Economic Review

FEDERAL RESERVE BANK OF KANSAS CITY

May 1987

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A Weaker Dollar and U.S. Farm Exports: Coming Rebound or Empty Promise?

May 1987, Volume 72, No. 5

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Why Do Banks' Loan Losses Differ?

By William R. Keeton and Charles S. Morris

Loan losses have risen significantly at many commercial banks over the last several years, decreasing the average profitability of the industry and increasing the rate of bank failures. The severity of loan problems has varied greatly, however, with delinquencies and loan writeoffs reaching very high levels at some banks but remaining relatively low at other banks. This diversity in loan performance raises an important question. Do the severe loan problems at some banks result entirely from adverse local and industry conditions beyond their control, or do they also result from a greater propensity to take risk?

The answer to this question has important implications for regulatory policy. Because geographic barriers to expansion and the lack of a secondary loan market make diversification difficult, some banks are highly vulnerable to downturns in individual regions or industries. If this vulnerability is primarily responsible for loan problems being much worse at some banks than others, geographic deregulation and other measures to facilitate diversification should be given high priority in reforming the banking system. However, if the severe loan problems at some banks are due partly to deliberate risk-taking, greater diversification will not be enough to ensure a safe and sound banking system. Because bank failures are costly to society, steps also will need to be taken to curb excessive risk-taking, whether through tighter supervision, variable insurance premiums, or higher capital standards.

This article investigates the causes of the recent variation in loan losses among banks, using data on commercial banks in states of the Tenth Federal Reserve District. A substantial part of the total variation in loan losses is attributed to differences in local economic conditions and the unusually poor performance of particular industries like agriculture and energy. However, adverse local and industry conditions do not come close to explaining all the diversity of loan losses. Even among banks located in the same market and making the same types of loans, there are very

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large differences in loan losses, some of which can be attributed to risk-taking.

The article begins by documenting the increase in the level and diversity of loan losses and explaining how the causes of loan loss diversity can be determined empirically. To quantify the impact of adverse local and industry conditions, the article next estimates the variation in losses due to some markets having higher average loss rates than others and to some banks specializing more in high-loss loan categories like agriculture and energy. Then, after a discussion of other factors affecting loan losses, various tests are performed to determine whether any of the remaining variation in loan losses can be attributed to deliberate risk-taking.

The level and diversity of loan losses

Although loan losses have increased throughout the United States, some regions have been more affected than others. One of the regions most affected is the area covered by the seven states of the Tenth Federal Reserve District. Banks in Tenth District states have experienced a large increase in average losses. At the same time, differences in performance have widened, with losses reaching very high levels at some banks but remaining relatively moderate at many others. The high level and wide diversity of loan losses in Tenth District states make the region particularly suitable for exploring the causes of loan losses.

The most direct measure of banks' loan problems is the percent of loans charged off during the year. When a loan is judged to be uncollectible, it is written off the bank's balance sheet and charged against the bank's loan loss reserves. As shown in Chart 1, the average chargeoff rate at banks in Tenth District states began rising sharply in the early 1980s, increasing by a factor of four from 1981 to 1985.[1] Loan chargeoffs also rose in 1974-75, a period of nationwide recession. However, the recent increase in chargeoffs has been both sharper and more protracted.

Another measure of the severity of banks' loan problems is the percent of nonperforming loans. A nonperforming loan is a loan that has not been charged off but is 90 days or more overdue, failing to accrue interest, or renegotiated to facilitate repayment. Data on such loans did not become available until 1983. Since then, however, nonperforming loans in Tenth District states have followed the same upward path as chargeoffs, increasing from 3.2 percent of total loans at the end of 1983 to 3.9 percent at the end of 1985.

Although chargeoffs and nonperforming loans are both useful measures of loan problems, looking at either measure alone can be misleading. Banks tend to write off unsecured loans like consumer loans faster than well secured loans like real estate loans. Also, banks that are highly conservative or under pressure from regulators to recognize losses tend to be quicker to charge off loans of all types. Thus, in the short run, repayment problems may appear primarily as nonperforming loans at some banks but chargeoffs at others.

To control for these differences in banks' speed in charging off loans, the primary measure of loan losses used in this study is the sum of nonperforming loans and 1984-85 chargeoffs.[2] A total loss rate was computed by dividing this measure by "adjusted loans," the sum of total loans outstanding at the end of 1985 and 1984-85 chargeoffs. The total loss rate indicates what a bank's nonperforming loan rate would have been at the end of 1985 if the bank had not charged

[1] All data in this article are from the Reports of Income and Condition filed by insured commercial banks.

[2] Only 1984 and 1985 chargeoffs were included in total losses because data on chargeoffs by loan category were required for the empirical analysis and such data were not available for earlier years.

CHART 1
Net loan chargeoffs

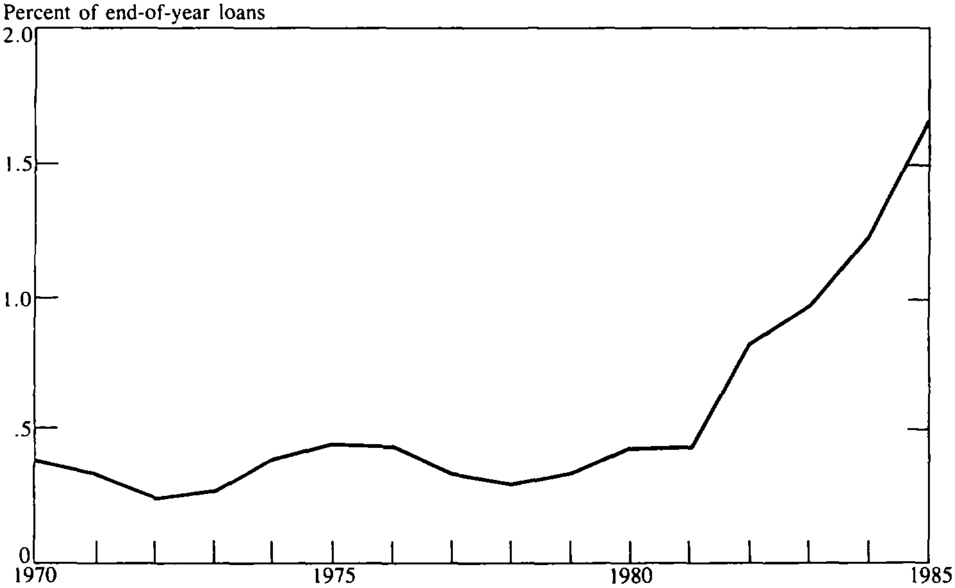


CHART 2
Variation of loss rates

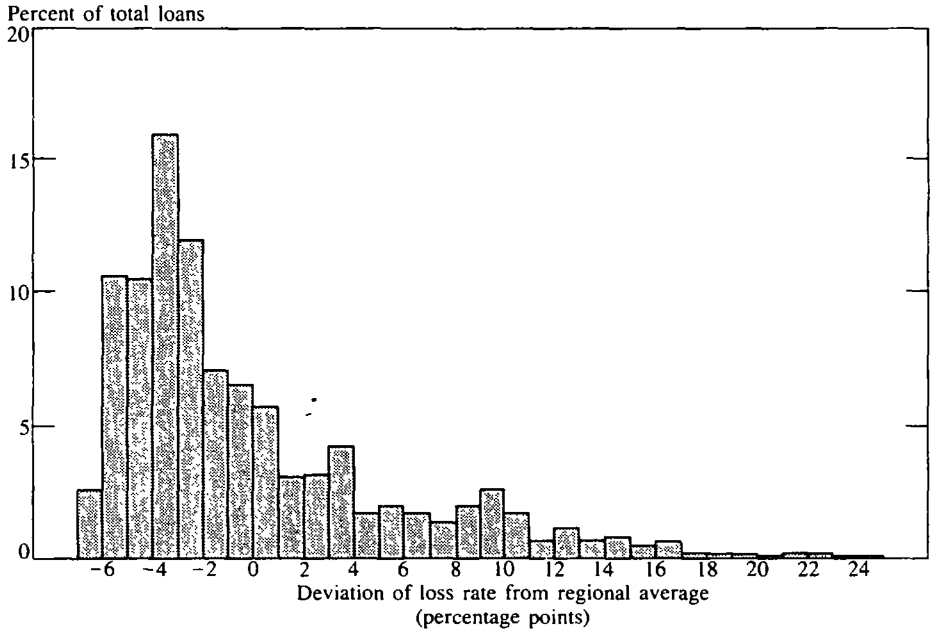
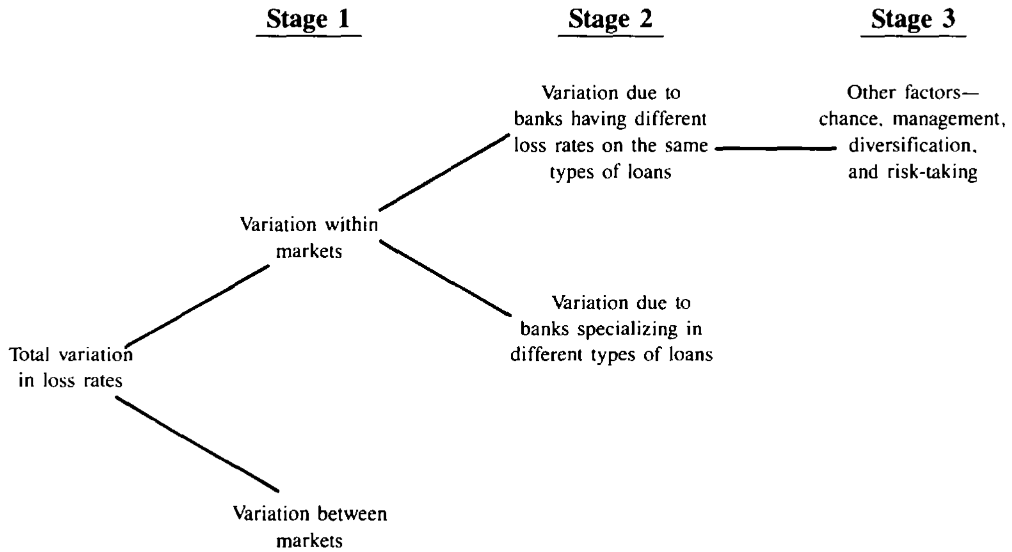


FIGURE 1
Determining the causes of loan loss diversity



off any of its bad loans in 1984 or 1985 but instead left the loans on its books as nonperforming.

Measuring loan losses by the total loss rate, Chart 2 shows that the high average level of loan problems has been accompanied by large differences in performance among banks. At the end of 1985, the average total loss rate for the 2,470 banks in the sample was 6.6 percent. Chart 2 divides the banks into groups according to the deviation of their loss rates from this regional average. The height of each bar is the percentage of total adjusted loans in the region held by the group. For example, the tallest bar indicates that 16 percent of loans in the region were held by banks with loss rates three to four percentage points below the regional average. As the chart shows, the majority of loans were held by banks with below-average loss rates. But a significant proportion of loans were held by banks with loss rates well above average. Thus, as measured by the standard deviation, the dispersion of loss rates in the sample was extraordinarily high, 6.0 percentage points.[3]

What accounts for this great diversity in loss rates among banks? There are several ways of explaining the variation in loss rates. The approach taken in this article is summarized in Figure 1 and consists of three stages.

Part of the variation in loss rates among banks could be due to differences in local economic conditions. Some areas may have depended more on the troubled agriculture and energy sectors, while others may have experienced strictly local shocks such as bad weather. As indicated in Figure 1,

[3] The standard deviation of a variable is the square root of the variance. The variance is the average of squared deviations of the variable from the average of the variable. All averages and variances in this article were computed with each bank or market assigned a weight proportional to its adjusted loans. Details of the calculations are provided in the Appendix.

the first stage of the analysis is to isolate the role of local economic conditions by dividing the total variation in loss rates among banks into two components—the variation in average loss rates across local banking markets and the variation in loss rates among banks in the same market.

