Working Paper Series

Interest–Rate Derivatives and Bank Lending

Elijah Brewer III, Bernadette A. Minton and James T. Moser

LIBRARY
OCT 22 1996
FEDERAL RESERVE
BANK OF CHICAGO

Working Paper Series
Issues in Financial Regulation
Research Department
Federal Reserve Bank of Chicago
September 1996 (WP-96-13)

FEDERAL RESERVE BANK
OF CHICAGO

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Please do not quote

Interest-Rate Derivatives and Bank Lending

by

Elijah Brewer III, Bernadette A. Minton and James T. Moser*

First draft: December 1993
This draft: September 1996

* The authors' respective affiliations are: the Federal Reserve Bank of Chicago; Ohio State University and the Federal Reserve Bank of Chicago. We have benefitted from conversations with Herb Baer, Charles Calomiris, Mark Flannery, George Kaufman, Lew Segal, Philip Strahan, Steven Strongin, Dan Sullivan, and two anonymous reviewers. All views expressed in this paper are those of the authors and are not necessarily those of the Federal Reserve Bank of Chicago.

Please address correspondence to: James T. Moser,
Research Department
Federal Reserve Bank of Chicago
230 South LaSalle Street
Chicago, IL 60604-1413
Phone: (312) 322-5769
INTERNET: JMOSER@FRBCHI.ORG.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Interest-Rate Derivatives and Bank Lending

Abstract

We study the relationship between bank participation in derivatives contracting and bank lending for the period June 30, 1985 through the end of 1992. Since 1985 commercial banks have become active participants in the interest-rate derivative products markets as end-users, or intermediaries, or both. Over much of this period significant changes were made in the composition of bank portfolios. We find that banks which utilized interest-rate derivatives experienced greater growth in their commercial and industrial (C&I) loan portfolios than banks which did not use these financial instruments. This result is consistent with the model of Diamond (1984) which predicts that intermediaries' use of derivatives enables increased reliance on their comparative advantage as delegated monitors.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

During the 1980s and 1990s, interest-rate derivatives have provided banks with opportunities to manage their interest-rate exposure and to generate revenue sources beyond those available from traditional bank operations. As a result, banks have accumulated large positions in these off-balance sheet assets. At the same time that banks have become more active participants in the derivative products markets, their role as the main providers of credit has diminished. Previous research on credit accessibility has focused on determining the effects of bank financial conditions or capital requirements on the provision of credit.[1] By contrast, there is limited empirical research on the impact of bank use of derivative products on intermediation, despite banks' large positions in these financial instruments. This paper adds to this research by examining the effects of the use of interest-rate derivative products on the commercial and industrial (C&I) lending activity of U.S. commercial banks.

Our sample represents all FDIC-insured commercial banks with total assets in excess of $300 million as of June 30, 1985 having a portfolio of commercial and industrial loans. Using this sample, we extend extant models of C&I loan growth to include a measure of a bank's use of interest-rate derivatives and find that C&I loan growth is positively related to the use of interest-rate derivatives during the period from June 30, 1985 to December 31, 1992. These results suggest that interest-rate derivatives allow commercial banks to lessen their systematic exposures to changes in interest rates, thereby increasing their ability to provide more intermediation services.

Additionally, we find that this positive association holds for both swaps and exchange-traded futures contracts suggesting that either form of contract permits

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

management of systematic risk and that the observed demand for the customization features of swap contracts may address concerns beyond management of systematic risk. Consistent with previous research on C&I lending activity, we also find that a bank's C&I loan growth is positively related to its capital ratio and negatively related to its ratio of C&I loan charge-offs to total assets.

We interpret the positive relation between derivatives use and C&I loan growth as being consistent with the notion that derivatives markets allow banks to increase lending activities at a rate greater than they would otherwise. However, it is possible that a bank's C&I activity might affect its decision to use derivatives. We address the endogeneity between bank lending and derivatives activity in a number of ways. First, we replace the actual derivatives-use variables with instruments for derivatives use. These instruments are the predicted probabilities that institutions will use derivatives in a given time period. The probit specification used is based on Kim and Koppenhaver (1992).

Second, we estimate our base model of C&I loan growth for two subsamples of banks for which the derivatives and lending decisions are by construction unrelated. The first subsample contains banks that never used derivatives during the sample period. The second subsample contains banks that always used derivatives during the sample period. The coefficients from the subsample of banks which never used derivatives during our sample period are used to predict loan growth for a sample which began using derivatives during our sample period. We find that the base model underpredicts the C&I loan growth of banks choosing to use derivatives. Similarly, coefficients obtained from a

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

sample of banks which always used derivatives are used to predict loan growth for banks which halted derivatives use during our sample period. For these institutions, the base model overpredicts loan growth of banks choosing to stop using derivatives. Together these results offer further support that interest rate derivatives enable banks to increase the growth rates of their C&I loan portfolios.

Overall, our results suggest that the C&I loan portfolios of banks which use derivatives tend to grow faster than banks that do not use derivatives. Thus, excessive regulatory constraints on commercial banks' participation in derivative contracting may result in lower lending growth.

The remainder of this paper proceeds as follows. Section I describes the sample and data sources. The empirical specification for C&I lending is discussed in Section II. Section III discusses the empirical methodology. Section IV examines the association between banks' participation in derivatives and growth of credit extensions. Section V summarizes our main findings.

I. Sample description and data sources

A. Sample description

The sample of banks includes FDIC-insured commercial banks with total assets in excess of $300 million as of June 30, 1985. Of these institutions, we exclude those banks having no commercial and industrial loans. Our sample begins with 734 banks in June 1985 and ends with 480 in December 1992. A fraction of the banks were liquidated prior to the end of the sample period. These institutions are included in the sample

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

before liquidation, and are excluded from the sample for the periods after liquidation. Banks which merged during the sample period are included in the sample. Thus, construction of the sample produces no survival bias. Balance sheet data and information on banks' use of interest-rate derivative instruments are obtained from the *Reports of Condition and Income* filed with the Federal Reserve System.

B. Lending Activity

Because the accessibility of credit depends importantly on banks' roles as financial intermediaries, loan growth is a meaningful measure of intermediary activity.[2] We use C&I loan growth as a measure of lending activity because of its importance as a channel for credit flows between the financial and productive sectors of the economy.

Table 1 presents year-end data for bank lending activity for our sample banks for the 1985-1992 period. Data for four subsets of institutions classified by total asset size are also reported in panels B through D. While C&I loans account for a large fraction of loans in banks' portfolios, the average ratio of C&I loans to total assets, declined from about 19.0 percent at the end of 1985 to 14.2 percent at the end 1992 for the entire sample. Most of the decline occurred during the period from year-end 1989 to year-end 1992. As panels B through D report, this decline existed across different-sized banks with the largest decline occurring for banks having total assets in excess of $10 billion.

