The value of using interest rate derivatives to manage risk at U.S. banking organizations

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Introduction and summary

Commercial banks help their customers manage the financial risks they face. Of the risks that banks help to manage, one of the most important is interest rate risk. For example, suppose that we obtain a fixed rate mortgage from our bank. From our perspective, we have eliminated most of the interest rate risk associated with this mortgage. In reality the risk is shifted from us to the bank. Now, the bank that approved our fixed rate mortgage loan is subject to losses from changes in interest rates. These changes affect the costs to the bank of providing the mortgage. For example, if market interest rates rise, our mortgage payment to the bank is not affected because we have a "fixed" rate mortgage. However, the cost to the lending bank does increase unless it actively manages its cost. This rise in market interest rates increases the bank's funding costs, that is, the interest rate the bank pays on the money it uses to "fund" our mortgage loan.

Changes in funding costs are considered part of the interest rate risk associated with a fixed rate mortgage loan. Managing this interest rate risk is very important to the bank as it lessens the likelihood of extreme fluctuations in the bank's financial condition and thus decreases the probability of the bank becoming insolvent. Lessening the likelihood of insolvency allows the bank to hold less capital, as capital is the bank's first line of defense against insolvency. However, capital is expensive. Thus, interest rate risk management is valuable because it lessens the amount of expensive capital that a bank must hold.

A typical bank has several methods available to manage interest rate risk. For the purposes of this article, we focus on the use of certain interest rate derivative instruments (for example, interest rate swaps) to offset the inherent interest rate risk in fixed rate lending. An interest rate swap is a financial contract that allows one party to exchange (swap) a set of interest payments (say, fixed rate) for another set of interest payments owned by another party (say, floating rate).

This article examines the major differences in the financial characteristics of banking organizations that use derivatives relative to those that do not. Specifically, we address six research questions.[1] First, do banks that use derivatives also grow their business loan portfolio faster than banks that do not use derivatives? Our results suggest that they do. So, derivative usage appears to foster greater business lending, or financial intermediation.

Second, do banks that use derivatives to manage interest rate risk also have different risk profiles than nonusers? Our results suggest that they do. They tend to hold lower levels of (expensive) capital. This implies that derivative usage (and interest rate risk management in general) allows banks to substitute (inexpensive) risk management for (expensive) capital. Derivative users have higher balance-sheet exposure to interest rate risk. This is reasonable because interest rate derivatives provide them with an opportunity to hedge this balance-sheet exposure. Users tend to have lower insolvency risk, suggesting that derivative activity allows banking organizations to lower their risk or that low risk banking organizations are more likely to use derivatives.

Third, are large banks more likely to use derivatives? Our results strongly suggest that large banking organizations are much more likely than small banking organizations to use derivatives. This is in agreement with the idea that there is a fixed cost associated with initially learning how to use derivatives. Large banks

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are more willing to incur this fixed cost because they will more likely use a larger amount of derivatives. Thus, this fixed cost can be spread across more opportunities to actually use derivatives and thereby lower the average usage cost.

Fourth, does derivative usage negatively affect banking organizations' performance? Our results suggest that the performance of users is not better or worse than that of nonusers. Accounting-based measures of performance suggest that returns on assets and book equity are roughly the same for derivative users and nonusers. However, net interest margins are higher for nonusers than for users. A part of this margin could be nonusers' compensation for bearing interest rate risk. Banks charge their loan and deposit customers for providing interest rate intermediation services and assuming the associated interest rate risk. This fee is included in the difference between the loan rate charged and the deposit rate paid.

Fifth, are derivative users more efficient than nonusers? The results here are mixed. In the two smallest groups, users are less efficient than nonusers, while in the large banking organization category, users are not more efficient than nonusers.

Lastly, and perhaps most importantly, we ask whether derivative usage by commercial banks is associated with different sensitivities to stock market and interest rate fluctuations? Interestingly, our results imply that it is.

