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The Effect of Bank-Held Derivatives on Credit Accessibility

Abstract

Since 1985 commercial banks have become active participants in the interest-rate derivative products markets either as end-users or as intermediaries or as both. Over this same period significant changes were made in the composition of bank portfolios. This paper investigates the relationship between the lending activities of individual banks and their participation in the interest-rate derivative markets. Banks which utilized over-the-counter (OTC) interest-rate swaps 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. Consistent with banks viewing loans and securities as substitutable assets, we also find that securities portfolio growth is negatively related to banks' use of OTC swaps. By contrast, the use of futures is associated with no change in C&I loan growth and a positive change in securities portfolio growth, suggesting futures contracts allow banks to better manage the interest-rate risk exposures in their securities portfolios.

I. Introduction

During the 1980s, the derivative products markets grew dramatically. From year-end 1986 to year-end 1991, the notional principal amount of outstanding contracts in exchange-traded derivative instruments increased 500 percent to $3.5 trillion from $583 billion.[1] During the same period, the notional principal amount in outstanding over-the-counter (OTC) financial instruments grew nine-fold to $4.45 trillion.[2] In both organized exchange and OTC markets, the growth in derivatives has been dominated by contracts based on interest-rates. These financial instruments provide banks with opportunities to manage their interest-rate exposure as well as opening 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, the role of bank intermediaries in the provision of credit has diminished. Previous research on credit accessibility focuses on determining the effects of bank financial conditions or capital requirements on the provision of credit.[3] 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 lending activity of

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[1]This number excludes options on individual stocks and derivatives involving commodity contracts. See Promisel/BIS (1992).

[2]These numbers include interest-rate swaps, currency and cross-currency swaps and interest-rate caps, floors and swaptions.

[3]See Sharpe and Acharya (1992), Berger and Udell (1993), and Bernanke and Lown (1991).

U.S. commercial banks.

Our paper begins by examining the relationship between banks' participation in the interest-rate derivative markets and lending activity. Consistent with Diamond's (1984) model of financial intermediation, we find that changes in commercial and industrial (C&I) loans are positively related to bank participation in OTC interest-rate swaps. By contrast, the use of exchange-traded, interest-rate futures contracts has no statistical impact on the growth in C&I loans, suggesting that customized swap contracts allow banks to better manage the interest-rate risk of their lending portfolios than do interest-rate futures contracts. We then expand the base model and examine whether the swaps variable could be serving as a proxy for other factors. Our primary conclusion is robust to these alternative specifications. We also find that our base model of intermediation underpredicts the loan growth of banks choosing to use derivatives and overpredicts the loan growth of banks not choosing to use derivatives further supporting the above result.

Since loans and securities are often viewed as substitutable assets, the above results suggest that the use of swaps may have an indirect effect on security growth. Hence, we investigate this possibility and find that growth of banks' securities portfolios is negatively related to their use of swaps. Thus, interest-rate swaps allow banks to hold more C&I loans and less securities. Lastly, in contrast to C&I loan growth, security growth is positively related to bank use of interest-rate futures.

Overall, our results suggest that commercial banks' use of OTC interest-rate swaps allows these banks to better manage the interest-rate exposure of their C&I loan portfolios. By contrast, interest-rates futures contracts allow banks to better manage the interest-rate exposure of their security portfolios. These results suggest that excessive regulatory constraints on participation in derivative contracting will result in lower lending growth.

The remainder of this paper proceeds as follows. Section II describes the sample and data sources. The methodology is discussed in Section III. Section IV examines the association between banks' participation in derivatives and growth of credit extensions. The relationship between banks' participation in derivatives and security portfolio growth is investigated in Section V. Section VI concludes the paper.

II. 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 for which commercial and industrial lending is not a primary line of business[4] and those for which total assets are reported as zero or missing. Our sample begins with 727 banks in June 1985 and ends with 478 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 before liquidation, and are excluded from the sample for the periods after liquidation. Banks which merged during the sample 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.

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[4]C&I lending is not considered a primary line of business if the reported value of C&I loans is zero. Generally these are commercial banks whose primary business line is credit-card operations.

B. Lending Activity

The accessibility of credit depends importantly on banks' roles as financial intermediaries. Thus, loan growth is a meaningful measure of intermediary activity.[5] Since the mid-1970s, there has been a decline in bank-intermediated credits. During the period from year-end 1974 to year-end 1992, banks' share of short-term business credit has declined substantially from 79 percent to 54 percent. Concurrently, the proportion of business loans in bank portfolios also has decreased. Such loans represented 16 percent of total bank assets at the end of 1992, down from 21 percent at the end of 1974.[6] This significant decline in banking's share of total U.S. short-term nonfinancial business credit outstanding reflects the increasingly competitive market for short-term business credit, as banks have lost market share to nonbank credit suppliers such as finance companies. In addition, rapid growth in the markets for commercial paper and other forms of "nonintermediated" debt during the 1980s and 1990s allowed firms to bypass banks and sell debt securities directly in the open market.[7]

Table 1 presents year-end data for bank lending activity for the 1985-92 period. Data for four subsets of institutions classified by total asset size are also reported. In general, and consistent with banks nationwide, the size of C&I loan portfolios as a percentage of total assets has declined annually since the end of 1985. While C&I loans account for a large fraction of loans in banks' portfolios, the proportion of C&I loans in bank portfolios declined

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[5]See Kashyap, Stein and Wilcox (1991), Sharpe and Acharya (1992) and Bernanke and Lown (1991).