This downward trend in C&I lending, reported in Table 1, is consistent with the industry trend. Since the mid-1970s, there has been a decline in bank-intermediated credits. During the period from year-end 1974 to year-end 1992, the proportion of business loans in bank portfolios also has decreased from 21 percent to 16 percent of

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

total bank assets. Concurrently, banks' share of short-term business credit has declined substantially from 79 percent to 54 percent.[3] This significant decline in banking's share of total U.S. short-term nonfinancial business credit outstanding reflects increased competition for short-term business credit from nonbank credit suppliers such as finance companies. Further, rapid growth in the markets for commercial paper and other forms of "nonintermediated" debt during the 1980s and 1990s allowed many firms to bypass banks and sell debt securities directly in the open market.[4]

C. Interest-rate derivative products

During the period in which banks were becoming less important in the market for short- and medium-term business credit, they were becoming increasingly active in markets for interest-rate derivative instruments as end-users, as intermediaries, or as both. We examine two main categories of interest-rate derivative instruments: swaps and the aggregate of positions in futures and forward contracts.

Forward and futures contracts create an obligation to exchange a stated quantity of an asset on a specified date at a predetermined rate or price. Unlike forward contracts, futures contracts involve third parties which specify contract terms designed to mitigate their credit exposures. For example, unlike forward contracts which are settled at their termination, futures contracts are settled each day. Thus, one can think of a futures contract as a portfolio of daily forward contracts. Despite these differences, the effectiveness of forwards and futures contracts for adjusting exposures to market risk is very similar. Thus, reporting practices generally aggregate disclosures of these contracts. Following these reporting practices we treat forward and futures contracts as equivalent.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Interest-rate futures and forwards markets experienced substantial growth during the period from 1987 to 1991. The total face value of open interest in interest-rate futures reached $2.16 trillion, on a world-wide basis, at the end of 1991, nearly 483 percent higher than that at year-end 1987.[5] Within the U.S., the total face value of open interest in futures contracts climbed to $1.7 trillion for short-term interest-rate futures contracts and $54 billion for long-term interest-rate contracts by year end 1991. In terms of open futures positions, U.S. banks reporting to the Commodity Futures Trading Commission (CFTC) were most actively involved in short-term interest-rate futures contracts. Our sample of bank-reported positions account for 15 percent and 11 percent, respectively, of the long and short positions taken by all banks in short-term interest-rate futures contracts (BIS/Promisel, 1992).

In addition to interest-rate forwards and futures, banks also report their use of interest-rate swaps. In its simplest form, an interest-rate swap is an agreement between two parties that obligates each party to make payments based on the net of two interest rates at predetermined settlement dates. In a plain vanilla swap, one interest-payment stream is fixed, and the other is based on a floating-rate index such as the six-month London interbank offer rate (LIBOR). Interest rate payments are based on the same principal amount which itself is never exchanged, and therefore, is referred to as the notional principal amount.

Since the introduction of swaps in the mid-1980s, activity has increased dramatically. At year-end 1992, the total notional principal amount of U.S. interest-rate swaps outstanding was $1.76 trillion, about 225% percent higher than the amount in 1987

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

(International Swaps and Derivatives Association, ISDA). Of those swaps outstanding, 56% had maturities between one and three years. In contrast, only 10% had maturities of ten years or more.

Table 2 presents the notional principal amount outstanding and frequency of use of interest-rate derivatives by banks during the period from year-end 1985 to year-end 1992. As in table 1, data are reported for the entire sample of banks and for four subsets of banks sorted by total asset size.

As evidenced by the growth of the derivatives markets, banks increased their participation in the interest-rate derivatives market over the sample period. This increased use of interest-rate derivatives and the concurrent downward trend in lending activity reported in table 1 suggests the possibility that derivatives use might be a substitute for lending activity. We consider this hypothesis in our empirical analysis in Section IV.

Despite the growth in the frequency of use of both types of financial instruments, certain patterns emerge. First, during most sample periods, the fraction of banks using interest-rate swaps is greater than the percentage using interest-rate futures and forwards. At the end of 1985, 23.8 and 16.8 percent of banks reported using interest-rate swaps and futures-forwards, respectively. By the end of 1992, these percentages had nearly doubled to 44.6 and 30.6 percent, respectively. With the exception of banks with total assets exceeding $10 billion, most categories of banks showed a similar pattern. Of banks with total assets greater than $10 billion, over 90 percent reported using both types of financial instruments throughout the sample period. Swap dealers are included

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

in this group of banks. These dealers often use interest-rate futures-forward contracts to manage the net or residual interest-rate risk of their overall swap portfolios.[6] Table 2 also shows that banks with total assets greater than $10 billion report the highest average ratio of the notional amount of interest-rate swaps outstanding to total assets. However, reporting practices imply that these numbers are likely to overstate the actual positions held by these banks. Since dealer banks are likely to have offsetting swap transactions, reported notional amounts generally overstate actual market exposures.

Second, while the percentage of banks participating in the over-the-counter swap market has increased over time, the proportion of banks using interest-rate futures-forward contracts has fallen. This decline is most notable between year-end 1989 and year-end 1990. Finally, except for banks with total assets greater than $10 billion, less than 25 percent of the banks reported having positive positions in both interest-rate swaps and interest-rate futures and forwards.

II. A Specification for Intermediation

The association between banks' intermediation and their use of derivatives can be measured by examining the relationship between the growth in bank C&I loans and banks' involvement in interest-rate derivative markets. The first step in this analysis is the development of a testable specification for bank lending. Following Sharpe and Acharya (1992), we relate the change in C&I loans relative to the previous period total assets ($CILGA_{j,t}$) to a set of variables representing supply and demand factors ($x_{j,t-1}$) for bank j during period t. In order to allow for the impact of banks' use of derivative

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

instruments on loan growth, we also include various measures of participation in interest-rate derivative markets ($DERIV_{j,t}$) in the following regression specification:

$$CILGA_{j,t} = \frac{CIL_{j,t} - CIL_{j,t-1}}{A_{j,t-1}} = f(DERIV_{j,t}, x_{j,t-1}) \; . \qquad (1)$$

A. Traditional supply and demand factors

The literature on the determinants of bank lending suggests several possible supply and demand factors ($\mathbf{x}_{j,t-1}$). Sharpe and Acharya (1992), Bernanke and Lown (1992), among others, indicate that, because of capital requirements, banks' capital positions can influence the growth in bank loans. A bank with too little capital relative to required amounts could attempt to improve its capital position by reducing its size. One way a bank can do this is by decreasing its C&I loans. This strategy implicitly assumes that it is costly to issue equity and the supply of bank equity is not perfectly elastic. Thus, banks with weak capital positions are less able to increase their loan portfolios while fulfilling their regulatory capital requirements. In contrast, banks with stronger capital positions have greater capacity to expand loans and still meet regulatory requirements.