Even within markets, loss rates could differ because banks specialized to different degrees in loans to troubled sectors. For example, some banks may have ended up with higher loss rates only because their expertise in agricultural or energy lending led them to specialize more in such lending than other banks in the same market. The second stage of the analysis accounts for this possibility by decomposing the variation in losses within markets into two parts—a part due solely to banks in the same market specializing in different types of loans and a part due to banks in the same market having different loss rates on the same types of loans.

There are several reasons why banks in the same market could have different loss rates on the same types of loans. Some banks could have higher losses through pure chance, some because they exercised poor credit management, and some because they had highly diversified loan portfolios that enabled them to relax their credit standards while keeping their total risk low. Finally, some banks may have been willing to gamble on loans with high default risk because they had a high propensity to take risk. It is impossible to say how much of the remaining variation in losses was due to each of these four factors. However, various tests are performed in the last stage of the analysis to determine if deliberate risk-taking was at least partly responsible.

Local economic conditions

One possible explanation for the wide variation in loan losses is that banks with heavier loan losses are located in areas with worse economic conditions. The region covered by this study has a highly diverse economy. Although many rural markets depend heavily on agriculture, some of the major cities have more diversified economies based on services and manufacturing. Energy and mining are highly important in two states, moderately important in three states, and of relatively little importance in the other two states. Because banks face obstacles in lending outside their own markets, loan losses have naturally tended to be higher in areas dependent on agriculture and energy than in areas dependent on other industries that have performed better. In addition, some areas have experienced strictly local shocks, such as bad weather or the closing of a major plant, adding to the variation in loss rates across markets.

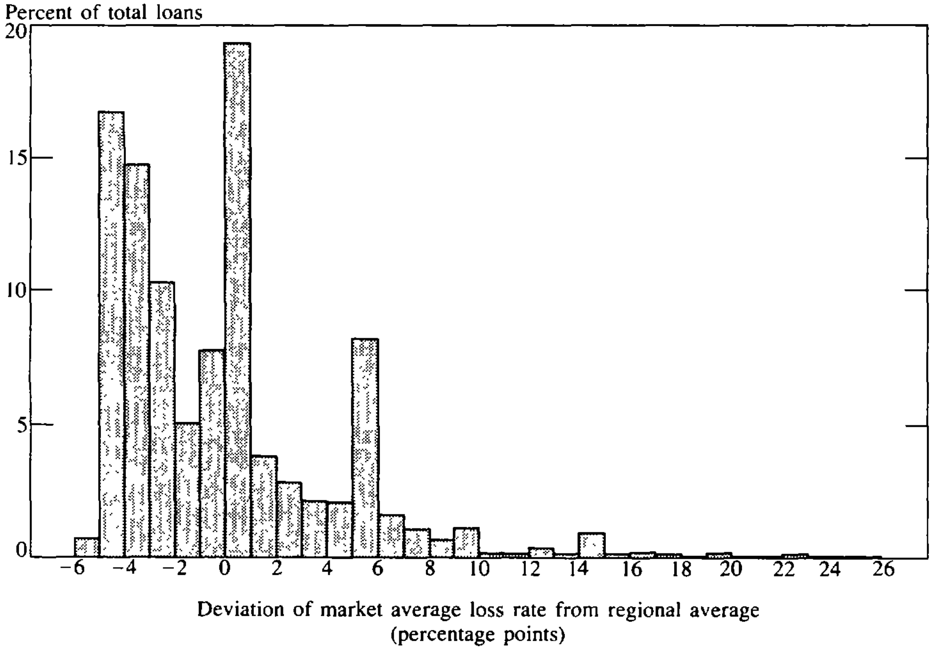
The impact of location on loan loss diversity was evaluated by dividing the total variation in loss rates in the region into two components—the variation between local banking markets and the variation within local banking markets. Local banking markets were defined as metropolitan areas and non-metropolitan counties with at least two banks. Under this definition, the sample included 411 markets. The greater the impact of local economic conditions, the greater the between-market variation in loss rates should have been relative to the within-market variation.[4]

Variation between markets was found to account for 49 percent of the total variation in loss rates, confirming that local economic conditions were an important source of diversity in loan losses.[5] The extent of between-market varia-

[4] The total variation in loss rates was measured by the variance of loss rates among banks, the between-market variation by the variance of average loss rates among markets, and the within-market variation by the variance of deviations of banks' loss rates from market averages.

[5] Some of the between-market variance could be due to other factors. Because the average number of banks in each market is small, random variation in loss rates among banks could lead

CHART 3
Variation of loss rates between markets



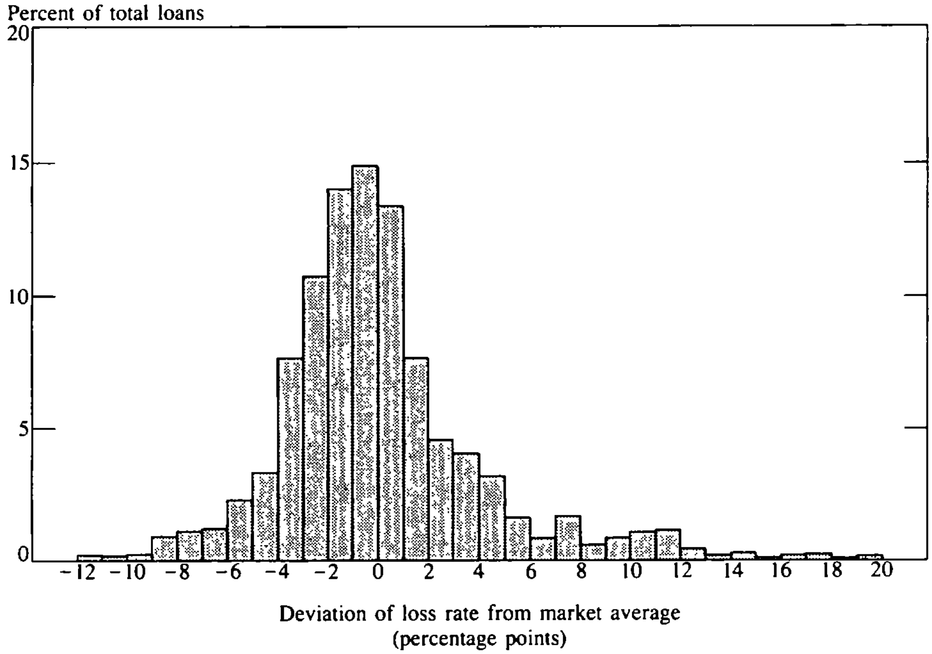
tion can be appreciated from Chart 3. This chart divides markets into groups according to the deviation of their average loss rates from the regional average. The height of each bar is the percentage of total adjusted loans in the region held by the group. As the chart shows, most loans were in markets with average loss rates below or just above the regional average. But because a significant fraction of loans were in markets with average loss rates well above the regional average, the standard deviation of average loss rates was still large—4.2 percentage points. This diversity in loss rates existed not only among markets in different states but also among markets in the same state.[6]

The remaining 51 percent of the total variation in loss rates was due to differences in loss rates within markets, suggesting that local economic conditions were not the only influence on loan losses. The extent of within-market variation in loss rates can be seen from Chart 4. This chart divides banks into groups according to the deviation of their loss rates from the averages for their markets. As before, the height of each bar is the

to significant differences in market averages even if local economic conditions were identical. Also, some of the variation in loss rates across markets could be due to systematic differences in bank behavior—for example, a tendency for all banks in some markets to adopt low credit standards or exercise poor credit management.

[6] The standard deviation of loss rates among markets in the same state averaged 3.5 percentage points and exceeded 3.0 percentage points in all but one state. This finding suggests that greater diversification could be achieved not only by allowing more interstate expansion but also by allowing more intrastate expansion.

CHART 4
Variation of loss rates within markets



percentage of total adjusted loans in the region held by the group. Although most loans were held by banks with small deviations from market average, a significant fraction were held by banks with loss rates well above or well below market average. As a result, the standard deviation of loss rates within markets was 4.3 percentage points—slightly larger than the standard deviation of loss rates between markets. This large variation in loss rates within markets could have a number of causes, one of which is differences in loan specialization.

Loan specialization

The poor performance of the agriculture and energy sectors not only accounts for much of the variation in losses among markets but may also explain some of the variation in losses within markets. Even if a bank had the same loss rate on each type of loan as other banks in the same market, its total loss rate could be higher because it specialized more in the types of loans with the highest loss rates. Table 1 suggests that in most markets the types of loans with the highest loss rates were either agricultural loans or energy loans. Although energy loans are not reported directly, the vast majority of these loans fall in the commercial and industrial (C&I) category. As shown in the table, C&I loans tended to have significantly higher loss rates than other categories in energy-producing states, while agricultural operating loans and farm real estate loans tended to have much higher loss rates than other categories in the remaining states.

Like banks in depressed areas, banks specializing heavily in agricultural and energy loans were to a great extent victims of external circum-

TABLE 1
Loss rates by loan category
(percent)

	Energy States*	Other States†
Agricultural operating loans	9.6	13.7
Consumer loans	4.6	3.0
Real estate loans	7.4	3.6
Residential	6.8	1.9
Nonresidential	7.2	3.5
Farm	14.8	14.5
C&I and all other loans	13.8	6.4
C&I	16.6	8.3
All other	5.1	0.9

*Oklahoma and Wyoming
†Colorado, Kansas, Missouri, Nebraska, and New Mexico
Note: Loss rates on subcategories were estimated by regression analysis.

stances. It could be argued that these banks could have avoided their high loan losses by investing in other types of loans. After all, if a bank specialized more in agricultural and energy loans than other banks in the same market, it was presumably specializing out of choice, not necessity. However, banks specializing in these loans may not have had any reason to believe that such specialization increased the likelihood of future loan losses.[7] And even if they were aware of the dangers, banks that invested large amounts of time and money in developing an expertise in agricultural or energy lending may have found it difficult to switch to other types of lending.

To evaluate the relative contribution of loan specialization to loan loss diversity, two components of the within-market variation in loss rates were computed. The first component is the variation due to some banks specializing more than others in the loan categories with the highest loss rates—categories such as agricultural operating loans in nonenergy markets and C&I loans in energy markets. The second component is the variation due to some banks having higher loss rates than others on one or more loan categories.[8]

Differences in loan specialization accounted for 9 percent of the total variation of loss rates within markets. In many markets, the percentage of loans invested in the highest-loss categories varied substantially among banks. For example, in rural markets in nonenergy states, the standard deviation of the share of agricultural operating loans was 10.3 percentage points. And in markets in energy states, the standard deviation of the C&I loan share was 11.7 percentage points. These differences in loan specialization were large enough to produce significant differences in total loss

[7] Specializing in a particular loan category could increase the likelihood of a high loss rate in two ways. First, loans in the category could have a higher average probability of default than loans in other categories, raising the bank's expected loss rate. Second, by investing more in the category, the bank could reduce the overall diversification of its loan portfolio, increasing chances that the actual loss rate ends up well below or well above the expected loss rate. In the late 1970s and early 1980s, banks may not have believed that agricultural and energy loans had a higher probability of default than loans to other sectors. Also, while a bank that held only agricultural or energy loans was obviously undiversified, it is not so clear that a bank with, say, 30 percent of its loan portfolio in these categories was less diversified than a bank with 5 percent.

[8] The first step in the decomposition was to estimate each bank's "normal" loss rate, the loss rate the bank would have had if its loss rate on each loan category had been the same as at other banks in the same market. The deviation of each bank's actual loss rate from the market average was then divided into two parts—the deviation of the normal loss rate from the market average and the deviation of the actual loss rate from the normal loss rate. The variance of the first deviation is the variation in loss rates due to differences in loan specialization. The variance of the second deviation is the variation due to different loss rates on the same types of loans.

rates. However, they were not large enough to account for more than a small part of the total variation in loss rates within markets.