[6]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.

[7]See Laderman (1991) and Rosengren (1990).

from about 19.0 percent at the end of 1985 to 14.3 percent at year-end 1992. Moreover, the decline between 1989 and 1992 is more than three times that from the end of 1985 to the end of 1989.

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 the markets for interest-rate derivative instruments as end-users or as intermediaries or as both. We use two measures to gauge banks' use of interest-rate derivative instruments: swaps and financial futures.

In its simplest form, an interest-rate swap is a bilateral agreement with a fixed maturity obligating counterparties to exchange a series of interest-rate payments of one configuration (e.g., fixed) for those of another configuration (e.g., floating). Interest rate payments are based on the same principal amount which is never exchanged, and therefore, referred to as the notional principal amount. On predetermined settlement dates, only net interest payments are exchanged between counterparties. In 1991, the notional principal amount of interest-rate swaps written was $1.62 trillion, nearly 350 percent higher than the amount in 1987, increasing the total notional principal amount outstanding to $3.065 trillion (Promisel/BIS, 1992).

Similar to the OTC market, interest-rate futures markets also 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 at year-end 1987. 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. 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. At year-end 1991, the institutions accounted for 15 percent and 11 percent, respectively, of the long and short positions taken by banks in short-term interest-rate futures contracts (Promisel/BIS, 1992).

More recently, banks have increasingly reported utilizing interest-rate derivative instruments as part of their asset/liability management (Group of Thirty, 1993 and Promisel/BIS, 1992). The variability of the market value of a bank's net worth depends on the relative interest-rate sensitivity of its assets and liabilities. This interest-rate sensitivity arises from differences in the maturity and repricing schedules of bank assets and liabilities. Traditionally, financial institutions managed their interest-rate risk through balance sheet restructuring. Since interest-rate swaps are negotiated between counterparties off financial exchanges, they can be highly customized contracts. Such customization makes swaps versatile interest-rate risk management tools. According to a recent market survey of the derivative markets, financial institutions use customized interest-rate swaps to manage the heterogenous interest-rate risk of their lending portfolios (Group of Thirty, 1993, and Promisel/BIS, 1992).

In contrast to the OTC market, financial exchanges require that the terms of interest-rate futures contracts be highly standardized. Because of this standardization, futures contracts may provide a better match for managing the interest-rate exposures found in banks' securities portfolios than that in their lending contracts. Unlike their heterogenous loan portfolios, banks' security portfolios tend to consist of a more homogenous set of assets. Furthermore, a large fraction of their security holdings are in U.S. government securities, the same securities which are the basis for many interest-rate futures contracts.

In addition to their roles as end-users in the OTC derivative markets, banks also participate in these 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. Lastly, banks' also may take positions in OTC swaps and exchange-traded futures contracts due to arbitraging anomalies between the OTC and futures markets. These three ways in which banks may participate in the interest-rate derivative markets have resulted in banks accumulating large positions in these off-balance sheet instruments.

Table 2 presents the notional principal amount outstanding and frequency of use of interest-rate swaps and futures during the period from year-end 1985 to year-end 1991. 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. 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. At the end of 1985, 23.8 and 16.8 percent of banks reported using interest-rate swaps and futures, 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. Included in this group of banks are dealers who use interest-rate futures contracts to manage the net or residual interest-rate risk of their overall swap portfolios.[8] Also, table 2 shows that the largest banks 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, the principal notional amounts of individual contracts will frequently be reported twice.

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 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. This suggests that while certain over-the-counter and exchange-traded instruments may have nearly identical cash flow patterns, they are not necessarily viewed as equivalent instruments by banks. Differences which may account for this include contract type (e.g., customized OTC products versus standardized futures contracts), counterparty credit risk, and accounting treatment of each instrument.

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

III. 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. Following Sharpe and Acharya (1992), the change in C&I loans relative to the previous period total assets ($CILGA_{j,t}$) is related to a set of variables representing supply and demand factors ($\mathbf{x}_{j,t}$) for bank j during period t. In order to allow for the impact of banks' use of derivative instruments on loan growth, various measures of participation in interest-rate derivative markets ($DERIVS_{j,t-1}$) are included in the specification; that is, we are interested in the following relationship:

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

In order to examine the impact of banks' use of interest-rate derivative products on lending activity, measures of the possible supply and demand factors are needed. The literature on the determinants of bank lending suggests several of these factors.