We include a measure of banks' capital-asset ratios (CARATIO) in the empirical specification for C&I loan growth to control for the effect of capital requirements on C&I lending activity. CARATIO is measured as the ratio of total equity capital to total assets at time t-1. If banks with low capital-asset ratios adjust their lending in order to meet some predetermined target capital-asset ratio, we would expect a positive relationship between CARATIO and C&I loan growth.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

The quality of a bank's loan portfolio is another factor which has been found to affect loan growth. Using C&I loan charge-offs as a proxy for loan quality, Sharpe and Acharya (1992) document that C&I loan quality is negatively related to C&I loan growth. Following Sharpe and Acharya (1992), we measure loan quality as the ratio of C&I loan charge-offs in period t-1 to total assets in period t-1 (CILCOFA).[7] Besides measuring good loan quality, a low charge-off ratio can also be indicative of a stronger economic activity in the region in which the bank operations. Finally, the ratio of C&I loan charge-offs to total assets could capture the impact of regulatory pressures on loan growth because regulators often apply pressure to banks to increase their rates of charge-offs. LDC and real estate loans are recent example. *Ceteris paribus*, each of these reasons suggest that banks with lower charge-offs should be viewed as financially stronger than banks with higher charge-offs. Subsequently, CILCOFA is expected to have a negative association with C&I loan growth.

As pointed out by Bernanke and Lown (1991) and Williams-Stanton (1996), regional economic conditions should influence bank C&I loan growth. Banks located in states with weak economic conditions are likely to have fewer profitable opportunities than banks located in states with stronger economies. We include the growth rate in state employment ($EMPG_{j,t-1}$) in the empirical specification as a proxy for local economic conditions, conditions which are not captured by the other explanatory variables. If state employment growth is a proxy for economic conditions, one would expect a positive relation between this variable and C&I loan growth, *ceteris paribus*.

B. Measures of derivatives activities

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

To determine the effect of derivatives on bank lending activity, our specification includes DERIV as a variable measuring bank participation in derivatives.[8] The coefficient on DERIV summarizes the impact of derivatives activity conditional on adequately incorporating the intermediating process in the remaining terms of the specification. Inclusion of this variable allows us to investigate whether derivatives activity is complementing or substituting for lending activity.

Diamond's (1984) model of the intermediary role of banks offers one explanation for why derivatives use and lending might be complements. In his model, banks optimally offer debt contracts to "depositors" and accept debt contracts from "entrepreneurs." Banks' intermediating roles stem from their ability to economize the costs of monitoring contracts issued by entrepreneurs. To access these economies, depositors must delegate monitoring to banks. However, delegation of monitoring results in incentive problems referred to as "delegation costs." These costs can be reduced through diversification, provisional on the independence of risks stemming from the contracts made between entrepreneurs and their banks. The presence of systematic risks in these loan contracts implies the usefulness of derivatives as a third form of contract. Diamond demonstrates the optimality of derivative contracts which enable banks to reduce their systematic risk levels. The use of derivative contracts to hedge systematic risks enables banks to obtain further reductions in delegation costs and, in turn, enables banks to intermediate more effectively. Diamond's (1984) model predicts that derivatives activity will be a complement to lending activity. Subsequently, we would expect a positive coefficient estimate on DERIV.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Alternately, the increase in derivatives documented in table 1 in conjunction with the decline in lending activity documented in table 2 suggests that banks might use derivatives as a replacement for their traditional lending activities. Bank revenues from participating in interest-rate derivative markets have two possible sources. One source of revenue comes from banks' use of derivatives as speculative vehicles. Gains from speculating on interest-rate changes would enhance revenues from bank-trading desks. A second source of income is generated when banks act as OTC dealers and charge fees to institutions placing derivative positions. Pursuit of either of these activities as replacements for the traditional lending activities of banks would imply that derivatives will be a substitute for lending. If these activities are substitutes, we would expect a negative coefficient on the DERIV variable.

Banks also participate in derivative markets as dealers acting as counterparties to intermediate customers' hedging requirements. In this capacity, dealers maintain a portfolio of customized swap contracts and manage the interest-rate risk of this portfolio using interest-rate futures contracts. The liquidity and relative ease with which futures positions may be reversed allows banks to effectively hedge the residual interest-rate risk in their OTC swap portfolios. Banks also may take positions in OTC swaps and exchange-traded futures contracts to exploit arbitrage opportunities between these two markets. To incorporate these dealer dimensions of the derivatives-usage question, we also estimate equation 1 using two additional measures to gauge banks' use of interest-rate derivatives: SWAPS which measures participation in swaps contracts and FUTURES which measures participation in futures and forward contracts.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

From the above discussion, a specification for equation 1 can be written as:

$$CILGA_{j,t} = \alpha_0 + \sum_{t=2}^{T} \alpha_t D_t + \beta_1 CARATIO_{j,t-1} + \beta_2 CILCOFA_{j,t-1} + \beta_3 EMPG_{t-1} + \beta_4 DERIV_{j,t} + \varepsilon_{j,t} \tag{2}$$

In equation 2, D_t is a time period indicator variable equal to unity for period t and zero otherwise; $e_{j,t}$ is an error term; other variables are as previously defined. In auxiliary specifications, participation measures for swaps and futures activity replace the $DERIV_{j,t}$ measure.

III. Empirical Methodology

If the decision to participate in derivatives is exogenous to the lending choices made by banks, an indicator variable for derivatives usage during each time period adequately captures participation in derivatives. However, it is quite possible that the decision to use derivatives may be made jointly with the C&I lending decision. Consequently, the specification of the DERIV variable requires attention.

A Hausman specification test was conducted to examine this exogeneity issue.[9] The test compares the coefficient and its standard error on the indicator variable measuring derivatives use with the coefficient and standard error on an instrumental variable for derivatives use. This instrumental variable was obtained from a probit specification based on Kim and Koppenhaver (1992). The null hypothesis rejected the exogeneity of the indicator variable at the 1% significance level. Consequently, an

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

instrument for derivatives participation was adopted.