A much larger part of the within-market variation in loss rates, 84 percent, was due to banks having different loss rates on the same types of loans.[9] The variation in loss rates within markets was particularly great for agricultural operating loans, which had a standard deviation of 9.3 percentage points. But even on consumer loans, the category with the least variation, the standard deviation of loss rates within markets was 3.0 percentage points. The exceptional magnitude of the within-market variation in loss rates on each of the loan categories strongly suggests that other factors besides location and loan specialization influenced banks' loan losses.

Other factors affecting loan losses

Even with the influence of local economic conditions and loan specialization removed, the variation in loss rates among banks was very large. There are four possible explanations for this residual variation in loss rates.

One reason banks operating in the same market might have different loss rates on the same type of loan is that the performance of borrowers is partly random. Even if all borrowers had the same probability of success when they took out their loans, some would always do better than others. By pure chance, the banks with the highest loan losses in each market may have ended up with a disproportionate share of the borrowers who failed.

Another explanation for the remaining variation in loss rates is differences in the quality of credit management. Some banks may have done a poor job of assessing borrowers' creditworthiness. For example, they may have failed to project applicants' cash flow carefully or evaluate their collateral realistically. Other banks may have neglected to monitor borrowers' progress after the loans were granted to ensure that funds were being properly spent. Any of these deficiencies in credit management could cause a bank to suffer higher losses than other banks even if the bank itself believed it was making loans with the same probability of default.

A third possibility is that some banks had more opportunities to diversify their loan portfolios and, consequently, were more willing to make loans with a high probability of default. The benefit to a bank of lowering its credit standards is that it may be able to increase its expected profits by charging higher interest rates or making more loans. The cost is that the increase in the average probability of default on loans will make profits more variable. The more diversified the loan portfolio, the less the variability of profits will increase, and thus, the lower will be the cost of relaxing credit standards relative to the benefit.[10] Other things equal, then, banks that can easily diversify should be more willing to make loans with a high probability of default.

[9] The remaining 6 percent of within-market variation in loss rates is an interaction effect resulting from a tendency for banks specializing in high-loss loan categories to have higher loss rates on one or more loan categories. This interaction effect is equal to twice the covariance between the deviation of the normal loss rate from the market average and the deviation of the actual loss rate from the normal loss rate.

[10] The impact of diversification can be clarified by a simple example. Suppose a bank makes n independent loans at interest rate r, and that each loan has a probability p of defaulting completely and a probability 1-p of paying off in full. The variance of the rate of return on the loan portfolio will then be $r^2p(1-p)/n$. An increase in p will raise the variance as long as p remains below one-half, but the larger n is, the smaller the rise in the variance will be. This example also points out that diversification has an important bearing on the first factor mentioned in this section, chance. If all banks in a market are highly diversified, random variation in borrower performance will result in relatively little variation in loss rates across banks.

Finally, some banks may have been more willing to make loans with a high probability of default, not because they had more opportunities to diversify but because they had a greater propensity to take risk. If a bank has an undiversified loan portfolio, relaxing credit standards and increasing the average probability of default may significantly increase the variability of its profits. The greater a bank's propensity to take risk, the more inclined it will be to tolerate this cost of lower credit standards in return for the benefit of a higher expected profit level. Thus, in each market, banks with a high propensity to take risk will tend to adopt lower credit standards than other banks, deliberately making loans with a higher probability of default.

Of the four possible explanations for the remaining variation in loan losses, the risk-taking hypothesis has particularly important implications for policy. Banks that have highly variable profits because they deliberately make loans with a high probability of default are more likely to fail than banks with stable profits. If a bank's owners were the only ones to lose when the bank failed, there would be no reason to discourage a bank from taking actions that significantly increased its chance of failing. Under the current system, however, bank failures can impose heavy costs on other parties, especially the Federal Deposit Insurance Corporation (FDIC). Thus, the greater the evidence that banks with heavy loan losses took exceptional risks, the stronger is the case for regulatory reforms aimed at curbing such behavior. Because of these important policy implications, the remainder of the article concentrates on testing the hypothesis that diversity in loan losses was at least partly due to risk-taking.

Evidence on risk-taking

Differences in risk-taking appear to be at least partly responsible for banks in the same market having very different loss rates on the same types of loans. In particular, the evidence suggests that some banks with a high propensity to take risk deliberately made loans with a high probability of default, causing them to end up with higher loss rates than other banks in the same market. Indirect evidence of risk-taking includes a positive correlation among loss rates on different loan categories and a positive association between banks' current and past loan losses. More direct support for the risk-taking hypothesis comes from evidence that banks with higher loan losses tended to earn a higher return on their loans in earlier years and tended to engage in other forms of risk-taking besides making risky loans.

In all the tests for risk-taking, an effort was made to control for differences in diversification opportunities. As noted in the previous section, some banks might deliberately make loans with a high probability of default only because their greater opportunities for diversification allow them to make such loans without significantly increasing the variability of their profits. Within any market, large banks and banks affiliated with multibank holding companies (MBHC's) are likely to have more diversification opportunities than small unaffiliated banks.[11] Accordingly, loss rates were purged of the influence of size and holding company status in each risk-taking test.[12]

[11] Opportunities for diversification could be greater at large banks and MBHC-affiliated banks for several reasons. Because it is impractical to make loans below a minimum size, a very small bank may not be able to make enough loans to reap the benefits of diversification. Large banks and MBHC-affiliated banks may also be more able to diversify their loan portfolios by exchanging their own loans for loans originated by other banks. Finally, even if each affiliate of a MBHC has a highly concentrated loan portfolio, the company's aggregate loan portfolio will be diversified if the affiliates are in different areas and specialize in loans to different industries. Of course, size and holding company status could also affect loan losses because they are related in some way to the quality of credit management.

[12] As suggested by the diversification argument, loss rates on agricultural operating loans were found to be significantly lower

TABLE 2
Distribution of banks by loss rates on different loan categories

	Number of banks with loss rates that were:	
	High or low on both categories	High on one category and low on the other
C&I and all other loans versus:		
Agricultural operating loans	992	719
Real estate loans	1,414	1,046
Consumer loans	1,444	1,013

Note: The sum of the two numbers in each row is the total number of banks reporting loss rates on both loan categories. The total number of banks in the first row is smaller than the total number of banks in the other rows because about 750 banks did not report loss rates on agricultural operating loans.

Correlation in loss rates

Banks seeking to increase their expected profits by making loans with a high probability of default should be more willing to make such loans in all their loan categories. Thus, to the extent that deliberate risk-taking was responsible for the variation in losses among banks, it is reasonable to expect banks with unusually high loss rates on one loan category to also have unusually high loss rates on their other loan categories.

Table 2 shows the relationship among loss rates on four major loan categories—agricultural operating loans, real estate loans, consumer loans, and C&I and all other loans. Each row of the table compares C&I and all other loans with one of the other categories.[13] For each loan category, banks were divided into two groups of equal number according to the deviation of their actual loss rate from the rate predicted on the basis of market location, size, and holding company status. The first column shows the number of banks that had either high loss rates on both categories or low loss rates on both categories. The second column shows the number of banks that had a high loss rate on one category and a low loss rate on the other.

Table 2 confirms that loss rates on C&I and all other loans were not independent of loss rates on the other three loan categories. If differences

at unaffiliated banks and very small banks—those with less than $25 million in assets. However, loss rates on all other loan categories were relatively unaffected by size and holding company status.

[13] The choice of the category "C&I and all other" as the basis of comparison was not entirely arbitrary. In principle, a bank could have high loss rates on two loan categories only because its worst customers had taken out loans in both categories. A bank's loan customers are less likely to have both C&I loans and loans in one of the other categories than, say, agricultural operating loans and consumer loans.

in loss rates were entirely random, the numbers in the two columns would be approximately the same in each case. Instead, significantly more banks fall in the first column, with either high loss rates on both of the categories shown or low loss rates on both categories.[14]

The correlation in loss rates on different loan categories provides strong evidence that luck was not solely responsible for the large differences in individual loss rates within markets. However, the association does not prove that some banks took more risk than others—it could also result from some banks having worse credit management than others.

Current and past loss rates

Another form of indirect evidence on risk-taking is the relationship between current and past loan losses. To the extent that risk preferences remained unchanged over time, the banks that were willing to make relatively risky loans in the late 1970s and early 1980s should also have been willing to make such loans in earlier years. But if some banks have always been willing to make relatively risky loans, their average loan losses should have been higher in the past as well as the present. To be sure, the variation in loan losses among banks was much smaller in earlier years. Nevertheless, to the extent that losses did vary, the risk-taking hypothesis would suggest that banks with higher-than-normal losses in the 1970s should tend to have higher-than-normal losses now.

To determine the relationship between current and past loan losses, banks' loss rates at the end of 1985 were compared with their average loss rates from 1973 to 1981. For each year, a bank's loss rate was measured by the "excess" loss rate, the actual loss rate minus the loss rate that would have been normal for the bank given its market location, loan specialization, size, and holding company status. Only chargeoffs were included in losses for the 1973-81 period because data on nonperforming loans were not available for that period.

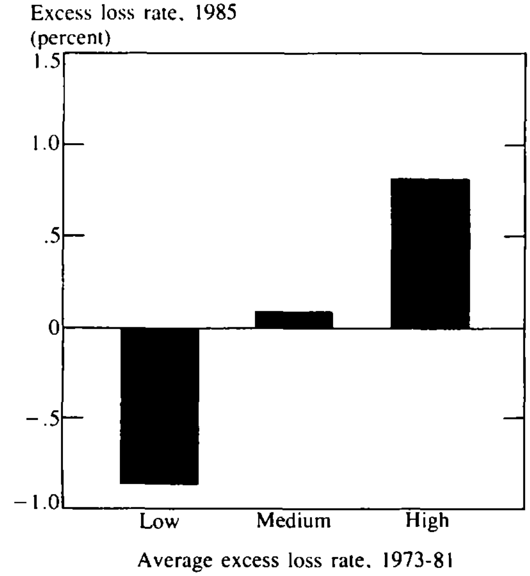
Chart 5 shows that banks with higher average excess loss rates during the 1973-81 period also tended to have higher excess loss rates at the end of 1985. The chart divides banks into three groups according to their average excess loss rate in the earlier period, with each group accounting for the same share of 1985 adjusted loans.[15] The height of each bar is the group's average excess loss rate at the end of 1985. The group with the lowest excess loss rate in 1973-81 had a negative excess loss rate in 1985—on average, loss rates in that group were 85 basis points below normal. By contrast, the group with the highest excess loss rate in 1973-81 had a positive excess loss rate in 1985, with loss rates averaging 74 basis points above normal.

As with the correlation in loss rates across loan categories, the tendency for some banks to have persistently higher loss rates does not prove that those banks were deliberately taking greater risk. As before, the evidence refutes the view that the variation in loan losses among banks was entirely random. However, instead of reflecting differences in risk preferences, the persistently higher loan losses at some banks could reflect differences in the quality of management—differences that persisted over time only because

[14] In this section, a relationship is said to be "significant" if there is only a small probability of observing the relationship by chance when in fact no relationship exists at all. Unless otherwise noted, all relationships reported are significant at the 1 percent probability level or less.

[15] The average 1973-81 excess loss rate in the "high" group exceeded the average 1973-81 excess loss rate in the "low" group by 0.4 percentage points.

CHART 5
Current and past losses



branching restrictions and other barriers to entry enabled badly managed banks to stay in business. To isolate the role of deliberate risk-taking, more direct forms of evidence must be considered.

Compensation for risk-taking

Banks that deliberately made riskier loans should have been compensated for their risk in the form of higher expected profits. The most likely possibility is that banks that adopted loose credit standards and made loans with a higher average probability of default were able to charge a higher average interest rate on their loans. To the extent the compensation for risk-taking took this form, the banks with the highest loan losses should be banks that earned the highest average return on their loan portfolios in the late 1970s and early 1980s, when the agriculture and energy booms were at their height.