Sharpe and Acharya (1992), Bernanke and Lown (1992), among others, indicate that banks' capital positions can influence the growth in bank loans. We include a measure of banks' capital-asset ratios (CARATIO) in the empirical specification to control for the effect of capital requirements on credit. For example, banks with low capital-asset ratios may adjust their lending in order to meet some predetermined target capital-asset ratio. Such behavior suggests a positive relationship between CARATIO and C&I loan growth. CARATIO is measured as the ratio of total equity capital to total assets at time t-1.

The quality of a bank's loan portfolio is another factor which affects loan growth. Loan quality is measured by the ratio of C&I loan charge-offs in period t to total assets in period t-1 (CILCOFA). Sharpe and Acharya (1992) document that loan charge-offs explain cross-sectional variation in C&I loan growth in each of the four years from 1988 through 1991. In particular, they find that loan charge-offs are negatively related to C&I loan growth. A low ratio may be indicative of a stronger economic environment, and thus, can be associated with higher C&I loan growth. Alternately, the CILCOFA variable could capture the impact of regulatory pressures on loan growth. *Ceteris paribus*, both 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), 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. The growth rate in state employment, EMPG, is included in the following empirical analysis to represent local economic conditions which are not captured by the other explanatory variables. One would expect C&I loan growth to be positively related to the growth rate in state employment.

Given the above discussion, a specification for equation (1) can be written as:

$$CILGA_{j,t} = \alpha_0 + \alpha_d \sum_{t=2}^{T} \alpha_t D_t + \beta_1 CARATIO_{j,t}$$
$$+ \beta_2 CILCOFA_{j,t} + \beta_3 EMPG_{t-1} + \beta_4 DERIVS_{j,t} + \varepsilon_{j,t} \quad (2)$$

where D_t's are time-period indicator variables, and $\varepsilon_{j,t}$ is a stochastic error term. The time-period indicator variables are intended to control for any economy or market-wide shocks that vary over time.

The coefficient on DERIVS summarizes the impact of derivatives activity conditional on adequately incorporating the intermediating process in the remaining terms of the specification. We include two measures to gauge banks' use of interest-rate derivatives, SWAPS and FUTURES. SWAPS is an indicator variable equal to unity if a bank reports a nonzero notional value of swaps outstanding at time t-1 and zero otherwise. FUTURES is an indicator variable equal to unity if a bank reports a nonzero long or short position in interest-rate futures or forward contracts at time t-1 and zero otherwise. Inclusion of an indicator variable for each type of derivatives activity allows us to investigate whether these activities can be regarded as complements or substitutes for lending activity. Lagged values of these indicator variables are used to condition lending performance on the derivatives technology available throughout the period thereby reducing endogenous feedback effects. As table 2 indicates, the use of interest-rate derivative instruments increased during the sample period. To incorporate this dynamic effect, we estimate pooled cross-sectional time series regression equations.

In the regression analyses which follow, the standard errors of the regression estimates are corrected for heteroskedasticity by employing the White (1980) technique for panel data.

Specifically, following Chamberlain (1982, 1984), 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-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. This procedure does not affect the coefficient estimates.

IV. Lending activity and the use of interest-rate derivative products

A. Base model results

Table 3 reports the coefficient estimates of the determinants of C&I lending activity using quarterly data from September 1985 to December 1992. Regressions (1) and (2) of table 3 examine the impact of the fundamental supply and demand factors on C&I loan growth, whereas regressions (3) through (5) include the indicator variables measuring banks' use of interest-rate derivatives. Regression (1) includes only the capital and loan charge-off variables. Regression (2) augments the specification with the inclusion of the employment growth variable.

Overall, our representation of the intermediation process is consistent with the results of prior research. First, C&I loan growth is positively related to beginning-of-period capital-asset ratios. 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. Second, like Sharpe and Acharya (1992), we find a negative association between C&I loan losses and C&I loan growth. This result is consistent with the charge-off variable capturing the impact of regulatory pressures. Third, C&I loan growth is positively related to the previous period state employment growth. Banks located in states with stronger economic conditions, on average, experience higher 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 coefficients on the time-period indicator variables are all significantly negative. This indicates that the observed decrease in lending activity reported in Section II represents a secular trend.

Having modelled the fundamental intermediation process, we now investigate the impact that derivatives contracting has on this process. Diamond's (1984) model of the intermediary role of banks predicts that derivatives contracting will facilitate intermediation. His model characterizes the optimal forms of contracts used by these institutions. Banks optimally offer debt contracts to "depositors" and accept debt contracts from "entrepreneurs." The banks' intermediating role stems 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 which are referred to as delegation costs. These costs can be reduced through diversification, provisional on the independence of risks stemming from contracts made between entrepreneurs and 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 more effectively intermediate. Diamond's (1984) model predicts that derivatives activity will be a complement to lending activity.