Expected derivatives use is used as an instrument for derivatives participation. We estimate a probit specification for the probability that banks use derivatives for each sample date t. Predicted values from this specification provide probabilities of derivatives use by each bank. The probit specification used, which is the same one used in the above Hausman test, is based on Kim and Koppenhaver (1992). The explanatory variables included are: the log of bank assets, the net-interest margin, an indicator variable for whether the bank was dealer in derivatives, the capital to asset ratio, and the concentration ratio for each bank's primary market area. The test procedure of Kiefer (1981) was also conducted to determine whether derivatives use at time t is dependent on derivatives use at time t-1. The null hypothesis of no dependence was rejected at standard significance levels. To incorporate this dependence over time the first lag of the dependent variable was included in the probit specification.

As previously mentioned, the use of interest-rate derivative instruments by banks increased during the sample period. To incorporate this dynamic effect, we estimate pooled cross-sectional time series regression equations. However, estimation of equation 2 with pooled cross-sectional time series data using OLS is potentially inefficient because of the possibility of firm-specific differences in the error terms and a time-varying error term in the sample. To address this issue, we use the Chamberlain (1982, 1984) procedure. Specifically, we treat each period as an equation in a multivariate system. This allows us to transform the problem of estimating a single-equation model involving both cross-sectional and time series dimension into a multivariate regression with cross-

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

sectional data. By using this formulation, we can avoid imposing any *a priori* restrictions on the variance-covariance matrix, allowing the serial correlation and heteroskedasticity in the error process to be determined by the data.

In a further effort to deal with potential pooling issues, we also estimate equation 2 using cross-sectional regressions at each sample date. Coefficients from the thirty cross-section regressions were averaged. These averages are qualitatively the same as reported in table 3. Further, the means of these coefficients were more than two standard errors from zero indicating that our pooling procedures do not overstate the significance levels reported here.[10] In the discussion of the empirical results in the next section we focus on the pooled cross-sectional time series regressions.

IV. Empirical Results

A. Base model results

We estimate equation 2 to examine the determinants of C&I lending and the impact of derivatives on C&I lending activity. Table 3 reports the results of these pooled cross-sectional time series regressions using quarterly data from September 1985 to December 1992. Regression (1) of table 3 examines the impact of fundamental supply and demand factors on C&I lending activity. This regression serves as a benchmark for the examining the relation between derivatives use and C&I lending.

Overall, our representation of the intermediation process using traditional supply and demand factors is consistent with the results of prior research. C&I loan growth is significantly and positively related to beginning-of-period capital-asset ratios (CARATIO).

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

This result is consistent with the hypothesis that banks with low capital-asset ratios adjust their loan portfolios in subsequent periods to meet some target capital-asset ratio. Like Sharpe and Acharya (1992), we also find a significant and negative association between C&I loan charge-offs (CILCOFA) and C&I loan growth. This negative relation is consistent with the charge-off variable capturing the impact of regulatory pressures, a strong economic environment or both. C&I loan growth is statistically and positively related to the previous period's state-employment growth (EMPG). Banks located in states with stronger economic conditions, on average, experience greater C&I loan growth. Thus, one may interpret the negative coefficient on CILCOFA as capturing economic conditions (i.e., national) not captured by EMPG or the impact of regulatory pressures. Lastly, though not reported, the sum of coefficients on the time-period indicator variables is negative consistent with the decrease in lending activity reported in table 1.

B. Inclusion of the Derivatives-Participation Variables

Regressions (2) and (3) include different measures of derivatives activity. Column (2) reports our results using an instrumental variable for use of any type of interest-rate derivatives (DERIV). Column (3) reports results from a decomposition of the DERIV variable into instruments for use of interest-rate swaps (SWAPS) and futures (FUTURES) representing the use of interest-rate futures and forwards.

Comparing our derivatives-augmented regressions with the results for the base case, the coefficient estimates on CARATIO, CILCOFA, and EMPG are qualitatively similar to those in column (1). However, the coefficients on CILCOFA and EMPG are not

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

significant at usual levels.

Column 2 of table 3 indicates that banks using any type of interest-rate derivative, on average, experience significantly higher growth in their C&I loan portfolios. This positive relation is consistent with Diamond's (1984) model of financial intermediation in which interest-rate derivatives allow commercial banks to lessen their systematic exposures to changes in interest rates and thereby increase their ability to provide more C&I loans. Further, given this positive coefficient estimate, one may conclude that derivatives use, on net, complements the C&I lending activities of banks; that is, its complementarity with lending dominates the extent to which derivatives activity substitutes for bank lending.

As previously described, regression (3) decomposes the derivatives activity variable into participation in swaps (SWAPS) and futures-forward contracts (FUTURES) to examine the relative contributions of each type of derivatives activity in explaining C&I loan growth. The coefficient estimates on both SWAPS and FUTURES variables differ significantly from zero.

As a further check on the validity of our results, regression (4) considers the possibility of a spurious relationship. We augment the specification reported in column (3) by adding variables measuring other characteristics of financial institutions which may explain lending activity during the sample period. Adding these variables addresses the concern that spurious correlation between lending activity and participation in interest-rate derivatives that might be driven by unobserved correlations between the use of these financial instruments and these potentially omitted variables.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

We include the lagged dependent variable in the regression (LCILGA) to control for the possibility that the derivatives participation variable is proxying for growth potential. We include a control for a foreign-firm effect by including an indicator variable equal to unity if a bank is a subsidiary of a foreign financial institution (FOREIGN). In some cases, the operations of foreign banks are intended to facilitate the operations of their industrial firms (Japan). Hence, they can be expected to provide both loans and interest-rate derivatives to their customers, thereby inducing a positive coefficient. Our sample of banks includes dealer institutions, so we include a control for membership in the International Swaps and Derivatives Association (ISDA) to insure that the lending activity of this subsample of banks is not determining our results. DEALER is an indicator variable equal to unity if a bank is identified as swap dealer by the ISDA membership lists or listings published by Intermarket (1988, 1989), and zero otherwise.[11] Observations prior to 1988 were classified as dealers if the institution was included on the ISDA member list in 1988.

Column 4 of table 3 reports results from regressions controlling for spurious results. The coefficient on the foreign-bank variable is positive and moderately significant, suggesting that growth in the C&I lending of foreign-owned banks is greater than that for domestically owned institutions. The coefficient on the dealer variable is negative and significant, suggesting that dealer activities do substitute for lending activities. The coefficient on the lagged dependent variable is not significant, rejecting the high-growth explanation. With these controls for potential spurious results included, the coefficients on swaps and futures remain positive and significant, providing an indication of the

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

robustness of our results.

B. Further robustness tests

The above results indicate that C&I lending activity is positively related to banks' participation in the derivatives market. In this section, we examine the robustness of these results.