In any market, a bank's average return on loans could differ from that of other banks for reasons unrelated to the risk the bank was taking on each category of loans. Some banks may have earned a higher average return on their loan portfolio only because they were specializing in loan categories that had high average returns in the market as a whole. And other banks may have charged higher interest rates on their loans because they had to pay more for their funds. To control for these other factors, a bank's normal return on loans was assumed to depend on its loan composition and funding costs as well as its size, holding company status, and market location.[16] The bank's "excess" loan return—the deviation of its actual return from its normal return—was then used as a measure of the compensation the bank received for taking greater risk on individual categories of loans.

Chart 6 shows that banks with higher excess loan returns tended to end up with higher excess loss rates, a result that supports the risk-taking hypothesis. The chart divides banks into three groups with equal amounts of 1985 adjusted loans according to their excess return on loans during the 1979-81 period.[17] For each group, the height of the bar indicates the group's average excess loss rate at the end of 1985. In the group with the lowest excess loan returns, loss rates were lower than normal by 32 basis points. On the other hand, in the group with the highest excess loan returns, loss rates were higher than normal by 40 basis points. This difference in excess loss rates is significant, though it accounts for only

[16] Even among banks with the same cost of funds, some may have adjusted their loan rates more quickly to the steep rise in market rates in the late 1970s. No data were available to control directly for differences in loan rate flexibility. However, because large banks and urban banks tend to adjust their loan rates more quickly than small rural banks, using size and market location to estimate the normal return on loans helps control for such differences indirectly.

[17] The average excess loan return in the "high" group exceeded the average excess return in the "low" group by 1.5 percentage points.

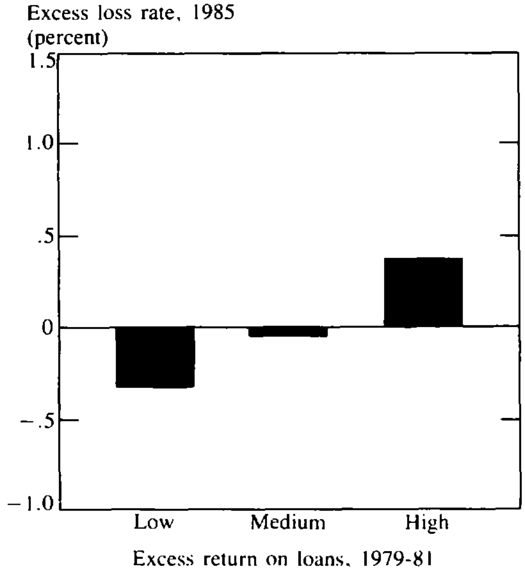
a small part of the total variation in excess loss rates among banks.

Coincident risk-taking

Banks with a high tolerance for risk should not only have been willing to make loans with a higher probability of default but should also have been willing to take other forms of risk. In particular, at the same time they were making high-risk loans in the late 1970s and early 1980s, these banks should have been more willing to invest their funds in loans, more willing to rely on volatile sources of funds, and less willing to back their assets with equity.

Loan-asset ratio. One form of risk-taking is the choice of a high loan-asset ratio. Most banks can expect to earn higher profits by lending to local borrowers than by investing in open market assets like government securities. Banks can earn these higher returns on loans because they know more than outside investors about local borrowers and because they are uniquely situated to monitor borrowers' progress and ensure that loans are repaid. But the more of its assets a bank invests in loans, the more variable its profits are likely to be. For one thing, loans have much greater default risk than assets like government securities. Also, loans to local borrowers tend to be less liquid than securities, making it more difficult for the bank to meet a sudden need for funds by selling assets. Because loans involve both greater credit risk and greater liquidity risk than other assets, the banks in each market that are most willing to invest their funds in loans are likely to be the banks with the greatest tolerance for risk.[18]

CHART 6
Compensation for risk-taking



Another reason why banks making riskier loans might have higher loan-asset ratios is that higher loan-asset ratios can represent a form of compensation for risk-taking. In some markets, a bank may be able to expand its loan portfolio without having to lower its credit standards. For example, in a highly competitive market with many banks, a bank can usually acquire more customers of the same average creditworthiness by slightly underbidding other banks. In other markets, however, the only way a bank may be able to expand its loan portfolio is by significantly lowering its credit standards and accepting a higher average probability of default on its loans. In such cases, part of the compensation for making riskier loans is the opportunity for the bank to invest more of its funds in loans and less in lower yielding assets like government securities.

Volatile funds ratio. A second form of risk-taking is reliance on volatile sources of funds. Funds like large negotiable CD's that are obtained on the open market have much greater risk of

[18] If loans were of different effective maturity than other assets, the substitution of loans for other assets could also affect a bank's exposure to interest rate risk. Due to data limitations, it was not possible to measure the amount of interest rate risk each bank was taking in the earlier period.

being suddenly withdrawn than "core" deposits like demand deposits and passbook savings that are obtained from local customers. By relying more on volatile funds and less on core deposits, a bank might be able to acquire more assets and earn higher average profits. At the same time, however, liquidity crises would become more frequent, increasing the variability of the bank's profits. For that reason, banks with high ratios of volatile funds to total liabilities are more likely to be risk-takers than banks with low ratios.

Equity-asset ratio. A final form of risk-taking is the choice of a low equity-asset ratio. A bank whose owners and managers want to keep the chance of going out of business very low is more likely to seek a high equity-asset ratio than a bank whose owners and managers are willing to risk failure for the uncertain prospect of high profits. But a bank whose owners and managers are anxious to avoid failure should also be averse to making loans with a high probability of default. Thus, other things equal, banks with the highest equity-asset ratios should be the least willing to make high-risk loans.

Fixed-rate deposit insurance reinforces the tendency for banks with low equity-asset ratios to make riskier loans. A bank that has suffered a string of losses and is unable to tap the capital market may find itself stuck with a lower equity-asset ratio than it would prefer. Such a bank has an especially strong incentive to make risky loans at high interest rates. If the loans pay off in full, the bank's owners will recoup their losses. On the other hand, if the loans default, the FDIC will bear most of the costs.

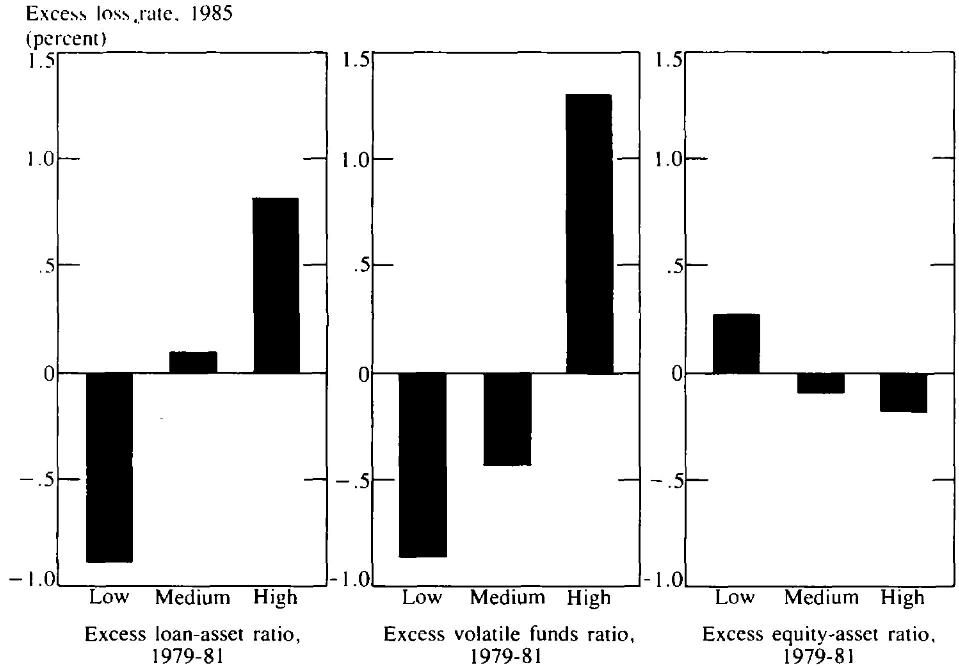
To determine if a bank chose unusually high or low values of the three risk-taking variables described above, the normal value of each variable was estimated on the basis of the bank's size, holding company status, and market location. The "excess" value of the variable—the actual value minus the normal value—was then used as a measure of coincident risk-taking. Like loan returns, the three risk-taking variables could differ among banks for reasons other than the willingness to take risk. For example, a bank that can borrow easily on the open market because of its size and reputation is more likely to rely on volatile funds. Similarly, a bank that can easily raise new equity from a correspondent bank, holding company, or private investors is less likely to maintain a substantial equity cushion against unforeseen losses. Removing the influence of size, holding company status, and market location from each risk-taking variable helps control for some of these factors but not all.

The relationship between loan losses and the three measures of coincident risk-taking is presented in Chart 7. Each panel in the chart corresponds to one of the three variables—the loan-asset ratio, the volatile funds ratio, and the equity-asset ratio. In each panel, banks are divided into three equal-size groups according to the excess value of the risk-taking variable in the 1979-81 period.[19] As in Charts 5 and 6, the height of a bar represents the group's average excess loss rate at the end of 1985.

Chart 7 confirms that banks taking unusually large amounts of coincident risk tended to end up with higher excess loss rates, a result that provides further support for the risk-taking hypothesis. The relationship between coincident risk-taking and loan losses is particularly strong for the loan-asset ratio and the volatile funds ratio. For example, the group of banks with the lowest excess loan-asset ratios had an average loss rate 90 basis points below normal, while the group of banks with the highest excess loan-asset ratios had an average loss rate 82 basis points above

[19] The average value of the excess loan-asset ratio in the "high" group exceeded the average value of the ratio in the "low" group by 14.3 percentage points. For the volatile funds ratio and the equity-asset ratio, the corresponding ranges are 15.2 percentage points and 2.7 percentage points.

CHART 7
Coincident risk-taking



normal. These differences in excess loss rates are significant.[20] As before, though, they are small relative to the total variation in excess loss rates among banks.

How can the evidence on risk-taking be summarized? The various tests suggest that differences in risk-taking were partly responsible for banks in the same market having different loss rates on the same types of loans. The positive correlation between banks' loss rates on different loan categories and the positive association between banks' current and past loss rates are consistent with the notion that some banks deliberately took greater risk than others. However, because the correlations could also reflect differences in management quality, they provide only weak support for the risk-taking hypothesis. The main support for the risk-taking hypothesis comes from evidence of past compensation for risk-taking and from signs of coincident risk-taking. Excess loss rates were found to be related to the average return on loans in the 1979-81 period and to three measures of coincident risk-taking during that period—the loan-asset ratio, the volatile funds ratio, and the equity-asset ratio. The four variables explain only a small part of the total variance in excess loss rates.[21] But in

[20] Although weaker, the relationship between excess loss rates and excess equity-asset ratios is significant at the 2 percent probability level.

[21] Taken as a group, the four variables account for only 8 percent of the total variance in excess loss rates. It should be

each case, the relationship with excess loss rates is much too strong to be coincidental.

Conclusions

The overall increase in loan losses in recent years has been accompanied by exceptionally large variation in loan losses across banks. This study has investigated the causes of loan loss diversity using a sample of almost 2,500 banks in Tenth Federal Reserve District states. A substantial part of the variation in loan losses in the sample was due to differences in local economic conditions and to the unusually poor performance of particular industries like agriculture and energy. Even after the influence of these factors has been removed, however, the variation in losses among banks remains very large. At least part of this remaining variation in losses can be attributed to some banks deliberately taking greater risk than others and making loans they knew to have a higher probability of default.