Alternately, banks are thought to use derivatives as a replacement for their traditional lending activities. Bank revenues from derivatives have two sources. First, banks can use derivatives to speculate on future changes in interest rates. Gains on these speculative positions enhance revenues from bank trading desks. Second, banks operating as OTC dealers generate income by charging fees to institutions placing derivative positions. Pursuit of these activities as replacements for the traditional lending activities of banks would imply that derivatives constitute a substitute for lending. Thus, our specifications seek to determine whether bank derivative activities are best regarded as complements or substitutes for traditional banking activities.

Regressions (3) through (5) include our alternative indicators of derivatives participation. The coefficient estimates on CRATIO, CILCOFA, and EMPG are qualitatively similar to those in the first two regressions. As table 3 indicates, the change in C&I loans relative to last period's assets is significantly related to banks' use of OTC interest-rate swaps. Consistent with Diamond's (1984) model, commercial banks that use swaps, on average, experience statistically significant higher growth in their loan portfolios.

Unlike swaps, neither the use of futures or simultaneous use of both instruments by banks affects the growth of their C&I loan portfolios. This result combined with the higher frequency of use of swaps by banks suggests that banks view interest-rate futures and swaps as different instruments despite their nearly identical cash flows. Customized OTC swaps appear to allow banks to manage more effectively the interest-rate risk of the loan portfolio than interest-rate futures contracts. Future research using more detailed information about banks' positions in these instruments and the terms of their lending contracts is needed to further address this question.

B. Lending activity, swaps, and other characteristics of banks

The above results indicate that C&I lending activity is positively related to banks' participation in the OTC interest-rate swap market. In table 4, additional variables measuring other characteristics of financial institutions are added to the regression which may explain lending activity during the sample period. In particular, we test for whether banks' use of swaps is proxying for the growth of financial institutions during the sample period; bank size; or a foreign-firm effect. Adding these three variables eliminates the spurious correlation between lending activity and swap participation that might be driven by unobserved correlations between swap participation and these potentially omitted variables. For example, if the loan portfolios of large institutions tend to grow more rapidly than those of smaller institutions and if large banks are more likely to use swaps, the regressions in table 3 would find a spurious correlation between swap participation and lending activity. The regressions of this subsection are intended to rule out these spurious correlations.

We include the lagged dependent variable in the regression (LCILGA) to control for the possibility that the swap participation variable is proxying for growth potential. To control for the possibility that the use of swaps is proxying for bank size we include the natural logarithm of the total assets lagged four quarters (SIZE). Using the lagged value reduces the endogeneity problems that might arise from the joint determination of investment and the use of swaps. Lastly, we test for whether the use of swaps is proxying for a foreign firm effect by including an indicator 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 swaps to their customers, thereby inducing a positive coefficient.

Table 4 presents coefficient estimates of the determinants of C&I lending activity. In general, the results in table 4 are qualitatively the same as those presented in table 3. The change in C&I loans relative to last period's total assets is still significantly related to banks' use of interest-rate swaps in the previous year. However, the magnitude of the coefficient on the swaps variable declines slightly to 0.0009. C&I lending activity also is significantly associated with the size of the bank. Bigger banks, on average, experience larger increases in their loan portfolios than smaller banks. Overall, the results in table 4 provide additional support for the view that banks' use of OTC swaps allow them to decrease their delegation costs, and therefore, increase intermediation activity.

C. Examining the effect of decisions to use derivatives

If the decision to participate in derivatives is made jointly with bank lending decisions, constraints are needed to interpret the coefficients from the previous regressions. Our use of lagged values for the participation variables may not be adequate to resolve this endogeneity issue. In this subsection, we take an alternate approach and 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 fundamental 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. In this subsection, 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:

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

where variables retain their previous definitions. This procedure gives two sets of coefficient estimates, one for the all-in sample and one for the all-out sample. To calibrate predicted loan growth for the all-in sample, the coefficient estimates from the all-out sample are applied to the sample of all-in variables. 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-value 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. Average actual loan growth for the all-out sample is 0.0012. These averages are statistically difference at the one percent level (The t-statistic from this paired-comparison test is -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 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 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.

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.

V. Securities portfolio activity and the use of interest-rate derivatives

A. Base model results

In this section, we examine the impact of banks' use of interest-rate derivatives on the growth of their security portfolios. Traditionally, banks have viewed loans and securities as substitutable assets. Consequently, when loan growth strengthens because of banks' greater utilization 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 relation between the swap variable and securities portfolio growth. This conjecture is examined by estimating equation (2) using the current change in security holdings relative to previous period level of total assets (SECGA) rather than CILGA as the dependent variable and total loan charge-offs (TLCOFA) instead of CILCOFA. The results are presented in table 5.

