventory growth and plant and equipment spending. From the regression results, they concluded that the tightening of credit standards in 1990-91 was enough to cause a substantial reduction in business loans—a reduction similar in magnitude to that which occurred after banks tightened credit standards in the 1970s.

[9] Further support for these conclusions comes from the variance decomposition for loan growth. The VAR was used to determine how much of the unexpected change in loan growth over a two-year horizon could typically be attributed to shocks in the GDP gap, credit standards, and loan growth. The results indicate that shocks to credit standards were a much more important determinant of loan growth in the later period. Specifically, shocks to credit standards explain 87 percent of the unexpected variation in loan growth in the 1990-98 period but only 40 percent of the unexpected variation in loan growth in the 1967-83 period. (In such an exercise, some assumption must be made about the contemporaneous effects of shocks to the variables. In the present case, it was assumed that a shock to loan growth has no effect on credit standards in the same quarter, and that a shock to loan growth or credit standards has no effect on the GDP gap in the same quarter.)

[10] Delinquent loans are defined in this article as loans 90 days or more overdue or failing to accrue interest. Banks are allowed to count as income any interest that is due but not received, provided the interest and principal are less than 90 days overdue or the loan is well secured and in process of collection. Nonaccruing loans are overdue loans that do not meet either of these conditions. From the end of 1982 until the middle of 1985, banks with less than $100 million in assets reported loans 90 days or more overdue by category but did not report nonaccruing loans by category. For these banks, nonaccruing business loans were estimated by multiplying the amount of overdue business loans by the ratio of total nonaccruing loans to total overdue loans.

[11] Loans are deflated by the chain-weighted price index for GDP.

[12] For some types of loans, such as home mortgage loans or consumer loans, statewide data can be severely distorted by loan transfers among banks located in different states but belonging to the same holding company. Fortunately, busi-

ness loans are less likely to be shifted in this way, making the statewide data more accurate.

[13] The main exception to the general prohibition against interstate branching was that federally chartered banks could move their headquarters up to 90 miles across a state line and convert the original office to an out-of-state branch.

[14] Nonfarm earnings are the sum of wage and salaries, other labor income, and proprietors' income in the nonfarm sector. This measure is widely used in regional analysis as a proxy for income earned in nonfarm production.

[15] As with the variance decomposition in note 9, computing impulse responses requires some assumption about the contemporaneous effects of shocks in the variables. In deriving the impulse response curve in Chart 4, it was assumed that a) a shock to loans or a shock to the delinquency rate has no effect on earnings in the same quarter, and b) a shock to loans causes an equiproportionate decline in the delinquency rate in the same quarter. The justification for the second assumption is that loans cannot become delinquent in the same quarter in which they are made.

[16] The confidence band was estimated using the Monte Carlo technique in the RATS software package (Doan).

[17] Although not shown in Chart 4, the volume of loans begins to decline two years after the initial shock, returning to its initial value in about seven years.

REFERENCES

Bernanke, Ben, and Mark Gertler. 1987. "Banking and Macroeconomic Equilibrium," in William A. Barnett and Kenneth J. Singleton, eds., *New Approaches to Monetary Economics*. Cambridge: Cambridge University Press.

Doan, Thomas A. 1992. *RATS User's Manual: Version 4.* Evanston, Ill.: Estima.

Hamdani, Kausar, Anthony P. Rodrigues, and Maria Varvatsoulis. 1994. "Survey Evidence on Credit Tightening and the Factors Behind the Recent Credit Crunch," in Federal Reserve Bank of New York, *Studies on the Causes and Consequences of the 1989-92 Credit Slowdown,* February.

Keeton, William R. 1979. *Equilibrium Credit Rationing*. New York: Garland.

Rajan, Raghuram G. 1994. "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence," *Quarterly Journal of Economics*, May.

Schreft, Stacey L., and Raymond E. Owens. 1991. "Survey Evidence of Tighter Credit Conditions: What Does It Mean?" Federal Reserve Bank of Richmond, *Economic Review,* March/April.

Stiglitz, Joseph, and Andrew Weiss. 1981. "Credit Rationing in Markets with Imperfect Information," *American Economic Review,* June.

Weinberg, John A. 1995. "Cycles in Lending Standards?" Federal Reserve Bank of Richmond, *Economic Review,* Summer.

Williamson, Stephen D. 1986. "Costly Monitoring, Financial Intermediation, and Equilibrium Credit Rationing," *Journal of Monetary Economics*, September.