The positive coefficient on derivatives activity in the previous section might be explained as risk taking by banks. Banks attempting to increase their risk might increase their lending activity and at the same time take on speculative positions in the derivatives markets. Such behavior also would induce a positive coefficient between these two activities. However, if banks were pursuing this risk-taking strategy, it is reasonable to expect a greater number of failures by banks using derivatives. To examine this possibility, we test whether derivatives activity is a good predictor of bank failure. During our sample period, 55 banks failed or required FDIC assistance to merge with other institutions. This group represents 7.49% of the institutions in the initial period of the sample. Under the null hypothesis that interest-rate derivatives have no effect on bank failure, the percentage of derivative-using banks that failed should not exceed this 7.49% expected failure rate. However, we find that 6.18% of derivative-using banks failed, indicating a rejection of the null hypothesis. Moreover, this result implies that the percentage of banks that reported never using derivatives which failed exceeded the expected failure rate of 7.49%: a result which strengthens the conclusion that derivatives use by banks does not cause bank failure.

To more closely examine the concurrent use of derivatives and bank failures, this

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

experiment was repeated on a calendar year basis. Banks were categorized according to their derivatives use during each calendar year and the percentage failing during that year was compared with the expected failure rate. In only one year (1992) did the number of failed banks using derivatives exceed the expected number of failures under the null hypothesis of no effect. Overall, the results of these tests imply that bank failures cannot be predicted on the basis of interest-rate derivatives use. As bank failures should be related to their risk-taking activities, we conclude that derivatives are not being used to increase bank risk levels.

Traditionally, banks have viewed loans and securities as substitutable assets. Consequently, when loan growth strengthens because of banks' greater use of interest-rate swaps, anecdotal evidence suggests that banks would become less willing to hold securities. By, contrast, when loan growth is weak because of lower use of interest-rate swaps, banks will tend to hold more securities. Thus, an indirect effect of the positive impact of interest-rate swaps on loan growth is a negative relationship between the swap participation variable and growth of the security portfolio.

While not reported in the tables, we investigate this relationship and a significant negative association is found between the banks' use of swaps and the growth in banks' security portfolios during the sample period. Thus, interest-rate swaps lead to increased loan growth and decreased securities holding. This combination of results also does not support the use of swaps as speculative instruments. While increases in C&I loans by banks using derivatives are consistent with speculative activity, simultaneous declines in security portfolios are not. The reductions in securities portfolios are consistent with

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

banks' reduced needs to adjust the interest-rate sensitivity of their assets through adjustments in the composition of their most liquid assets, the security portfolio.

C. Examination of Out-of-sample Model Predictions

In the regressions presented in table 3, we used instrumental variables to control for the possibility that the lending decision and the decision to use derivatives were endogenous. As an alternative approach to deal with this potential endogeneity, we study the predicted lending behavior of bank subsamples classified by their participation in derivatives.

If banks' participation in derivatives leads to increases in their lending activity, then a predictive model based entirely on the traditional demand and supply determinants of intermediation--the capital ratio, loan charge-offs, economic conditions, and any secular trend--should underpredict the loan growth of banks choosing to use derivatives and overpredict the loan growth of banks choosing not to use derivatives. We classify the sample according to their decisions on the use of derivatives and estimate predicted lending growth for two subsets of sample banks. The "all-in" sample consists of those banks which used either swaps or futures throughout the sample period (3,282 observations). The "all-out" sample consists of those banks which used neither swaps nor futures at any point in the sample (11,653 observations). The base model for intermediation is estimated for each of these samples; that is, we estimate the following specification:

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

$$CILGA_{j,t} = \alpha_0 + \sum_{t=2}^{T} \alpha_t D_t + \beta_1 CARATIO_{j,t-1} + \beta_2 CILCOFA_{j,t-1} + \beta_3 EMPG_{t-1} + \varepsilon_{j,t} \tag{3}$$

By performing these two sets of regressions, we obtain two sets of coefficient estimates, one for the all-in sample and one for the all-out sample. To calibrate predicted loan growth for banks included in the all-in sample, the coefficient estimates from the all-out sample (those that never use derivatives during the sample period) are applied to the sample of all-in variables (those banks that use derivatives during the entire sample period). Average predicted loan growth (standardized by total assets) for the all-in sample is 0.0005. By contrast, average actual lending growth equals 0.0026. A paired comparison test for the difference between these averages yields a t-statistic of 4.72 indicating a statistically significant underprediction of lending activity by the base model of intermediation.

Similarly, when the all-in coefficient estimates are applied to the sample of the all-out variables, the average predicted loan growth for this latter set of banks is 0.0051, whereas the average actual loan growth for the all-out sample is 0.0012. These averages are statistically different at the one-percent level (t-statistic = -18.81). These results again indicate that participation in derivatives usefully predicts the extent of lending activity. Moreover, the results of both paired comparison tests are consistent with the panel regressions of section III. Each approach suggests that the loan portfolios of banks participating in derivatives grow faster than banks not participating in derivatives.

Another test is performed to determine the effect of bank-held derivatives on the

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

lending activity of institutions. Two samples are constructed using banks which utilized derivatives at some point during the sample period but not for the entire period. The first subsample includes institutions which did not use derivatives at the beginning of the sample period and later initiated the use of derivatives. The second subsample consists of banks using derivatives at the beginning of the sample period and at some later quarter stopped this activity. For each set of banks, cumulative prediction errors in loan growth are estimated as the difference between average predicted and average actual loan growth.

Specifically, the coefficients from the all-out sample (banks which used neither swaps nor futures) are applied to the fundamental intermediation variables of the institutions which began using derivatives to calculate their predicted loan growth. Average prediction errors are computed and then sorted by the number of quarters since the institution initiated its use of derivatives. The first quarter the institution used derivatives during our sample period is event date 0. On event date 0, the sample consists of 88 banks. Cumulated average prediction errors are calculated for the 41-quarter window surrounding the first quarter of derivatives use (i.e., from event date -20 through event date +20). Figure 1 plots these cumulative average predicted errors. Prediction errors are positive throughout the 41 event quarters, indicating underprediction of lending activity by the base regression. Further, the rise in cumulative average prediction errors occurring at event date zero indicates sharp increases in lending activity at and following the first quarter in which derivatives are used.

Similarly, average predicted loan growth is calculated for the banks using

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

derivatives at the beginning of the sample period and, at some point, stopped this activity using the all-in coefficient estimates. In this sample, event date 0 is the quarter in which derivatives activity stopped. On event date 0, the sample consists of 29 banks. Cumulative average prediction errors for this group of banks which are plotted in figure 2 are mostly negative. The results imply that banks which halted the use of derivatives were lending at rates well below those predicted by the levels of their fundamental intermediation variables. Further, the size of these prediction errors increases in the quarter that derivatives activity ceased and in the quarters following.