As indicated in columns 1-3 of table 5, the change in a bank's security portfolio, on average, is negatively related to its use of interest-rate swaps. Thus, interest-rate swaps lead to increased loan growth and decreased securities holdings. This combination of results contrasts with use of swaps as speculative instruments. While increases in C&I loans by banks using derivative instruments are consistent with speculative activity, simultaneous declines in the securities portfolio are not. An alternative interpretation of this evidence is that banks use swaps to manage systematic risks present in their loan portfolios. The reductions in securities portfolios observed in our sample are consistent with banks' reduced needs to adjust durations through adjustments in the composition of their securities portfolios.

In contrast to the regressions presented in table 3, the results in columns 2-3 of table 5 indicate that banks' use of interest-rate futures tends to lead to greater security growth. Since a large fraction of banks' security portfolios is composed of U.S. Treasury securities, this result is consistent with banks' managing the interest-rate risk exposure of their security portfolio using interest-rate futures contracts.

B. Examining the effect of decisions to use derivatives

In this subsection, we examine the growth in securities portfolios for institutions which either used derivatives throughout our sample period or which never used derivatives. Paralleling the analysis performed in subsection IV.C, a predictive model is estimated for the growth in banks' securities portfolios. When the coefficients obtained from the all-in sample are applied to the variables of the institutions which did not use derivatives during the sample period, average predicted growth (normalized by total assets) for this latter sample of banks is 0.0065. In contrast, the actual growth for these institutions is 0.0052. The t-statistic for the paired comparison test is -3.87, indicating a significant difference between actual and predicted security growth.

Similarly, the coefficients obtained from the all-out sample are applied to the variables of the all-in sample to obtain predicted growth in the securities portfolios for banks which used derivatives throughout the sample period. Average predicted growth for these institutions is 0.0048 while the average actual growth is 0.0056. The 0.0008 difference between the average predicted and actual security growth is not statistically significant.

These comparisons suggest that use of derivatives significantly raises the growth rate of banks' securities portfolios. This is consistent with results reported in table 5: the sum of the three coefficients for derivatives activity in regression 3 is positive. Thus, while swaps activity is negatively related to securities growth; overall derivatives activity predicts higher growth. Further, the lack of a statistically significant difference between actual and predicted security growth for the derivative institutions implies that use of derivatives does not lead to shifts in the coefficients of our predictive model.

An additional test is performed to examine the effect of changes in bank policies on the use of derivatives. As reported in subsection IV.C, cumulative average prediction errors are calculated for the differences between actual and predicted growth in the securities portfolios for two subsets of banks: banks which began the sample period not using derivatives and later used these instruments; and the institutions which reported using derivatives at the beginning of the sample and later stopped. For the first set of banks, predicted security growth is estimated using the coefficients from the all-out sample. Cumulative average prediction errors for this sample of banks are graphed in figure 3. These errors are consistently positive and become greater at quarter -12. From event quarter -12 through the event quarter 4, these prediction errors remain nearly constant. After this point they rise slightly before leveling off.

For those institutions which began the sample period using derivatives, but subsequently ceased their use, predicted security portfolio growth is estimated using the coefficients from the all-in sample. Figure 4 plots these cumulative average prediction errors. Cumulative average prediction errors for this group are negative throughout, though their magnitudes vary considerably. Predicted growth exceeds actual growth in the quarters immediately surrounding the event quarter and in quarters near the end of the sample period. Neither of these patterns shed additional insight on determining the effect that changes in bank policy toward derivatives might have on their securities portfolios.[9]

[9]As a further robustness check, we estimate the effect of the use of derivatives on changes in total assets. The coefficient estimates on the indicator variables for derivative activity are not statistically different from zero.

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 swaps 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.

We further find that swap activity is negatively related to growth in banks' securities portfolios while futures activity is positively related to growth of these portfolios. With respect to swaps activity, the results may indicate that banks managing their asset durations with swaps have less need for securities holdings to manage their durations. Additional research is needed to establish this point. However, this negative association is inconsistent with the contention that banks use swaps to elevate their risk levels. The results with respect to futures activity suggest that banks use futures contracts to manage the systematic risks of their securities portfolios.

Our results suggest that restrictive policies for banks' derivative activity have consequences for bank investments. The possibility that the use of interest-rate 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.

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Figure 1: For banks which began the sample period not using derivatives, differences are computed between actual growth in their C&I portfolios 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.