In the next section of this article we present some background on derivative usage and interest rate risk management by U.S. banking organizations. Next, we present an explanation of how the use of interest rate derivative instruments by banking organizations can complement lending strategies. We summarize some recent research on the relationship between lending and derivative usage of commercial banks. Then, we report some new results on the relationship between lending and derivative usage using a sample of bank holding companies that have both commercial banking and nonbanking subsidiaries. Finally, we examine the risk sensitivity of banking organizations' stock returns.

Measuring and managing interest rate risk

A typical U.S. bank has some floating rate liabilities (such as federal funds borrowings) and some fixed rate liabilities (such as certificates of deposit, or CDs). It will also have some floating rate assets (such as variable rate mortgages and loans and floating rate securities) and some long-term fixed rate assets (such as fixed rate mortgages and securities). Techniques for managing interest rate risk match the economic characteristics of a bank's inflows from assets with its outflows from liabilities. Early on, a bank matched the maturities of its assets and liabilities. More precise matching came later as banks began to look at the duration of assets and liabilities (we will discuss duration later in this section). U.S. commercial banks' need to match assets to liabilities arose from their strategic decisions regarding interest rate exposure. If the going forward changes in revenue from assets perfectly match the changes in expense from liabilities, then a rise or fall in interest rates will have an equal and offsetting effect on both sides of the balance sheet. In principle, perfect matching leaves a bank's earnings or market value unaffected by changes in interest rates. Alternatively, a bank can adjust its portfolio of assets and liabilities to make a profit when rates rise, but take a loss when rates fall. It could also position itself for the opposite. Realizing profits from changes in interest rates does represent a speculation and is risky, perhaps more risky than other profit opportunities.

In the past, banks typically had relatively fewer long-term fixed rate liabilities (such as CDs) than they had long-term fixed rate assets (such as loans). To make up for this shortfall, banks that wished to match assets and liabilities complemented their loan portfolios with fixed rate investments commonly called balancing assets, such as Treasury securities. By adjusting the characteristics of these balancing assets, a bank could better match the revenue inflows from its assets to the expense outflows from its liabilities.

Prior to the 1980s, most banks did not precisely measure their exposure to changes in interest rates. Instead, they generally avoided investing in longer maturity securities, feeling that these investments added undue risk to the liquidity of their investment portfolio. By the early 1980s, it had become clear to most bank management teams that measuring interest rate risk more precisely was a critical task. The second oil shock of the 1970s had increased the level and volatility of interest rates. For example, the prime rate soared to more than 20 percent in early 1980, twice the average for the 1970s and four times as large as the average in the 1960s. In 1980 alone, the prime rate rose to 19.8 percent in April, fell to 11.1 percent in August and rebounded to more than 20 percent in December. To determine their exposure to interest rate movements in this new, more volatile environment, many banks began measuring their *maturity gaps* soon after 1980.

Maturity gap analysis compared the difference in maturity between assets and liabilities, adjusted for their repricing interval. The repricing interval was the amount of time over which the interest rate on an individual contract remained fixed. For example, a three-year

loan with a rate reset after year one would have a repricing interval of one year. Banks grouped their assets and liabilities into categories, or "buckets," on the basis of their repricing schedules (for example, typical categories or buckets might be intervals less than three months, three to six months, six to 12 months, and more than 12 months). The maturity gap for each category was the dollar value of assets less the dollar value of liabilities in that category. If the bank made short-term floating-rate loans funded by long-term fixed rate deposits, it would have a large positive maturity gap in the shorter categories and a large negative maturity gap in the longer periods. Banks used these maturity gaps to predict how their net interest margin, or accounting earnings, would be affected by changes in market interest rates. For example, if interest rates dropped sharply, a large positive maturity gap for the short maturity buckets would predict a drop in interest income and therefore earnings, because the bank would immediately receive lower rates on its loans while still paying higher fixed rates on its deposits.