The results of this study provide support both for policies to promote greater diversification and for policies to curb excessive risk-taking. The large variation in loan losses across markets suggests that banks would be less vulnerable to the fortunes of individual areas or industries if they loaned over a broader area. Greater diversification of loan portfolios could be achieved by permitting more branching within states, allowing interstate banking, and encouraging secondary loan markets. But such measures will not guarantee a safe and sound banking system as long as banks with an unusually high propensity to take risk do not have to bear the costs their risk-taking imposes on the FDIC and society as a whole. From this study, it is not possible to say how much risk-taking contributed to the diversity in loan losses relative to other factors. However, given the potential for abuse under the current system of fixed-rate deposit insurance, the finding that risk-taking was at least partly responsible for the diversity in losses is cause enough for concern.

remembered, though, that the variables are only imperfect measures of risk-taking. Although an effort was made to control for extraneous influences, each of the variables could differ among banks for reasons completely unrelated to risk-taking, weakening the observed relationship with loan losses.

Appendix

Sample. The sample consists of 2,470 insured commercial banks in Tenth District states and is confined to local markets with two or more banks existing over the entire 1979-85 period. Local markets are defined as Metropolitan Statistical Areas (MSA's) and non-MSA counties. The MSA category includes Standard Metropolitan Statistical Areas that were reclassified as Consolidated Metropolitan Statistical Areas as of June 30, 1983.

Decomposition of total variance. The total variance of loss rates is

$$V = \sum_{m} \sum_{i} \frac{L_{im}}{L} (LR_{im} - \overline{LR})^2,$$

where L_{im} is adjusted loans of the i-th bank in the m-th market, L is adjusted loans in the entire sample, LR_{im} is the loss rate of the i-th bank in the m-th market, and $\overline{LR}$ is the weighted average loss rate for the entire sample.

The total variance was decomposed into the between-market variance, V_b, and the within-market variance, V_w:

$$V = V_b + V_w,$$

where

$$V_b = \sum_m \frac{L_m}{L} (\overline{LR}_m - \overline{LR})^2,$$

$$V_w = \sum_m \sum_i \frac{L_{im}}{L} (LR_{im} - \overline{LR}_m)^2,$$

L_m is adjusted loans in the m-th market, and $\overline{LR}_m$ is the weighted average loss rate in the m-th market.

Decomposition of within-market variance. The first step in the decomposition was to calculate each bank's "normal" loss rate. This rate was defined as

$$NLR_{im} = \sum_k \frac{L^k_{im}}{L_{im}} \overline{LR}^k_m,$$

where $\overline{LR}^k_m$ is the weighted average loss rate on the k-th loan category in the m-th market and the loan categories are the same as in Table 2.

Banks report nonperforming loans and chargeoffs for four major loan categories—agricultural loans, consumer loans, real estate loans, and C&I and all other loans. Banks under $300 million in assets are free to use their own definitions of these categories in reporting nonperforming loans and chargeoffs. However, as a close approximation, it can be assumed that all the nonperforming loans and chargeoffs reported in the agriculture category were agricultural operating loans. Banks whose agricultural operating loans are less than 5 percent of total loans do not have to report agricultural nonperforming loans and chargeoffs separately. Accordingly, agricultural operating loans of these banks were added to the C&I and all other category in calculating adjusted loans and loss rates for the C&I and all other category.

For agricultural operating loans and consumer loans, $\overline{LR}^k_m$ could be calculated directly. However, for the three subcategories of real estate loans and the two subcategories of C&I and all other loans, $\overline{LR}^k_m$ had to be estimated indirectly. The first step in this process was to run a weighted regression of the loss rate for the broader category (e.g., real estate loans) against a set of dummy variables for the 411 markets and a set of interactive terms equal to the share of loans in each subcategory times dummy variables for the seven states. The estimated coefficients from this regression were then used to compute the average loss rate $\overline{LR}^k_m$ for each subcategory and each market. The weight applied to each observation in the regressions was the square root of adjusted loans in the broader category. Because the regressions include market dummies, weighting the observations this way ensures that in each market the weighted average predicted loss rate equals the weighted average actual loss rate for each of the broader categories. This equality, in turn, ensures that the weighted average normal loss rate equals $\overline{LR}_m$ in each market.

After the normal loss rate was computed, the within-market variance was decomposed into three parts: the variance of the deviation of the normal loss rate from the market average, V_1, the variance of the deviation of the actual loss rate from the normal loss rate, V_2, and the covariance between the two deviations, COV_{12}:

$$V_W = V_1 + V_2 + 2COV_{12},$$

where

$$V_1 = \sum_m \sum_i \frac{L_{im}}{L} (NLR_{im} - \overline{LR}_m)^2,$$

$$V_2 = \sum_m \sum_i \frac{L_{im}}{L} (LR_{im} - NLR_{im})^2,$$

$$COV_{12} = \sum_m \sum_i \frac{L_{im}}{L} \times (NLR_{im} - \overline{LR}_m)(LR_{im} - NLR_{im}).$$

Size and holding company adjustment. Loss rates were adjusted for size and holding company status by estimating $\widehat{LR}^k_{im}$, a bank's predicted loss rate on the k-th loan category given its size, holding company status, and market location. For agricultural operating loans and consumer loans, $\widehat{LR}^k_{im}$ was obtained from a weighted regression of the loss rate against a dummy variable indicating whether the bank was affiliated with a MBHC in 1980 and a set of dummy variables reflecting the bank's average assets over the 1979-81 period. The size groups used were $0 to $25 million, $25 to $100 million, $100 to $250 million, $250 million to $1 billion, and greater than $1 billion. For the three subcategories of real estate loans and the two subcategories of C&I and all other loans, $\widehat{LR}^k_{im}$ was obtained from the same regressions that were used to compute $\overline{LR}^k_m$, but with the MBHC and size dummies added. In all the regressions, each observation was weighted by the square root of the bank's adjusted loans in the broader category.

Correlation of loss rates. For each of the broader loan categories, the deviation of the actual loss rate from $\widehat{LR}^k_{im}$ was calculated. Banks with deviations above the sample median were included in the "high" group and banks with deviations below the sample median were included in the "low" group.

Current and past loss rates. A bank's "excess" loss rate was defined as $ELR_{im} = LR_{im} - NLR_{im}$. For 1985, NLR_{im} was calculated the same way as in the decomposition of the within-market variance, except that $\widehat{LR}^k_{im}$ was substituted for $\overline{LR}^k_m$. For each year in the 1973-81 period, NLR_{im} is the predicted value from a weighted regression of the total chargeoff rate (net chargeoffs divided by end-of-year loans) against a set of market dummies, a MBHC dummy lagged three years, a set of size dummies lagged three years, and the shares of loans in different categories. The weight applied to each observation was the square root of the bank's end-of-year loans. Also, the same five size categories were used as above, except that average assets in every year were expressed in 1979-81 prices.

Compensation and coincident risk-taking. All four risk-taking variables were computed for the 1979-81 period. The average return on loans is average interest income on loans divided by average loans. The loan-asset ratio and the equity-asset ratio are average loans and average equity divided by average assets. The volatile funds ratio is the average value of large CD's, federal funds purchased, foreign deposits, and other borrowed money divided by average non-equity liabilities.

For the excess loss rate in 1985, the same measure was used as in the comparison of current and past loss rates. The excess value of each risk-taking variable is the actual value minus the predicted value from a weighted regression of the variable against the same size and MBHC dummies used to compute $\widehat{LR}^k_{im}$. For the average return on loans, the regression also included loan shares and the average cost of funds, which was computed by dividing average interest expense in the 1979-81 period by average non-equity liabilities. In all four regressions, the weight applied to each observation was the square root of the variable in the denominator of the risk-taking variable (e.g., the square root of average loans in the average-return-on-loans regression).

A Weaker Dollar and U.S. Farm Exports: Coming Rebound Or Empty Promise?

By David Henneberry, Mark Drabenstott, and Shida Henneberry

Crumbling export markets have been at the center of U.S. agriculture's economic and financial woes in the 1980s. Booming farm sales abroad ushered in agriculture's prosperous 1970s, and sagging sales signaled the deep farm recession of the 1980s. One principal factor in the wide swing in farm exports has been the exchange value of the U.S. dollar. A generally weak dollar throughout the 1970s made U.S. farm products attractive abroad, while a strengthening dollar in the early 1980s raised prices to foreign buyers.

The decline in the U.S. dollar over the past two years has been heralded by many as signaling a turnaround in farm exports. Since early 1985, the value of the dollar has fallen sharply against many currencies. The critical question for agriculture is, Will the drop in the dollar lead to a rebound in exports or will exports remain weak? If the lower dollar can boost exports, the currently austere farm outlook clearly would brighten. But if the lower dollar cannot provide that stimulus, agriculture must look elsewhere for its recovery.

This article concludes that the depreciation in the dollar may lead to some recovery in farm exports but that agriculture would benefit more if the dollar's decline extended to more currencies important to world grain trade and if the world economy were growing more strongly. Two questions are crucial to a consideration of how the value of the dollar affects farm exports. First, from agriculture's perspective, what is the appropriate measure of the dollar's value? And second, how does this measure of an "agricultural" exchange value affect farm exports? In addressing these questions, the first section compares movements in different measures of the dollar's value and the second section develops reasons why common measures of the dollar's exchange value do not fully reflect farm trade patterns. The third section explores the linkage between an "agricultural" exchange value of the dollar and farm exports by presenting some empirical results of exchange value fluctuations on the exports of wheat, a major

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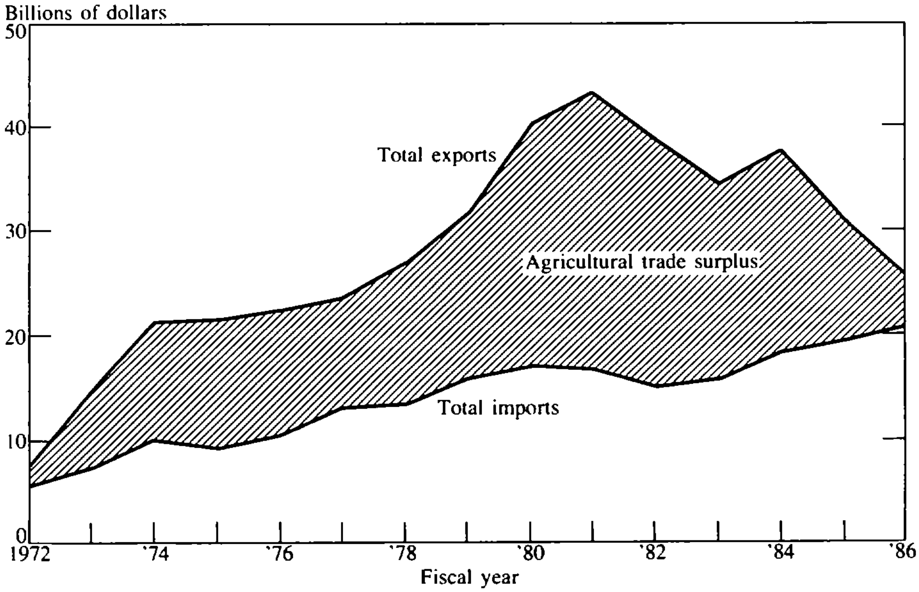
CHART 1
U.S. agricultural trade, 1972-1986



U.S. farm export commodity. The fourth section draws conclusions about the farm export outlook.

The rise and fall in the value of the dollar

U.S. farm exports have fallen sharply in the 1980s. Chart 1 shows that after topping in 1981, agricultural sales slumped to $26.3 billion in 1986, fully 40 percent less than the peak. A weak world economy, mounting competition from other exporting countries, and the strength of the dollar are the principal causes of the decline. Though analysts disagree on which factor has been more important, some observers have argued the dollar has had the most effect.