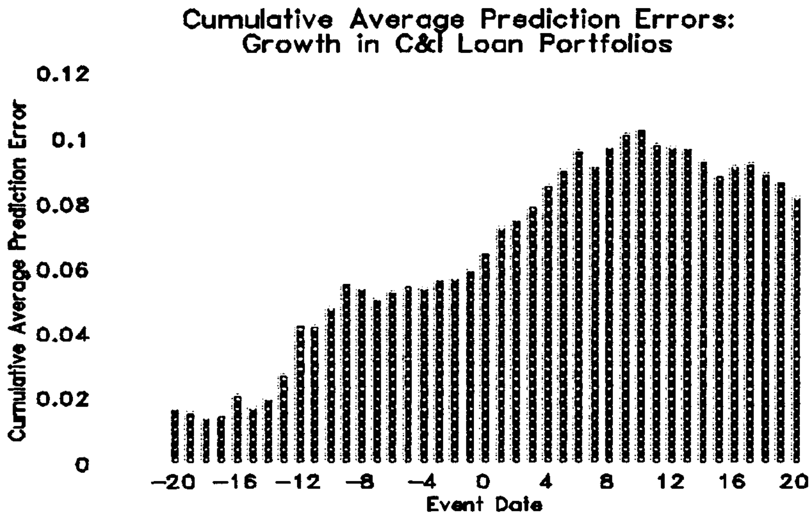

Figure 2: For banks which began the sample period using derivatives, differences are computed between actual growth in their C&I portfolios and the growth predicted based on coefficients estimated for banks which did use derivatives. These differences are averaged across banks and accumulated beginning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

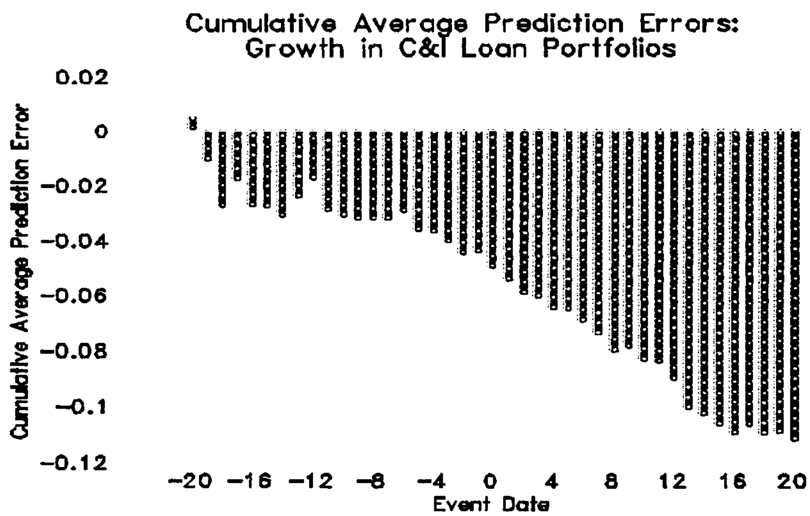

Figure 3: For banks which began the sample period not using derivatives, differences are computed between actual growth in their securities portfolios and the growth predicted based on coefficients estimated for banks which did not use derivatives. These differences are averaged across banks and accumulated beginning twenty quarters prior to their adoption of derivatives and for the twenty quarters following. The sample includes 88 banks at event period zero.

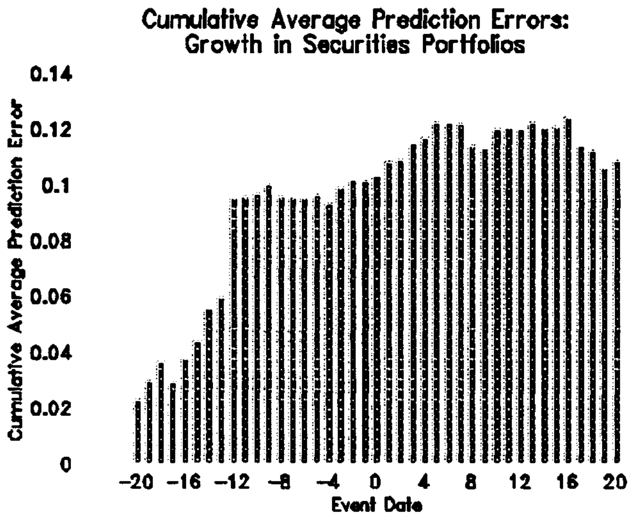

Figure 4: For banks which began the sample period using derivatives, differences are computed between actual growth in their securities portfolios and the growth predicted based on coefficients estimated for banks which did use derivatives. These differences are averaged across banks and accumulated beginning twenty quarters prior to their cessation of derivatives and for the twenty quarters following. The sample includes 29 banks at event period zero.

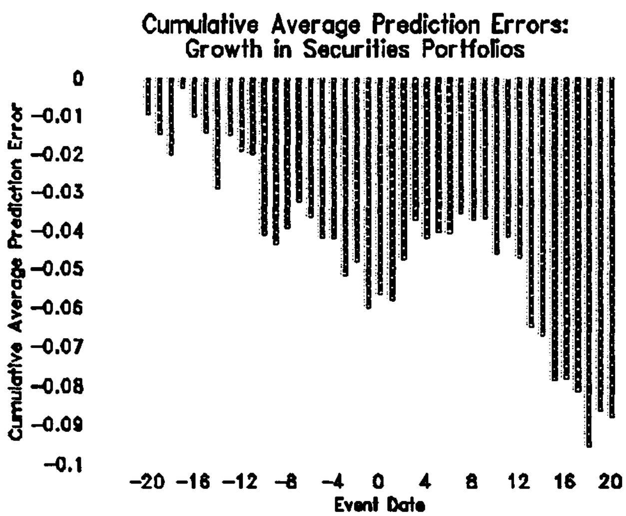

Table 1.