To assess the significance of user-to-nonuser or nonuser-to-user changes, the following procedure was adopted. The mean of prediction errors for each event date were standardized by their standard deviation for that event date. These standardized quantities were summed for the pre- and post-event periods. Assuming a normal distribution for the prediction errors, the difference between pre- and post-event sums is standard normal. These differences are: 2.02 for the nonuser-to-user sample of 88 institutions, indicating significance at better than the 5% level; and .70 for the user-to-nonuser sample of 29 institutions, not significantly different from zero. The results for the nonuser-to-user sample are consistent with the results reported in table 3: derivatives use is positively associated with growth in lending activity.

The results in this subsection are consistent with the conclusion that use of derivatives contracting is a predictor of increased lending activity. This, in turn, offers further support to our previous findings of a positive association between growth in lending activity and use of derivatives.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

VI. Summary and policy implications

Recent surveys on the derivatives markets report that banks are using financial derivative instruments to complement their traditional lending activities and to hedge risk-exposure resulting from their lending and deposit taking activities. The concerns of regulators, however, are that these derivative instruments substitute for lending, increase the riskiness of banks, and therefore, increase their reliance on federal deposit insurance and the Federal Reserve System's discount window.

The results presented in this paper demonstrate a positive association between the use of interest-rate derivative instruments and the growth in commercial and industrial loans. This positive correlation is consistent with the predictions of Diamond (1984) which shows that a bank can reduce the cost of monitoring contracts issued by their loan customers by holding a diversified portfolio. This model suggests that derivatives lead to a reduction in delegation costs which, in turn, provide incentives for banks to increase their lending activities.

Our results suggest that restrictive policies for banks' derivative activity have consequences for bank lending activity. The possibility that the use of interest-rate derivative instruments, in particularly OTC swaps, leads to higher growth rates in C&I loans implies that the recent calls to restrict bank participation in financial derivatives could increase the rate of declines in bank lending activity.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Endnotes

1. See Sharpe and Acharya (1992), Berger and Udell (1993), and Bernanke and Lown (1991).

2. See Kashyap, Stein and Wilcox (1991), Sharpe and Acharya (1992) and Bernanke and Lown (1991).

3. Data was obtained from various issues of the Federal Reserve Bulletin and refer to the last Wednesday-of-the-month series for all commercial banks in the U.S.

4. See Laderman (1991) and Rosengren (1990).

5. Interest-rate forward contracts are commonly referred to as forward rate agreements. Because these contracts are traded in the OTC markets, data on the growth of the market is not readily available.

6. See Group of Thirty (1993) for a discussion of the evolving role of financial institutions as dealers in the swap market.

7. As indicated, the loan charge-off variable comes under regulatory influence. To determine the relevance of this oversight, we also used provisions for loan losses. The results reported here were not affected.

8. Brewer, Minton and Moser (1994) use an indicator variable to measure derivatives participation. This approach raises an endogeneity question. In subsequent sections of this paper, we introduce an instrumental-variables approach to address these issues.

9. See Greene (1993), pp. 618-619.

10. As these results do not differ materially from those reported in table 3, they are not reported here. They are available on request.

11. Because the ISDA membership list only became available beginning the first quarter of 1987, the estimation covers the 1987:Q1-1992:Q4 sample period.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

References

Bank of International Settlements (BIS), 1992, "Recent Developments in International Interbank Relations". Report prepared by a working group established by the Central Banks of the Group of Ten Countries, chaired by L. Promisel, Basle.

Berger, Allen N. and Gregory F. Udell, 1993, "Did Risk-Based Capital Allocate Bank Credit and Cause a 'Credit Crunch' in the U.S?" paper presented at the Conference on Credit Allocation -- Theory, Evidence and History, Cleveland Ohio, October 1993.

Bernanke, Ben S. and Cara S. Lown, 1991, "The Credit Crunch," *Brookings Papers on Economic Activity*, 2:1991.

Boyd, John H. and David E. Runkle, 1993, "Size and Performance of Banking Firms: Testing the Predictions of Theory," *Journal of Monetary Economics* 31, pp. 47-67.

Brewer, Elijah III, Bernadette Minton and James T. Moser 1994, "The Effect of Bank-Held Derivatives on Credit Accessibility," *Proceedings* of the FRB Chicago 1994 Bank Structure Conference.

Buser, Steven, Andrew Chen, and Edward J. Kane, 1983, "Federal Deposit Insurance, Regulatory Policy and Optimal Bank Capital Structure," *Journal of Finance* 36, pp. 51-60.

Chamberlain, G., 1980, "Multivariate Regression Models for Panel Data," *Journal of Econometrics* 18, pp. 5-46.

Chamberlain, G., 1984, "Panel Data," in *Handbook of Econometrics*, vol II, Z. Griliches and M. Intriligator eds., pp. 1247-1318.

Diamond, Douglas W., 1984, "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies* 51, pp. 393-414.

Greene, William H. (1993), *Econometric Analysis* 2nd edition, New York: Macmillan Publishing Company.

Kashyap, Anil K., Jeremy C. Stein, and David W. Wilcox, 1991, "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance," Federal Reserve Board of Governors, Finance and Economics Discussion Series no. 154.

Kawaller, Ira, 1991, "A Swap Alternative: Eurodollar Strips" in *Interest Rates Swaps* Carl R. Beidleman, ed.

Kiefer, Nicholas M., 1982, "Testing for Dependence in Multivariate Probit Models," *Biometrika* 69, pp. 161-166.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Kim, Sung-Hwa and G. D. Koppenhaver, 1992, "An Empirical Analysis of Bank Interest Rate Swaps," *Journal of Financial Services Research*, pp. 57-72.

Laderman, Elizabeth S., 1991, "Determinants of Bank Versus Nonbank Competitiveness in Short-Term Business Lending," *Economic Review*, Federal Reserve Bank of San Francisco, 17-32

Merton, Robert C., 1977, "An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees: An Application of Modern Option Pricing Theory," *Journal of Banking and Finance* 1, pp. 3-11.

Minton, Bernadette A., 1994, "An Empirical Examination of U.S. Dollar Swap Spreads", working paper, University of Chicago.

Nadler, Daniel, 1991, Eurodollar Futures/Interest Rate Swap Arbitrage" in *The Handbook of Fixed-Income Securities*, Frank J. Fabozzi, ed.

Rosengren, Eric, S., 1990, "The Case for Junk Bonds," *New England Economic Review*, Federal Reserve Bank of Boston, 40-49.

Sharpe, Steven A. and Sankarshan Acharya, 1992, "Loan Losses, Bank Capital, and the Credit Crunch," Federal Reserve Board of Governors.

Sinkey, Joseph F., Jr. and David Carter, 1994, "The Derivatives Activities of U.S. Commercial Banks," *Proceedings of the 30th Annual Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago.