The most widely watched indexes of the dollar's value—those maintained by the Federal Reserve Board and by Morgan Guaranty—indicate the dollar has fallen in nominal value about 40 percent since it peaked in early 1985. The Federal Reserve index includes ten countries while the Morgan Guaranty index referred to here has 40 countries. The Federal Reserve index is a multilateral index with country weights based on the country's share of total world trade. The Morgan Guaranty index is a bilateral index with country weights based on the country's share of U.S. trade in manufactures.[1] Both indexes might be called "general" trade-weighted indexes because they pertain to trade in a broad mix of products. The decline in these indexes has led many observers

[1] A multilateral exchange rate index is based on total world trade, with each country's weight equal to its share of that trade. A bilateral exchange rate index is based on total trade for one country—in this case, the United States—with each country's weight equal to its share of the base country trade.

to expect a strong rebound in farm exports. But are indexes based on trade in a broad mix of products the right measure of the dollar's value for individual sectors of the economy, such as agriculture? Closer inspection indicates that the dollar has not declined as much against currencies important to agriculture.[2]

An agricultural exchange value of the dollar

Movements in general trade-weighted indexes of exchange value do not fully represent agriculture's interest in foreign trade. As many analysts of world food trade have noted, an index of dollar exchange value maintained by the U.S. Department of Agriculture (USDA) is the only major index available that focuses on currencies important for trade in agricultural products.[3] The USDA index is a bilateral index because it focuses on U.S. farm trading partner countries, with country weights equal to each country's share of total U.S. farm trade. The index also might be called an "agricultural" trade-weighted index of the exchange value of the dollar because the index pertains to trade in agricultural products, not traded goods in general. The USDA index is only one of many possible indexes of the agricultural exchange value of the dollar. The USDA index differs from the Federal Reserve Board and Morgan Guaranty indexes by attaching less weight to industrial trading partners and more weight to developing countries. Table 1 compares the country weights of the three indexes. The Federal Reserve Board index centers exclusively on the G-10 countries—Belgium, Canada, France, West Germany, Italy, Japan, the Netherlands, Sweden, and the United Kingdom—and Switzerland. The Morgan Guaranty 40-country index attaches less weight to these countries and gives some weight to developing countries. The 38-country USDA index, on the other hand, gives nearly a third of its weight to developing countries and 6 percent to other industrial countries important to U.S. farm exports.

The Federal Reserve Board and USDA indexes suggest broadly similar movements in the value of the dollar, as shown in Chart 2. There are minor differences, as might be expected since the Federal Reserve index has different country weights and is a multilateral index; that is, it focuses on total world trade, not U.S. trade alone. The Federal Reserve Board index indicates more than a 70 percent rise in the value of the dollar from 1979 through early 1985, and about a 40 percent drop in the value of the dollar from early 1985 through the end of 1986. The USDA index suggests a rise and fall, but of different dimensions. This index shows the dollar increasing a little over 50 percent between 1979 and early 1985 and then falling about 25 percent through the end of 1986. At the end of 1986, the two indexes were nearly equal. Thus, comparing movements in the two indexes since early 1985 suggests the agricultural exchange value of the dollar—as measured by the USDA index—has declined roughly in step with the general exchange value of the dollar—as measured by the Federal Reserve Board index.

The U.S. dollar and U.S. farm commodities

Is the agricultural exchange value of the dollar still relatively strong? The USDA index suggests a considerable decline, as discussed above. But alternative measures of the agricultural exchange value of the dollar indicate that it remains quite strong. This section presents a series of alternative indexes that measure the agricultural exchange

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[2] For a discussion of how specific U.S. industries are affected by movements in the dollar, see Deborah Olivier, "Few Industries Benefit from the Weaker Dollar," *Wall Street Journal*, January 30, 1987, p. 16.

[3] See, for example, Michael T. Belongia, "Estimating Exchange Rate Effects on Exports: A Cautionary Note," *Economic Review*, Federal Reserve Bank of St. Louis, Vol. 68, No. 1, January 1986.

TABLE 1
Country weights in alternative indexes of the exchange value of the dollar

	Exchange Value Index (Percent)		
	Federal Reserve Board	Morgan Guaranty (40-Country Index)	USDA
Belgium	6.4	2.2	2.6
Canada	9.1	20.7	8.3
France	13.1	5.1	2.7
West Germany	20.8	9.9	9.0
Italy	9.0	3.7	4.8
Japan	13.6	18.5	21.1
Netherlands	8.3	2.0	11.3
Sweden	4.2	1.5	—
United Kingdom	11.9	8.2	4.6
All G-10 countries	96.4	71.8	64.4
Switzerland	3.6	1.8	1.2
Australia	—	1.7	—
Denmark	—	0.4	1.0
Spain	—	1.3	3.7
Middle and low-income countries	—	23.0	29.7
Total	100.0	100.0	100.0

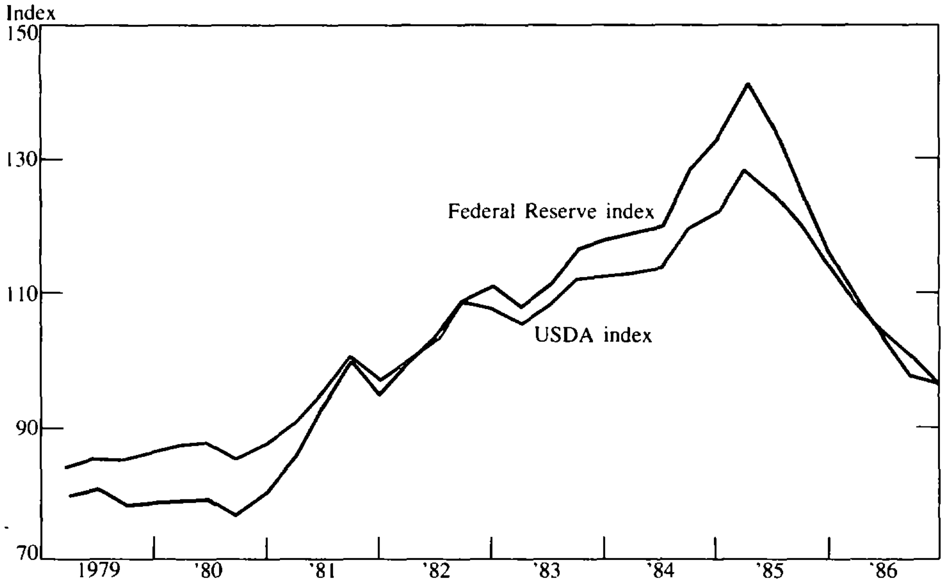
value of the dollar as it pertains to U.S. farm exports in general and specific farm commodities in particular. An examination of these indexes provides a more comprehensive view of the relative strength of the dollar from agriculture's perspective.

The indexes examined here measure changes in the real exchange rate, rather than the nominal rate discussed earlier. The nominal exchange rate represents changes caused by fundamental economic forces plus the effects of inflation across countries. In contrast, the real exchange rate represents only the changes caused by fundamental economic forces after adjusting for the different rates of inflation. Thus, the real exchange rate is what is most important to actual trade decisions.

The indexes focus on exchange rates with both food importing and food exporting countries.[4] The

[4] The indexes are all constructed as Fisher Ideal indexes. Put simply, the Fisher Ideal index is a way of combining the more

CHART 2
Trade weighted exchange value of the dollar, 1979-1986



importing country indexes are bilateral indexes with country weights determined by the country's share of U.S. farm exports. The importing country indexes each contain a large number of countries and account for virtually all U.S. farm exports destined for non-centrally planned countries. The exporting country indexes are multilateral indexes, with country weights equal to each country's share of the total world market for that commodity. The exporting country indexes concentrate on the small set of countries that are principal competitors to the United States in wheat, corn, and soybeans. The indexes were constructed for agricultural marketing years, from October 1 to September 30, and nominal exchange rates were deflated by changes in producer price indexes in the country involved to get real exchange rate movements.

Table 2 presents the indexes that provide a broader perspective on the agricultural exchange value of the dollar than the USDA index. Column 1 is a bilateral index based on total U.S. export trade with country weights based on trade flows with all U.S. trading partners. The index

commonly used Paasche and Laspeyres indexes. The Paasche index, which uses shifting quantity weights, tends to understate currencies that have weakened against the dollar. The Laspeyres index, which uses fixed, base-year weights, tends to overstate currencies that have weakened against the dollar. The Fisher Ideal index "averages" the two indexes. The two indexes are multiplied together, and the geometric mean is computed by taking the square root. The resulting Fisher index is a better measure than either of the other two indexes because it always falls between the boundaries of underestimation and overestimation set by the Paasche and Laspeyres indexes.

For a further discussion of these indexes, see David Henneberry, Shida Henneberry, and Luther Tweeten, "The Strength of the Dollar: An Analysis of Trade-Weighted Foreign Exchange Rate Indices with Implications for Agricultural Trade," *Agribusiness: An International Journal*, forthcoming.

TABLE 2

Trade-weighted real exchange rate indexes for the U.S. dollar based on trade in agricultural and related products, 1979-80 = 100*

	Indexes for Importing Countries						Indexes for Exporting Countries		
Year†	Total Exports (1)	Nonagricultural Exports (2)	Agricultural Exports (3)	Wheat Exports (4)	Corn Exports (5)	Soybean Exports (6)	Wheat Exports (7)	Corn Exports (8)	Soybean Exports (9)
1973-74	85	86	79	80	69	76	95	122	104
1974-75	83	85	78	81	67	74	102	192	154
1975-76	85	86	80	84	70	76	100	166	134
1976-77	84	86	78	80	68	74	105	178	142
1977-78	81	83	73	78	63	67	102	149	121
1978-79	81	83	73	81	62	64	101	119	104
1979-80	100	100	100	100	100	100	100	100	100
1980-81	109	108	110	108	110	118	109	122	116
1981-82	121	120	124	119	127	133	128	239	212
1982-83	125	124	129	126	133	143	131	230	236
1983-84	135	134	140	146	136	149	137	222	237
1984-85	139	138	148	156	143	158	146	239	254
1985-86	130	129	140	158	130	143	134	198	192
Number of countries represented	77	77	77	69	47	42	4	2	2

Source: David Henneberry, Shida Henneberry, and Luther Tweeten, "The Strength of the Dollar: An Analysis of Trade-Weighted Foreign Exchange Rate Indices with Implications for Agricultural Trade," *Agribusiness: An International Journal*, forthcoming

*Indexes were constructed using weights based on trade patterns in 1982, 1983, and 1984. These indexes were calculated as Fisher indexes—the geometric mean (the square root of the product) of the more common Paasche and Laspeyres indexes.

†Agricultural marketing years, October 1 to September 30

pertains to trade in all products and thus is a general trade-weighted index. Column 2 is a bilateral index focused strictly on U.S. nonagricultural trade. The country weights are based on the trade flows of all nonagricultural U.S. exports, and thus it can be considered a general trade-weighted exchange value index that excludes agriculture. Column 3 is a bilateral index based on exchange rates with all the countries that import U.S. farm products and might be thought of as broadly comparable to the USDA index. The index differs from the USDA index by focusing on real exchange rates and by having more countries—in fact, twice as many. In particular, it has more developing countries. The indexes in columns 3 to 6 measure real movements in the dollar against the currencies of the countries that buy U.S. farm products in general, and wheat, corn, and soybeans in particular. Columns 7 to 9 list indexes that measure the dollar against the currencies of other countries that export wheat, corn, and soybeans. Thus, the last six columns examine how the value of the dollar might affect exports of U.S. wheat, corn, and soybeans from the perspective of both importer and competitor.

The indexes in Table 2 generally show that the dollar appreciated sharply in real terms against the major food importing and exporting countries' currencies from the 1979-80 marketing year to the 1984-85 marketing year before beginning a modest decline. The indexes also show that, in real terms, the dollar appreciated more in agricultural markets than in nonagricultural markets throughout the 1980s. Specifically, the dollar increased 38 percent for nonagricultural products (column 2) and 48 percent for agricultural products (column 3). Similarly, the decline has been a little less for agricultural products than for nonagricultural products.

Fluctuations in the dollar have not been equal against the currencies of countries that import different types of U.S. farm products. From the 1979-80 marketing year to the peak in 1985-86, the dollar appreciated 58 percent against the currencies of countries that import U.S. wheat (column 4). For countries that import U.S. corn (column 5), the dollar appreciated 43 percent between 1979-80 and 1984-85 before declining about 10 percent in the 1985-86 marketing year. The dollar rose even more against the currencies of countries that import soybeans (column 6)—58 percent between 1979-80 and 1984-85—before declining about 10 percent in the 1985-86 marketing year.