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	3,026.0	3,259.2	3,559.9	3,868.1	4,221.0	4,477.4	4,863.2
Avg. C&I Loans/Total Assets	0.1896	0.1867	0.1825	0.1827	0.1778	0.1702	0.1526	0.1427
Avg. Commercial Real Estate Loans/ Total Assets	0.0400	0.0435	0.0457	0.0465	0.0444	0.0394	0.0321	0.0260
Avg. Residential Real Estate Loans/ Total Assets	0.0900	0.0914	0.1044	0.1122	0.1204	0.1298	0.1373	0.1429
No. of Obs.	727	693	650	609	584	548	516	478

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
Avg. Commercial Real Estate Loans/ Total Assets	0.0400	0.0373	0.0338	0.0317	0.0283	0.0247	0.0230	0.0271
Avg. Residential Real Estate Loans/ Total Assets	0.1041	0.1011	0.1105	0.1160	0.1252	0.1293	0.1330	0.1109
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
Avg. Commercial Real Estate Loans/ Total Assets	0.0378	0.0423	0.0435	0.0451	0.0389	0.0368	0.0308	0.0274
Avg. Residential Real Estate Loans/ Total Assets	0.0960	0.1014	0.1201	0.1297	0.1376	0.1511	0.1553	0.1616
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
Avg. Total Assets	2,910.98	2,980.01	2,972.88	3,128.94	3,204.01	3,267.02	3,364.71	3,263.88
Avg. C&I Loans/Total Assets	0.1940	0.1931	0.1930	0.1902	0.1862	0.1764	0.1513	0.1404
Avg. Commercial Real Estate Loans/ Total Assets	0.0422	0.4833	0.0531	0.0531	0.0517	0.0438	0.03457	0.0255
Avg. Residential Real Estate Loans/ Total Assets	0.0772	0.0826	0.0958	0.1054	0.1140	0.1220	0.1318	0.1416
No. of Obs.	274	283	285	286	291	279	262	254

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	29,885.57	29,606.74	28,039.12	28,174.64	28,781.23
Avg. C&I Loans/Total Assets	0.2687	0.2044	0.2546	0.2494	0.2393	0.2328	0.2148	0.1956
Avg. Commercial Real Estate Loans/ Total Assets	0.0367	0.0433	0.0455	0.0482	0.0481	0.0433	0.0342	0.0240
Avg. Residential Real Estate Loans/ Total Assets	0.0486	0.0517	0.0657	0.0737	0.0852	0.1022	0.1136	0.1255
No. of Obs.	27	32	35	37	40	45	46	48

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 with Total Assets

	1985	1986	1987	1988	1989	1990	1991	1992
Users of Swaps (%)	23.78	30.45	32.00	34.98	37.33	43.43	45.74	44.56
Avg. ratio to total assets[1]	0.0482	0.0633	0.0997	0.1303	0.1792	0.2013	0.2214	0.2568
Users of Futures (%)	16.78	19.05	19.23	19.70	22.43	20.07	19.17	20.71
Avg. ratio to total assets[2]	0.0482	0.0540	0.0623	0.0926	0.1019	0.1942	0.3259	0.3059
Users of Both Swaps and Futures (%)	11.42	14.00	14.46	15.11	16.78	16.42	16.27	17.36
No. of Obs.	727	693	650	609	584	548	516	478

Panel B: Total Assets < $500 Million

	1985	1986	1987	1988	1989	1990	1991	1992
Users of Swaps (%)	5.98	7.10	7.69	8.55	7.06	11.11	21.82	17.78
Avg. ratio to total assets[1]	0.0148	0.0200	0.0211	0.0372	0.0710	0.0531	0.0731	0.1048
Users of Futures (%)	2.56	1.64	2.80	0.00	1.18	0.00	0.00	0.00
Avg. ratio to total assets[1]	0.0125	0.0445	0.0430	0.00	0.0158	0.00	0.00	0.00
Users of Both Swaps and Futures (%)	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No. of Obs.	234	183	143	117	85	63	55	45

[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.