Williams-Stanton, Sonya (1996), "The Effects of Risk-Based Capital on Wealth and Risk-Taking in Banking," working paper, Ohio State University.

United States General Accounting Office, 1994, *Financial Derivatives: Actions Needed to Protect the Financial System*, Washington, DC: U.S. Government Printing Office.

White, Halbert, 1980, "Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica* 48, 817-838.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Figure 1: For banks which began the sample period not using derivatives and later initiated the use of such instruments. Prediction errors equal the differences between actual growth in C&I loans and the growth predicted based on coefficients estimated for banks which did not use derivatives. These differences are averaged across banks and accumulated beginning twenty quarters prior to their adoption of derivatives and for the twenty quarters following. The sample includes 88 banks at event period zero.

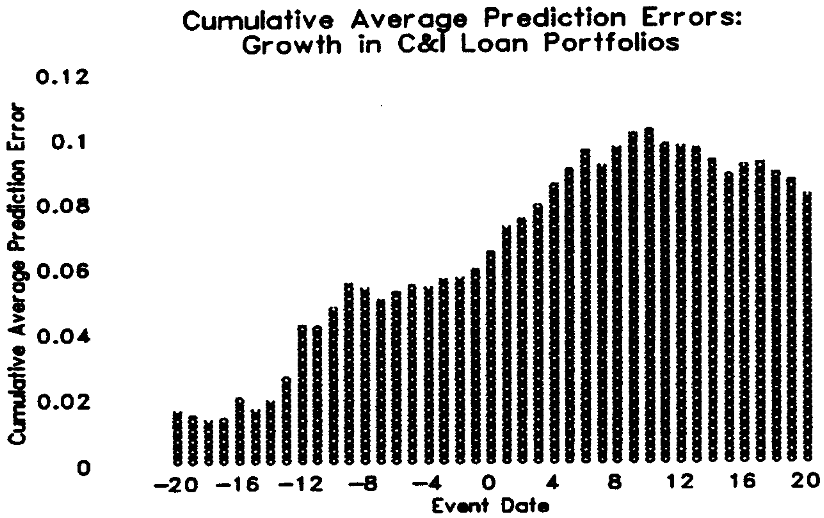
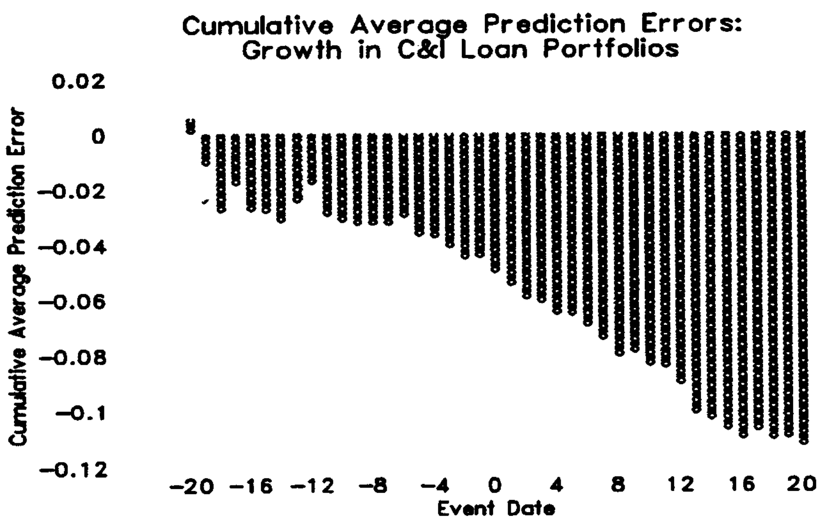


Figure 2: For banks which began the sample period using derivatives and later stopped using them. Prediction errors equal the difference between actual growth in their C&I loans and the growth predicted based on coefficients estimated for banks which did use derivatives. These differences are averaged across banks and accumulated beginning twenty quarters prior to their cessation of derivatives and for the twenty quarters following. The sample includes 29 banks at event period zero.



Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Table 1.

Lending activity for FDIC insured commercial banks with total assets greater than $300 million as of June 30, 1985. Year-end, 1985-1992.

Panel A: All Banks

	1985	1986	1987	1988	1989	1990	1991	1992
Avg. Total Assets	2,711.1	3,023.6	3,264.2	3,566.2	3,893.4	4,225.8	4,480.9	4,872.5
Avg. C&I Loans/Total Assets	0.1896	0.1868	0.1826	0.1829	0.1779	0.1704	0.1529	0.1424
No. of Obs.	727	694	652	611	586	550	518	480

Panel B: Total Assets < $500 Million

	1985	1986	1987	1988	1989	1990	1991	1992
Avg. Total Assets	394.42	401.02	402.52	407.13	412.16	407.30	408.39	405.36
Avg. C&I Loans/Total Assets	0.1760	0.1676	0.1541	0.1574	0.1405	0.1464	0.1432	0.1335
No. of Obs.	234	183	143	117	85	63	55	45

Panel C: $500 Million ≤ Total Assets < $1 Billion

	1985	1986	1987	1988	1989	1990	1991	1992
Avg. Total Assets	694.82	691.84	696.55	708.31	703.73	709.38	720.72	731.73
Avg. C&I Loans/Total Assets	0.1887	0.1829	0.1745	0.1698	0.1675	0.1514	0.1397	0.1294
No. of Obs.	192	195	187	169	168	161	153	131

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Panel D: $1 Billion ≤ Total Assets < $10 Billion

	1985	1986	1987	1988	1989	1990	1991	1992
Avg. Total Assets	2,910.98	2,974.33	2,986.22	3,145.21	3,222.03	3,283.19	3,379.99	3,287.55
Avg. C&I Loans/Total Assets	0.1940	0.1934	0.1934	0.1924	0.1864	0.1767	0.1518	0.1406
No. of Obs.	274	284	287	288	293	281	264	255

Panel E: Total Assets ≥ $10 Billion

	1985	1986	1987	1988	1989	1990	1991	1992
Avg. Total Assets	35,116.41	32,668.65	30,954.24	29,885.59	29,606.74	28,039.12	28,174.64	28,781.23
Avg. C&I Loans/Total Assets	0.2687	0.2618	0.2546	0.2494	0.2393	0.2328	0.2148	0.1956
No. of Obs.	27	32	35	37	40	45	46	48

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Table 2.