While the dollar maturity gap tool is a useful starting point to measure a bank exposure to interest rate risk, it is crude. Simplicity is its virtue; its drawback is that it focuses only on the impact of interest rate changes on accounting measures of performance rather than on market value measures of performance. It does not consider economic values prior to maturity or repricing dates. Because the precise timing of interest receipts and payments is important to the market valuation of assets and liabilities, bank began to use a concept called *duration* to measure their interest rate risk exposure.

This concept, first introduced by Frederick R. Macaulay in the pricing of the interest rate sensitivity of bonds, considers the timing of all cash flows both before and at the asset's or liability's maturity. Duration is defined as the present-value weighted time to maturity. The formula for duration is

$$D = \frac{\sum_{t=1}^{N} t PV(F_t)}{\sum_{t=1}^{N} PV(F_t)},$$

where D is duration, t is the length of time (number of months or years to the date of payment, $PV(F_t)$ represents the present value of payment (F) made at t, or $F_t/(1 + i)^t$, with i representing the appropriate yield to maturity, and $\sum_{t=1}^{N}$ is the summation from the first to the last payment (N).

Duration is an important measure of the average life of a security because it recognizes that not all of the cash flow from a typical security occurs at its maturity. Duration of a stream of positive payments is always less than the time until the last payment or maturity, unless the security is a zero-coupon issue, in which case duration is equal to maturity.[2] Duration also expresses the elasticity of a security's price relative to changes in the interest rate and measures a security's responsiveness to changes in market interest rates.

In the banking literature, a bank's exposure to interest rate risk is measured by the difference between the duration of assets, weighted by dollars of assets, and the duration of liabilities, weighted by dollar of liabilities. The larger this difference, or duration gap, the more sensitive is the bank's shareholder value to changes in interest rates.

If the duration gap is equal to zero, the shareholder value is protected against changes in interest rates. Thus, banks can hedge against uncertain fluctuations in the prices and yields of financial instruments by managing their loans and investments so that the asset duration, weighted by total assets, is equal to the liability duration, weighted by total liabilities. Because of the typical short duration of banks' liabilities and traditional emphasis on liquidity, banks often prefer short-duration to medium-duration assets.

If a bank accepts a liability, say, in the form of a deposit that is apt to be of short duration, it can offset that liability by lending for the same duration. In theory, the value of the asset and liability would be affected the same way by unanticipated changes in interest rates. The bank, presumably, is content to make its profit on the spread between the interest rate it pays on the liability and the rate earned on the asset.

To the extent, however, that banks try to match the durations of assets and liabilities, they can encounter conflicts between desired duration and opportunities for profits. This comes about when asset duration alters the duration of the existing portfolios, when the bank is unable to issue long duration liabilities, or when liquidity issues prevent needed adjustments. For greater flexibility and possibly greater profitability, most banks keep an approximate hedged position. Of course, once banks have obtained a more precise measure of their interest rate risk exposure, they can develop more precise strategies to manage it.

Interest rate risk management using derivatives

Most banks' evolving sophistication in managing interest rate exposure mirrored their sophistication in measuring it. In the early 1980s, most banks managed their exposure to interest rate risk by balancing the assets in their investment portfolio until they felt they had enough fixed rate investments to offset their fixed rate liabilities. By the mid-1980s, many banks shifted to

derivative instruments (specifically, interest rate swaps) to help manage their exposure to interest rate risk.

Since the mid-1980s derivative instruments have become an increasingly important part of the product set used by depository institutions to manage their interest rate risk exposure. As interest rates have become more volatile, depository institutions have recognized the importance of derivatives, particularly interest rate futures and interest rate swaps, in reducing risk and achieving acceptable financial performance. Many researchers have documented the effect of interest rate risk on the volatility of earnings and the ensuing adverse impact on the common stock returns of depository institutions (see Flannery and James, 1984; Scott and Peterson, 1986; Kane and Unal, 1988, 1990; and Kwan, 1991). In coping with interest rate risk, depository institutions may alter their business mix and move away from traditional lending activity to nontraditional activities. Deshmukh, Greenbaum, and Kanatas (1983) argue that an increase in interest rate uncertainty encourages depository institutions to reduce lending activities that entail interest rate risk and to increase fee-based activities (for example, selling derivative instruments or providing investment advice and cash management services) that do not entail interest rate risk. Derivative instruments may be useful to depository institutions because such instruments give firms a chance to hedge their exposure to interest rate risk, complementing their lending activities. However, the financial press during 1994 (Jasen and Taylor, 1994, and Stern and Lipin, 1994) widely reported that trading derivatives for profit is risky and may expose firms to large losses.[3]