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]	0.0296	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	47.70	47.02	47.90	51.20	54.12	54.58	50.00
Avg. ratio to total assets[1]	0.0364	0.0405	0.0507	0.0606	0.072	0.0941	0.1215	0.1402
Users of Futures (%)	29.56	29.68	28.07	26.92	28.87	22.94	22.14	20.87
Avg. ratio to total assets[2]	0.0391	0.0450	0.0343	0.0378	0.0452	0.0571	0.1214	0.0844
Users of Both Swaps and Futures (%)	20.01	22.26	19.65	19.23	21.31	17.92	17.56	16.14
No. of Obs.	274	283	285	286	291	279	262	254

[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.

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]	0.0554	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.

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). T-statistics are reported in parentheses. 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)	(5)
CARATIO	0.0442 (1.925)*	0.0442 (1.952)**	0.0518 (2.187)**	0.0518 (2.178)**	0.0517 (2.174)**
CILCOFA	-0.5359 (-3.807)***	-0.5290 (-3.771)***	-0.5254 (3.763)***	-0.5252 (-3.758)***	-0.5246 (3.757)***
EMPG		0.0383 (2.286)**	0.0388 (2.317)**	0.0388 (2.317)**	0.0385 (2.295)**
SWAPS			0.0014 (3.259)***	0.0014 (2.943)***	0.0016 (2.981)***
FUTURES				0.00006 (0.116)	0.0008 (1.152)
BOTH					-0.001 (-1.160)
Adj. R^2	0.0333	0.0336	0.0344	0.0343	0.0343
Mean of Dep. Var.	0.00168				
No. of Obs	18,065				

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.
SWAPS is a indicator variable equal to one if bank has positive position in interest-rate swaps in period t-1.
FUTURES is a indicator variable equal to one if bank has positive position in interest-rate futures or forward contracts in period t-1.
BOTH = SWAPS*FUTURES.

Table 4

Univariate multiple regression coefficient estimates for the determinants of the change in C&I loan growth relative to last period's assets. All regression equations contain time period indicator variables. Standard errors are corrected for heteroskedasticity by the method of Chamberlain (1982, 1984). T-statistics are reported in parentheses. Sample period: 1986:Q3 to 1992:Q4.

Dependent Variable = Change in C&I Loans relative to last period's total assets

Independent Variables	(1)	(2)	(3)
CARATIO	0.05512 (2.155)**	0.0534 (2.092)**	0.0553 (2.163)**
CILCOFA	-0.4780 (-3.278)***	-0.4770 (-3.269)***	-0.4778 (-3.276)***
EMPG	0.0405 (2.373)**	0.0405 (2.371)**	0.0404 (2.366)**
SIZE	0.0004 (1.884)*	0.0008 (3.029)***	0.0006 (2.300)**
LCILGA	0.0131 (0.810)	0.0134 (0.836)	0.0130 (0.805)*
SWAPS	0.0009 (1.724)*		0.00113 (2.045)**
FUTURES		-0.0006 (-1.019)	-0.00003 (-0.043)
BOTH			-0.011 (-1.090)
Adj. R^2	0.0337	0.0335	0.0338
Mean of Dep. Var.	0.00168		
No. of Obs	16,697		

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.
LCILGA = lagged asset deflated C&I loan growth.
SWAPS is a indicator variable equal to one if bank has positive position in interest-rate swaps in period t-1.
FUTURES is a indicator variable equal to one if bank has positive position in interest-rate futures or forward contracts in period t-1.
BOTH = SWAPS*FUTURES.

Table 5.

Univariate multiple regression coefficient estimates for the determinants of the change in total securities relative to last period's assets. All regression equations contain time period indicator variables. All regression equations contain time period indicator variables. Standard errors are corrected for heteroskedasticity by the method of Chamberlain (1982, 1984). Sample period: 1986:Q3 to 1992:Q4.

Dependent Variable = Change in total securities relative to last period's total assets

Independent Variables	(1)	(2)	(3)
CARATIO	0.0451 (2.469)**	0.0479 (2.592)***	0.0454 (2.464)**
TLCOFA	0.1310 (1.826)*	0.1309 (1.814)*	0.1347 (1.868)*
EMPG	0.0542 (1.884)*	0.0539 (1.877)*	0.0533 (1.852)*
SIZE	0.0002 (0.922)	-0.0004 (-1.478)	-0.0001 (-0.244)
LSECGA	0.0022 (0.140)	0.0021 (0.139)	0.0020 (0.895)
SWAPS	-0.0014 (-1.910)*		-0.0015* (-1.897)
FUTURES		0.0017 (1.930)*	0.0027* (2.182)
BOTH			-0.011 (-0.706)
Adj. R^2	0.0132	0.0132	0.0134
Mean of Dep. Var.	0.00537		
No. of Obs	16,697		

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$_{t-1}$).
TLCOFA = (Total 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.
LSECGA = lagged asset deflated change in total securities.
SWAPS is a indicator variable equal to one if bank has positive position in interest-rate swaps in period t-1.
FUTURES is a indicator variable equal to one if bank has positive position in interest-rate futures or forward contracts in period t-1.
BOTH = SWAPS*FUTURES.

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