The dollar has been particularly strong against the currencies of agricultural competitors. From the 1979-80 marketing year to the 1984-85 marketing year, the dollar rose 46 percent in real terms against the currencies of major wheat exporters (column 7)—Australia, Canada, and France. The dollar appreciated in real terms even more against corn and soybean exporters—139 percent against corn exporters (column 8) and 154 percent against exporters of soybeans (column 9). The major competitors in corn are Argentina and Thailand. The major soybean competitors are Brazil and Argentina. The dollar did decline some against competitor currencies in the 1985-86 marketing year but is still much higher than in the early 1980s.

In short, the alternative measures of the agricultural exchange value of the dollar presented here indicate the dollar remains quite strong for agriculture. Agricultural trading partner countries have had about a 40 percent erosion in the real purchasing power of their currencies since 1979. At the same time, the real value of the dollar has increased more than 40 percent against the currencies of major competitors—even more for some commodities. The U.S. dollar has begun to decline against the currencies of countries that purchase and compete against U.S. farm exports, but the declines in real terms have been modest so far.

Farm exports and exchange rate regimes

Why is the behavior of the "agricultural" trade-weighted exchange value of the dollar different from that of the "general" trade-weighted exchange value? One obvious reason, as explained in the previous section, is the different mix of countries in the indexes. But the difference in behavior goes beyond the mix of countries in farm trade. Another distinction between agricultural trading partners and general trading partners is the greater tendency for farm trading partner countries to have fixed exchange rate regimes.

Exchange rate regimes are important in considering the linkage between the value of the dollar and farm exports. The exchange regime a country uses can affect how quickly developments in the exchange market translate into changes in the exchange rate and, thus, in product prices to the foreign buyer. An exchange rate regime refers to the institutional mechanism that governs currency fluctuations. These regimes vary significantly across countries, but most can be grouped into one of three broad categories: floating regimes, which allow exchange rates to respond quickly to market forces; limited flexibility regimes, which allow only limited fluctuations and may involve frequent government intervention; and pegged or fixed regimes, which allow no fluctuations and, therefore, are not responsive to short-run market forces.

There is an important difference between flexibility in the exchange rate regime and fluctuations in the exchange rate. A fixed exchange regime does not imply that the exchange rate does not vary. Rather, the flexibility of the exchange regime determines the extent to which short-run market forces translate into changes in the exchange rate. Many South American currencies, for example, are pegged to the U.S. dollar, and these same currencies have been devalued repeatedly in recent years. Such devaluations are usually unanticipated and add an element of instability to international trade. Agricultural trade is particularly subject to this type of instability induced by the exchange rate regime.

While it is possible for a currency pegged to the U.S. dollar to vary more than currencies that are freely floating, in general, fixed exchange regime currencies tend to be less volatile. For example, the West German mark is an important currency to U.S. farm trade and is a benchmark floating currency. Since 1979, the mark has fluctuated an average of 4.8 percent each quarter, with a standard deviation of 2.9 percent. The standard deviation is one statistical measure of variability; the higher it is, the more variable the exchange rate is. Malaysia, a country of growing importance to U.S. farm exports, has a fixed exchange rate regime. The Malaysian currency, the ringgit, has fluctuated only 1.8 percent a quarter since 1979 with a standard deviation of 1.4 percent. Thus, in at least some cases, the evidence is that fixed exchange currencies tend to be more stable, responding less to exchange market developments, while floating exchange currencies tend to be more volatile, responding more quickly to exchange market developments.

A bigger share of U.S. farm exports goes to countries with fixed exchange rate regimes than is true for nonagricultural exports. An analysis of U.S. farm trade in 1984 showed that destination countries with fixed or pegged exchange rates accounted for almost 20 percent of the farm exports and only 15 percent of the nonagricultural exports.[5] On the other hand, destination countries with floating exchange rates accounted for 43 percent of U.S. nonagricultural exports but only 28 percent of U.S. agricultural exports. The higher proportion of fixed regimes in agricultural trade reflects the market importance of less developed countries, where fixed exchange regimes are more common. Thus, U.S. farm exports may respond more slowly than nonagricultural exports to an overall weakening of the dollar in the exchange market because farm trading partners tend to have less flexible exchange rates.

Trade in some U.S. farm products appears particularly unlikely to respond quickly to general exchange market fluctuations. Such commodities as wheat and live cattle are exported primarily to developing countries, where exchange regimes are less flexible. Conversely, such commodities as soybeans and frozen meats are sold primarily to industrial countries, and most of the industrial countries have managed floating or freely floating exchange regimes. Table 3 shows the proportion of U.S. wheat, corn, and soybean exports going to countries with various exchange regimes. The conclusion from these data is that U.S. wheat sales may be slower to respond to exchange market developments than corn and soybeans.[6]

[5] See David M. Henneberry, "Institutional Constraints on Foreign Exchange Markets: A Comparison of Agricultural and Nonagricultural Trade Flows," *Current Farm Economics*, Oklahoma State University, Vol. 58, No. 3, September 1985.

[6] Currencies pegged to currencies other than the U.S. dollar may fluctuate markedly against the dollar depending on the behavior of the base currency.

TABLE 3

Proportion of U.S. wheat, corn, and soybean exports classified by foreign exchange regime of the designation country, 1984

(Percent)

Foreign Exchange Regime (June 30, 1984)	Number of Countries	Proportion of Wheat Exports	Proportion of Corn Exports	Proportion of Soybean Exports
Pegged Regimes				
Pegged to U.S. dollar	28	7.69	8.25	0.12
Pegged to French franc	13	0.00	0.00	0.00
Pegged to other currencies	4	0.00	0.00	0.00
Pegged to SDR's	9	1.19	0.00	0.00
Pegged to other composites	24	19.91	0.53	3.46
Subtotal	78	28.79	8.78	3.58
Limited Flexibility				
Limited flexibility: single	8	0.92	0.00	0.00
Limited flexibility: group	7	4.68	8.54	35.14
Adjusted by set indicators	6	16.68	6.12	3.50
Subtotal	21	22.28	14.66	38.64
Floating				
Managed floating	23	34.11	22.16	30.27
Independently floating	7	14.83	54.40	27.50
Subtotal	30	48.94	76.56	57.77
All regimes	129	100.00	100.00	100.00

Source: U.S. Department of Agriculture, *Foreign Agricultural Trade of the United States*, various calendar year issues, and International Monetary Fund, Annual Report of the Executive Board

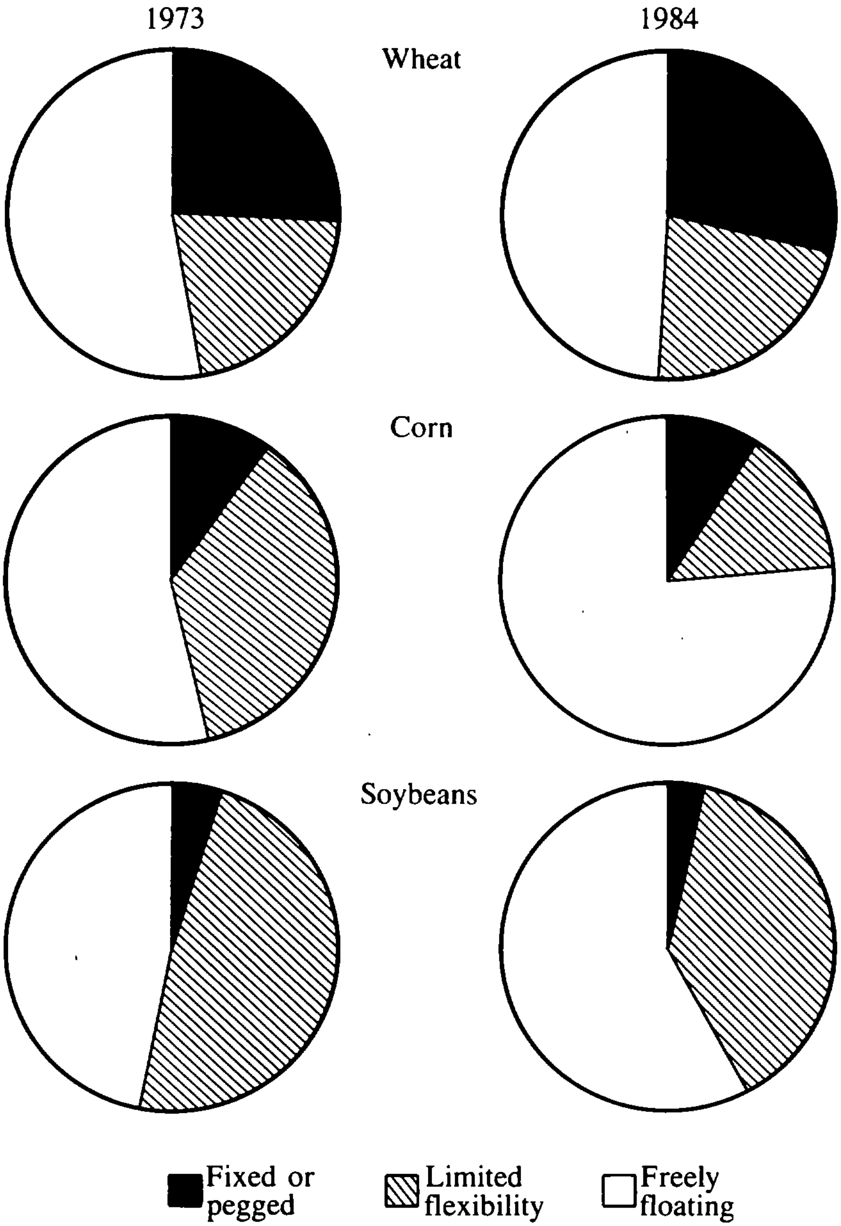
Moreover, as Chart 3 shows, wheat sales are becoming more concentrated in countries with fixed regimes while corn and soybean foreign sales are becoming more concentrated in floating regime countries.

In summary, a significant portion of U.S. farm exports are destined for countries with currencies that tend not to respond quickly to general exchange market forces. This insensitivity and the tendency of these countries to peg to the U.S. dollar help explain why various measures of the agricultural exchange value of the dollar have not declined as rapidly or as much as such broad measures of exchange value as the Federal Reserve Board general trade-weighted index.

An empirical analysis of farm exports and the dollar

How much will U.S. farm exports respond to movements in the "agricultural" value of the dollar? Only empirical analysis can offer insight

CHART 3
U.S. exports to countries by foreign exchange regimes



to that question. Previous studies attach different emphasis to exchange rate fluctuations on U.S. farm exports.

Two recent studies modeled the effect of exchange rates on U.S. farm exports. Chambers and Just examined the dynamic effects of exchange rate fluctuations on U.S. exports of corn, wheat, and soybeans.[7] They used quarterly data from 1969 to 1977 in an econometric model to explain the volume of exports in terms of the inflation-adjusted U.S. price, the exchange rate expressed in terms of Special Drawing Rights (SDR's), the European Economic Community threshold price for wheat imports, the stocks of wheat in other major wheat exporting countries, Public Law 480 (Food for Peace) shipments of wheat, and seasonal factors. They found that although the exchange rate variable has the expected negative sign, it was less significant for exports of wheat than for exports of corn and soybeans.

Bessler and Babula used a vector autoregression model in studying wheat exports.[8] Analyzing data from January 1974 to March 1985, they found that movements in the exchange rate do not help to explain U.S. wheat export shipments. But they did find that the exchange rate movements are a significant factor in explaining fluctuations in wheat prices.

This section presents a model that measures the effect of exchange rate movements and other key factors on U.S. wheat exports. Other farm commodities will react somewhat differently to the economic variables considered here. Nevertheless, the wheat model offers some insight into how farm exports in general may respond to the decline in the agricultural trade-weighted value of the dollar.