In theory, the existence of an active derivative market should increase the potential for banking firms to attain their desired levels of interest rate risk exposure. This potential has been widely recognized, and the question that has arisen in consequence is whether banking firms have used derivatives primarily to reduce the risks arising from their other banking activities (for hedging) or to increase their levels of interest rate risk exposure (for speculation). This research examines the role played by interest rate derivatives in determining the interest rate sensitivity of bank holding companies' (BHCs) common stock, controlling for the influence of on-balance-sheet activities and other BHC-specific characteristics.

Because the accessibility of credit depends heavily on banks' role as financial intermediaries, loan growth is a meaningful measure of intermediary activity.[4] We use commercial and industrial (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.

Derivative usage may complement lending

Lending is the cornerstone of explanations for the role of banks in the financial services industry (Kashyap, Stein, and Wilcox, 1991; Sharpe and Acharya, 1992; and Bernanke and Lown, 1991). Modern theories of the intermediary role of banks describe how derivative contracting and lending can be complementary activities (Diamond, 1984). Banks intermediate by offering debt contracts to their depositors and accepting debt contracts from borrowers. Their lending specialization enables them to economize the costs of monitoring the credit standings of their borrowers. Depositors facing the alternatives of incurring monitoring costs themselves or supplying funds to banks can benefit from the monitoring specialization by delegating monitoring activities to banks.

Delegation of monitoring duties does result in incentive problems referred to as "delegation costs." Banks can reduce delegation costs through diversification of their assets. However, even after diversifying, banks still face systematic risks. Diamond demonstrates that derivative contracts enable banks to reduce their exposure to systematic risk. The use of derivative contracts to resolve mismatches in the interest rate sensitivities of assets and liabilities reduces delegation costs and, in turn, enables banks to intermediate more effectively. Diamond's (1984) model predicts that interest rate derivative activity will be a complement to lending activity. Subsequently, we would expect a positive relationship between derivative usage and lending.

Derivatives might also be used to replace traditional lending activities. To improve financial performance, a bank might alter its business mix and move away from traditional business lines. Bank revenues from participating in interest rate derivative markets have two possible sources. One source of revenue comes from use of derivatives as speculative vehicles. Gains from speculating on interest rate changes enhance revenues from bank trading desks. A second source of income is generated when banks act as over-the-counter (OTC) dealers and charge fees to institutions placing derivative positions. When either of these activities is used as a replacement for the traditional lending activities of banks, we can expect a negative relationship between derivative usage and lending.

Lending and derivative usage of commercial banks—Early empirical evidence

Brewer, Minton, and Moser (2000) examine the relationship between lending and derivative usage for a sample of Federal Deposit Insurance Corporation insured commercial banks. Figure 1 presents

year-end data for derivatives and bank lending activity for the sampled banks used in the Brewer, Minton, and Moser study. Figure 2 graphs data for banks with total assets greater than or equal to $10 billion. Both figures illustrate a decline in lending activity and a contemporaneous rise in derivative activity during the sample period.

For the full sample, 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 of 1992. Most of the decline occurred during the period from year-end 1989 to year-end 1992. As the figures suggest, the largest decline occurred in banks having total assets more than $10 billion.

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, intermediaries, or both. There are two main categories of interest rate derivative instruments: swaps and positions in futures and forward contracts.