The use of interest-rate swaps and interest-rate futures by FDIC insured commercial banks with total assets greater than $300 million as of June 30, 1985. Year-end, 1985-1992

Panel A: All Banks

	1985	1986	1987	1988	1989	1990	1991	1992
Users of Swaps (%)	23.73	30.50	32.21	35.19	37.37	43.46	45.73	44.58
Avg. ratio to total assets[1]	0.0482	0.0631	0.0994	0.1297	0.1793	0.2014	0.2210	0.2565
Users of Futures/Forwards (%)	16.74	19.14	19.48	19.97	22.53	20.00	19.11	20.63
Avg. ratio to total assets[2]	0.0484	0.0536	0.0619	0.0920	0.1025	0.1924	0.3259	0.3059
Users of Both Swaps and Futures/Forwards (%)	11.39	14.10	14.72	15.39	16.89	16.36	16.22	17.29
No. of Obs.	727	694	652	611	586	550	518	480

Panel B: Total Assets < $500 Million

	1985	1986	1987	1988	1989	1990	1991	1992
Users of Swaps (%)	5.93	7.07	7.69	8.55	7.06	11.11	21.82	17.39
Avg. ratio to total assets[1]	0.0148	0.0199	0.0211	0.0372	0.0710	0.0531	0.0731	0.1048
Users of Futures (%)	2.54	1.63	2.80	0.00	1.18	0.00	0.00	0.00
Avg. ratio to total assets[1]	0.0254	0.0445	0.0430	0.00	0.0158	0.00	0.00	0.00
Users of Both Swaps and Futures (%)	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No. of Obs.	234	183	143	117	85	63	55	46

[1] Average ratio to total assets equals the ratio of the notional principal amount of outstanding swaps to total assets for banks reporting the use of swaps.
[2] Average ratio to total assets equals the ratio of the principal amount of outstanding futures to total assets for banks reporting the use of futures or forwards.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Panel C: $500 Million ≤ Total Assets < $1 Billion

	1985	1986	1987	1988	1989	1990	1991	1992
Users of Swaps (%)	9.90	16.41	14.97	17.16	13.69	22.36	23.53	23.66
Avg. ratio to total assets[1]	0.0390	0.0355	0.0257	0.0477	0.0549	0.0524	0.0779	0.1152
Users of Futures (%)	4.69	8.21	4.28	5.32	7.14	4.35	3.27	3.82
Avg. ratio to total assets[2]	0.0447	0.0120	0.0363	0.0194	0.0221	0.0242	0.0151	0.0457
Users of Both Swaps and Futures (%)	0.52	3.08	2.67	1.78	1.19	1.24	1.31	0.76
No. of Obs.	192	195	187	169	168	161	153	131

Panel D: $1 Billion ≤ Total Assets ≤ $10 Billion

	1985	1986	1987	1988	1989	1990	1991	1992
Users of Swaps (%)	41.24	47.89	47.39	48.26	51.20	54.09	54.55	50.20
Avg. ratio to total assets[1]	0.0364	0.0403	0.0509	0.0607	0.0801	0.0950	0.1216	0.1406
Users of Futures (%)	29.56	29.93	28.57	27.43	29.01	22.78	21.97	20.78
Avg. ratio to total assets[2]	0.0460	0.0445	0.0343	0.0382	0.0468	0.0571	0.1214	0.0844
Users of Both Swaps and Futures (%)	20.07	22.54	20.21	19.79	21.50	17.79	17.42	16.08
No. of Obs.	274	284	287	288	293	281	264	255

[1] Average ratio to total assets equals the ratio of the notional principal amount of outstanding swaps to total assets for banks reporting the use of swaps.
[2] Average ratio to total assets equals the ratio of the principal amount of outstanding futures to total assets for banks reporting the use of futures or forwards.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Panel E: Total Assets ≥ $10 Billion

	1985	1986	1987	1988	1989	1990	1991	1992
Users of Swaps (%)	100.00	96.88	100.00	100.00	100.00	97.78	97.83	97.92
Avg. ratio to total assets[1]	0.1215	0.2094	0.3714	0.4781	0.6392	0.7146	0.6933	0.6913
Users of Futures (%)	96.30	90.63	94.29	91.89	85.00	86.67	78.26	85.42
Avg. ratio to total assets[1]	0.0623	0.1042	0.1389	0.2361	0.2728	0.4448	0.6985	0.6238
Users of Both Swaps and Futures (%)	96.30	87.50	94.29	91.89	85.00	84.44	78.26	85.42
No. of Obs.	27	32	35	37	40	45	46	48

[1] Average ratio to total assets equals the ratio of the notional principal amount of outstanding swaps to total assets for banks reporting the use of swaps.
[2] Average ratio to total assets equals the ratio of the principal amount of outstanding futures to total assets for banks reporting the use of futures or forwards.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis

Table 3.

Univariate multiple regression coefficient estimates for the determinants of quarterly changes in C&I loans relative to last period's total assets. All regression equations contain time period indicator variables. Standard errors are corrected for heteroskedasticity by the method of Chamberlain (1982,1984). Sample period: 1985:Q3 to 1992:Q4.

Dependent Variable = Quarterly change in C&I loans relative to last period's total assets

Independent Variables	(1)	(2)	(3)	(4)
CARATIO	0.0524 (2.19)**	0.0625 (2.23)**	0.0622 (2.24)**	0.0607 (2.19)**
CILCOFA	-0.4420 (-2.59)***	-0.3810 (-1.64)	-0.3793 (-1.64)***	-0.3744 (-1.61)
EMPG	0.0363 (2.16)**	0.0285 (1.59)	0.0281 (1.56)**	0.0248 (1.38)
DERIV		0.0006 (4.04)***		
SWAPS			0.0002 (1.99)**	0.0003 (2.31)**
FUTURES			0.0004 (2.52)***	0.0005 (2.93)***
DEALER				-0.0049 (-2.61)***
FOREIGN				0.0197 (1.81)*
LAGGED CILGA				0.0090 (0.53)
Adj. R^2	0.0370	0.0374	0.0373	0.0379

The t-statistics in parentheses are starred if the regression coefficients are significantly different from zero at the 10 (*), 5(**) and 1 (***) percent level.

CARATIO = (Total Equity Capital$_{t-1}$)/(Total Assets$_{t-1}$). CILCOFA = (C&I Loan Charge-Offs$_t$)/(Total Assets$_{t-1}$). EMPG = (EMP$_{t-1}$ - EMP$_{t-2}$)/EMP$_{t-2}$, where EMP equals total employment in the state in which the bank's headquarters are located. DERIV, FUTURES, and SWAPS are instrumental variables obtained from a probit specification for participation in the indicated derivatives markets. DEALER is one if the institution is listed as an ISDA member, zero otherwise. FOREIGN is unity if the institution is a foreign-owned institution, zero otherwise. LAGGED CILGA is the first lag of the dependent variable.

Digitized for FRASER
http://fraser.stlouisfed.org/
Federal Reserve Bank of St. Louis