A quarterly model of wheat exports

Wheat exports presumably respond to a handful of key economic variables, including the price of U.S. wheat, the price of wheat produced in competing countries, the price of substitute commodities, the income of importing countries, and the exchange value of the dollar measured in terms of the currencies of countries that import U.S. wheat. These factors can be combined mathematically as an export demand equation for U.S. wheat as in Equation 1.

Economic theory provides insight into how each variable should affect exports. Increased world income can have both positive and negative effects on U.S. wheat exports, although an overall positive effect is expected. As incomes increase, there may be a substitution away from direct consumption of wheat for protein toward more animal protein. Wheat is a feed grain, however, and wheat consumption does increase with income in most countries. The model has two price variables. The first, PX_t, is the inflation-adjusted price of U.S. wheat. An increase in the real price of U.S. wheat should reduce export demand. Conversely, an increase in the real price of Australian wheat—PC_t, the other price variable—should help U.S. sales since U.S. and Australian wheat are direct substitutes in the world market. The exchange rate also should have a negative effect, since foreign demand should decline as the dollar increases in value. Similarly, the real price of wheat substitutes—rice in this case—should be positively related to U.S. wheat exports. And all things equal, as world wheat production increases and competing supplies rise, U.S. wheat exports may be expected to decline somewhat.

The critical exchange rate variable used in this model was a wheat trade-weighted dollar exchange rate index for 1973 to 1986 and is the same index

[7] Robert G. Chambers and Richard E. Just, "Effects of Exchange Rate Changes on U.S. Agriculture: A Dynamic Analysis," *American Journal of Agricultural Economics*, Vol. 63, 1981, pp. 32-46.

[8] David Bessler and Ronald A. Babula, "Forecasting Wheat Exports: Do Exchange Rates Matter?" *Journal of Business and Economic Statistics*, forthcoming.

EQUATION 1

Export demand function for U.S. wheat

$$X_t = f(YW_t, PX_t, ER_t, PC_t, PR_t, QW_t, e_t)$$

where:

X_t is the volume of U.S. commercial wheat exports as measured in metric tons.

YW_t is the real Gross Domestic Product of developed and developing wheat importing countries expressed as a weighted index. The weights are based on each group's wheat imports from the United States (1980 Q1: = 100).

PX_t is the real U.S. wheat export price expressed in U.S. dollars per metric ton. It is measured by the unit value of U.S. wheat exports deflated by the U.S. CPI (1980 Q1: = 100).

ER_t is the wheat trade-weighted real exchange rate index of the U.S. dollar versus the currencies of wheat importing nations (1980 Q1 = 100). The exchange rate is defined as foreign currency per U.S. dollar.

PC_t is the real price of Australian wheat expressed in U.S. dollars per metric ton. This variable is used as a proxy for all U.S. export competitor prices. Since world wheat prices move together quite closely, it is assumed that this variable adequately captures the variation in competitor prices. The Australian CPI (1980: Q1 = 100) is used as a deflator.

PR_t is the deflated world price of rice expressed in U.S. dollars per metric ton. The variable is represented by the price of Thailand rice.

QW_t is the production of wheat in the rest of the world expressed in thousands of metric tons.

e_t is the random error.

listed in column 4 of Table 2. The index was constructed as a weighted market basket of currencies for major U.S. wheat importers, with weights equal to each country's share of total U.S. wheat exports.[9] The most important countries in the index are Brazil, Mexico, South Korea, India, Egypt, and Morocco. The exchange variable is defined as the real, or inflation-adjusted, exchange rate because that is the exchange rate most critical to trade decisions.[10]

[9] The index was constructed as a Fisher Ideal index.

[10] For a more complete discussion of nominal and real exchange rates and their effect on farm trade flows, see David Henneberry, Shida Henneberry, and Luther Tweeten, "The Strength of the Dollar: An Analysis of Trade-Weighted Foreign Exchange Rate Indices with Implications for Agricultural Trade," *Agribusiness: An International Journal*, forthcoming.

The model was estimated for the period from the first quarter of 1973 to the second quarter of 1986. Different functional forms were estimated—linear, logarithmic, and semi-logarithmic—but results for the logarithmic form provided the best fit to actual data.[11] The model was estimated by using ordinary least squares. No serial autocorrelation was evident, so no other estimation techniques were used.

Model results

Regression results from the model are consistent with the effects economic theory would suggest. Table 4 presents ordinary and standardized regression coefficients for the model variables. The estimated equation explains only 43 percent of the variation in U.S. wheat exports, but that level of success is as good or better than other quarterly models that try to model U.S. farm trade. The model exhibits the direction of effects expected for all the key variables, and all but one variable is significant at the 5 percent level. The exception is world income, which is significant at the 10 percent level. As expected, the real exchange value of the dollar has a negative effect on exports. Based on the standardized regression coefficients, the exchange rate appears to have less effect on exports than U.S. prices, foreign prices, world wheat production, or world income. The price of U.S. and foreign wheat are clearly the most important variables.

The model suggests, therefore, that U.S. wheat exports will respond somewhat to a weaker dollar. To spark a significant turnaround in farm exports, however, a combination of factors probably will be necessary. The standardized coefficients indicate that the U.S. price, the competing country price, world production, and world income are all more important than the exchange rate. The muted effect of the exchange rate on wheat exports in the model may reflect the fact that more than half of U.S. wheat sales abroad are to countries that do not have floating exchange rates. To these foreign buyers, the U.S. market price and their own income are much more important determinants of their buying power. Also, the exchange rate variable in the model may not capture all the exchange rate effects. The two price variables may reflect part of the effect. In a competitive world market, the U.S. and Australian price of wheat would be expected to move together. Thus, it is especially difficult to interpret coefficient estimates on the price and exchange rate variables.

Implications for the export outlook

An empirical analysis of exports and exchange rates suggests that the exchange value of the U.S. dollar is important but may not be the most important factor in determining U.S. farm exports. The decline in the dollar that has already occurred should lead to improved farm exports in the near future. Still, that improvement will be less than the decline in the "general" trade-weighted exchange value of the dollar would suggest.

The response of farm exports to general movements in the value of the dollar will not be uniform across commodities. Wheat exports are likely to be slow in turning up. That outlook rests on the overriding importance of developing countries as importers of U.S. wheat. Many of the developing countries have fixed exchange rate regimes that are likely to be slow in responding to exchange market forces. Corn and soybean exports, on the other hand, should respond to the fall in the dollar more quickly because U.S.

[11] The estimated form of the model, then, can be expressed as the following equation.

$$LnX_t = B_0 + B_1 LnYW_t + B_2 LnPX_t + B_3 LnER_t + B_4 LnPC_t + B_5 LnPR_t + B_6 LnQW_t + U_t$$

TABLE 4
Determinants of U.S. wheat export demand, 1973 to 1986

Dependent Variable	Independent Variables					
U.S. Wheat Exports	Intercept	World Income	U.S. Price of Wheat	Real Wheat Trade-Weighted Exchange Value of U.S. Dollar	Foreign Price of Wheat	World Wheat Output
Ordinary coefficient	19.13	1.84	−1.56	−0.63	1.55	−2.01
t-value	6.93	1.63	−3.00	−2.07	2.87	−1.94
Standard error of estimate	2.761	1.127	0.520	0.305	0.542	1.035
Standardized coefficient	0.00	0.45	−0.62	−0.40	0.55	−0.54

Summary statistics: $R^2 = 0.43$ with 48 degrees of freedom
Durbin Watson = 2.06

markets for these commodities tend to have floating exchange rate regimes.

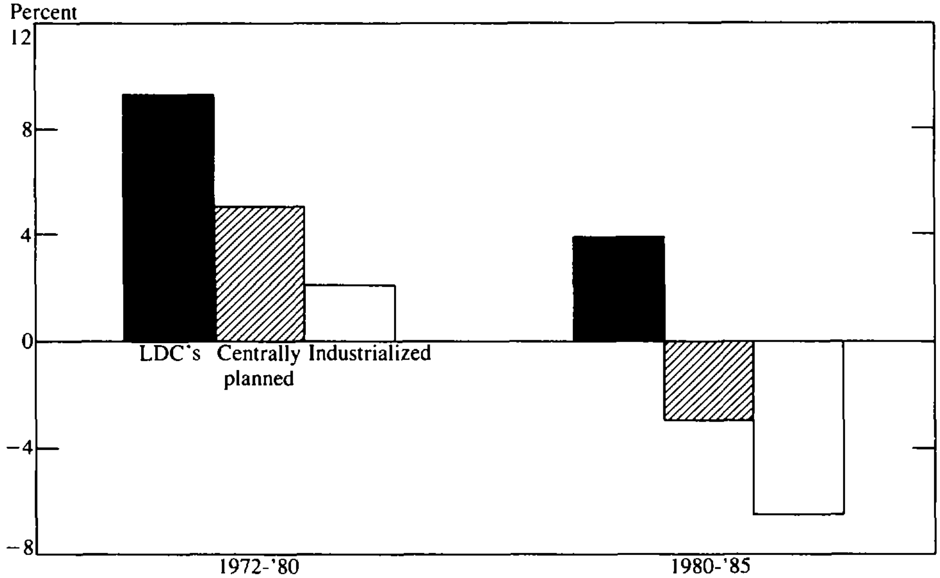
The model results may not reveal the full importance of stronger income growth abroad as a principal factor in restoring export growth for U.S. agriculture. There is no clear explanation for why the model results do not attach more weight to income. Improving per capita incomes was a principal reason for developing countries to increase purchases of U.S. farm products throughout the 1970s. The developing countries have become the primary export market for many U.S. farm products. For example, the share of U.S. wheat exports purchased by developing countries increased from 44 percent in the 1972-73 marketing year to 67 percent in 1985-86. Over that period, the proportion of U.S. corn exported to developing countries rose from 17 percent to 34 percent.

The pivotal role of developing countries in expanding U.S. farm export markets is reinforced by recognizing that centrally planned countries and the industrialized countries have not contributed any growth to U.S. farm exports in the 1980s. Chart 4 shows that sales to developing countries have continued to grow in the 1980s while exports to the other groups have fallen markedly. Thus, even though the United States still exports more farm products to the developed countries, U.S. agriculture can hope to find significant growth in exports only through improving economies in the developing world.

Market prices are a critical determinant of U.S. farm exports. Thus, the effect of farm and trade policies on export prices remains a key international issue. The model results indicate that, overall, the lower U.S. support prices brought

CHART 4

Average annual growth in wheat and feed grain imports, U.S. trading partner countries



about by the 1985 Food and Security Act should stimulate U.S. grain exports. Nevertheless, different price elasticities among trading partner countries suggest that the response may not be uniform.[12]

Summary

The agricultural exchange value of the dollar, as measured by a number of indexes, has begun to decline. The decline is less, however, than for general trade-weighted measures of the dollar's value. One reason that the agricultural value of the dollar has remained relatively strong is that farm trading partner countries are more likely to have fixed exchange rate regimes, and these regimes are less repsonsive to exchange market forces. In addition, many developing countries that peg their currencies have chosen to resist allowing their currencies to rise against the dollar. Empirical analysis suggests that a weakening agricultural trade-weighted dollar will stimulate U.S. farm exports somewhat, but market prices and income may be more important factors. On balance, a weaker dollar will lead to stronger farm exports, but a weaker dollar alone will not ensure the vigorous rebound in trade that U.S. agriculture is awaiting. The direction of U.S. farm commodity programs and the health of the world economy will probably have an even greater effect on how strong the turnaround in farm exports becomes.

[12] For a discussion of the varying price elasticities for food importing countries, see Shida Henneberry, "A Review of Agricultural Supply Responses for International Policy Models," Staff Paper, Department of Agricultural Economics, Oklahoma State University, May 1986.

Economic Review
Federal Reserve Bank of Kansas City
Kansas City, Missouri 64198
May 1987, Vol. 72, No. 5