Interest rate futures and forwards markets experienced substantial growth during the sample period. The total face value of open contracts in interest rate futures reached $1.7 trillion for short-term interest rate futures contracts and $54 billion for long-term interest rate contracts by year-end 1991.

In addition to interest rate forwards and futures, banks also use interest rate swaps. Since the introduction of swaps in the early 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 (International Swaps and Derivatives

Association, ISDA). Of those swaps outstanding, 56 percent had maturities between one and three years. In contrast, only 10 percent had maturities beyond ten years.
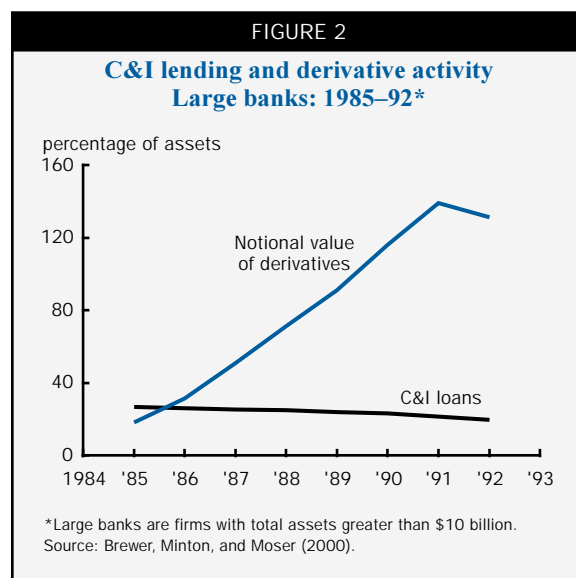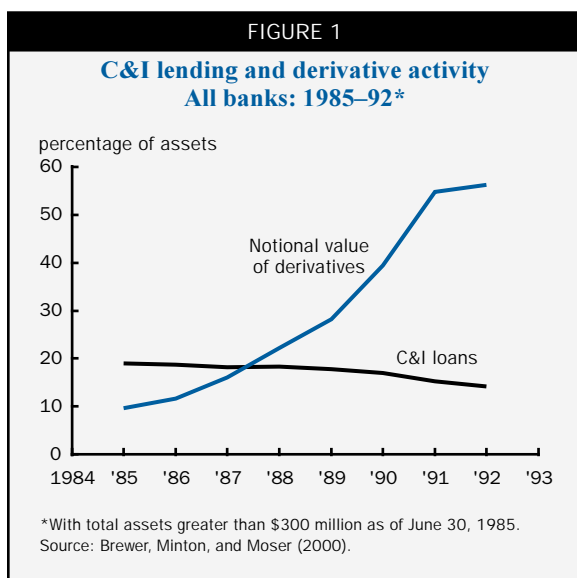
Figure 1 presents the notional principal amount outstanding of interest rate derivatives stated as a fraction of total assets from year-end 1985 to year-end 1992. Figure 2 reports the same ratio for banks with total assets greater than or equal to $10 billion.

As evidenced by the growth of the derivative markets, banks increased their participation in the interest rate derivative market over the sample period. This increased use of interest rate derivatives and the concurrent downward trend in lending activity depicted in figures 1 and 2 suggest that derivative use might be substituting for lending activity.

Empirical results

Brewer, Minton, and Moser estimate an equation relating the determinants of C&I lending and the impact of derivatives on C&I lending activity. The base model relates C&I lending to previous quarter capital to total assets ratio, C&I chargeoffs to total assets ratio, and the growth rate in state employment where the bank's headquarters is located. They add to the base model indicator variables for participation in any type of interest rate derivative contract.

In their base model results, C&I loan growth is significantly and 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. There is a significant and negative association between C&I

FIGURE 1

**C&I lending and derivative activity
All banks: 1985–92***

percentage of assets

Notional value of derivatives

C&I loans

*With total assets greater than $300 million as of June 30, 1985.
Source: Brewer, Minton, and Moser (2000).

FIGURE 2

**C&I lending and derivative activity
Large banks: 1985–92***

percentage of assets

Notional value of derivatives

C&I loans

*Large banks are firms with total assets greater than $10 billion.
Source: Brewer, Minton, and Moser (2000).

loan chargeoffs and C&I loan growth. This negative relation is consistent with the chargeoff 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. Banks located in states with stronger economic conditions, on average, experience greater C&I loan growth. Thus, one may interpret the negative coefficient on the chargeoffs variable as capturing market-wide economic conditions (that is, national) not captured by the employment growth variable or the impact of regulatory pressures.

The derivative-augmented regressions indicate 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 models 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 the net impact of derivative usage complements the C&I lending activities of banks. That is, the complementarity effect of derivative usage for bank lending dominates any substitution effect.

Some new results using a sample of bank holding companies

Financial characteristics of users and nonusers

We use a sample of BHCs that have publicly traded stock prices on June 30, 1986, the beginning of the first quarter in which BHC consolidated quarterly call reports of assets and liabilities (FR-Y9C) were filed with the Federal Reserve System. The sample begins with 154 BHCs in June 1986 and, because of failures and mergers, ends with 97 in December 1994. Balance-sheet data and information on banks' use of interest rate derivative instruments are obtained from the FR-Y9C reports. The sample of bank holding companies is sorted into three asset groups. There are 57 large BHCs, all of which have significant international banking operations and average total assets of more than $10 billion. The next group is labeled "mid-sized BHCs" and is made up of the 35 banking organizations with average total assets between $5 billion and $10 billion. The last group is referred to as "small BHCs" and consists of the 62 BHCs with average total assets less than $5 billion. At the end of 1986, the sample of BHCs had $1.9 trillion in total assets. Expressed as a percentage of the industry's total assets, sample BHCs constituted about 78 percent. By the end of 1994, the sample BHCs had $2.8 trillion in total assets (or 78 percent of total BHC assets).

For each quarter in the sample period, a BHC is labeled as a derivative user if it reported participation in any interest rate swap or futures-forward products on *Schedule HC-F* of the FR-Y9C report; otherwise it is labeled as a nonuser. Table 1 presents the notional principal amount outstanding and frequency of use of interest rate derivatives by BHCs during the period from year-end 1986 to year-end 1994. Data are reported for the three subsets of BHCs sorted by total asset size. Of BHCs with total assets greater than $10 billion, over 75 percent reported using both interest rate swaps and interest rate futures and forwards throughout the sample period. Swap dealers are included in this group of banking organizations. These dealers often use interest rate futures-forward contracts to manage the net or residual interest rate risk of their overall swap portfolios (Brewer, Minton, and Moser, 2000). Table 1 also shows that BHCs 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, the double counting referred to previously implies that these numbers overstate the actual positions held by these banking organizations. Since dealer institutions are more likely to have offsetting swap transactions, reported notional amounts generally overstate actual market exposures.

With the exception of 1987, over 50 percent of BHCs with total assets between $5 billion and $10 billion reported using both interest rate swaps and interest rate futures and forwards. On the other hand, less than 20 percent of BHCs with total assets less than $5 billion reported using both types of financial instruments. At the end of 1986, 30.6 percent of small BHCs reported using interest rate swaps and the same percentage reported using futures-forwards. By the end of 1994, these percentages were 48.5 percent and 24.2 percent, respectively.

Table 2 provides financial characteristics for derivative users and nonusers by asset categories. We use this information to highlight some of the differences between users and nonusers. Across all size categories derivative users tend to be on average larger than nonusers. For example, the average size of a representative nonuser in the small BHC category is $2.1 billion, while that of a user is $3.2 billion. The difference of $1.1 billion is statistically significant (at the 1 percent level). The average sizes of a representative nonuser and user in the mid-sized category are $6.1 billion and $7.3 billion, respectively. Nonusers in the large BHC category are less than one-third as large as users. Thus, relatively larger BHCs tend to make greater use of interest rate derivatives than smaller institutions.

Interest rate derivative activities for BHCs, year-end 1986–94

	1986	1987	1988	1989	1990	1991	1992	1993	1994
Bank holding companies with total assets < $5 billion									
Users of swaps (%)	30.64	27.12	34.54	30.91	31.37	31.91	35.71	44.44	48.48
Avg. ratio to total assets[a]	0.0299	0.0313	0.0284	0.0505	0.0514	0.0351	0.0346	0.0520	0.0514
Users of futures/forwards (%)	30.64	28.81	27.27	30.91	29.41	25.53	26.19	27.78	24.24
Avg. ratio to total assets[b]	0.0307	0.0221	0.0148	0.0218	0.0215	0.0362	0.0216	0.0230	0.0133
Users of both swaps and futures/forwards (%)	16.13	13.56	16.36	16.36	13.72	14.89	14.29	16.67	18.18
No. of observations	62	59	55	55	51	47	42	36	33
Bank holding companies with total assets > $5 billion but < $10 billion									
Users of swaps (%)	71.43	73.53	78.79	74.19	79.31	81.48	80.00	79.17	91.67
Avg. ratio to total assets[a]	0.0187	0.0236	0.0234	0.0228	0.0248	0.0282	0.0426	0.0811	0.0773
Users of futures/forwards (%)	60.00	55.88	57.58	64.52	62.07	59.26	64.00	66.67	62.50
Avg. ratio to total assets[b]	0.0247	0.0177	0.0290	0.0324	0.0303	0.0877	0.0367	0.0624	0.0709
Users of both swaps and futures/forwards (%)	51.43	47.06	51.51	51.61	51.72	51.85	56.00	58.33	62.50
No. of observations	35	34	33	31	29	27	25	24	24
Bank holding companies with total assets > $10 billion									
Users of swaps (%)	85.96	88.89	92.00	98.00	95.92	95.65	95.45	100.00	100.00
Avg. ratio to total assets[a]	0.1223	0.2118	0.2820	0.3836	0.4379	0.4929	0.5459	0.6434	0.8005
Users of futures/forwards (%)	91.23	85.18	90.00	86.00	79.59	82.61	86.36	90.48	82.50
Avg. ratio to total assets[b]	0.0634	0.0770	0.1376	0.1746	0.3768	0.3868	0.4825	0.5709	0.6986
Users of both swaps and futures/forwards (%)	80.70	77.78	86.00	86.00	79.59	82.61	86.36	90.48	82.50
No. of observations	57	54	50	50	49	46	44	42	40

[a]Average ratio to total assets equals the ratio of the notional principal amount of outstanding swaps to total assets for bank holding companies reporting the use of swaps.
[b]Average ratio to total assets equals the ratio of the principal amount of outstanding futures to total assets for bank holding companies reporting the use of futures or forwards.
Source: Authors' calculations using Federal Reserve FRY-9C data.

An important reason why managing interest rate risk through derivatives may be preferable to balance-sheet adjustments using securities and loans is that the former lessens the need to hold expensive capital. Capital protects the liability holders and institutions that guarantee those liabilities. Federal deposit insurers are especially important guarantors of bank liabilities. In addition, capital imposes discipline by putting owners' funds at risk. Regulators set minimum capital requirements.[5] Most BHCs chose their actual capital levels to satisfy the capital guidelines plus a buffer of excess capital. Capital buffers reduce the chance that

a banking firm will be forced to raise additional capital due to weak earnings performance. If a derivative position that allows banking firms to hedge against unanticipated changes in interest rates can negatively affect earnings, then users could hold less capital relative to assets than nonusers. This is because the gains or losses on the balance-sheet position as a result of unanticipated changes in interest rates are offset by losses or gains on the derivative position. For all size categories of BHCs, the average book capital ratios are higher for nonusers than for users. Nonusers' capital ratios are 39 basis points, 100 basis points, and 34

basis points higher than those of users for small-, mid-, and large-size BHCs, respectively. These differences are significant at conventional statistical levels. More importantly for banking institutions, they imply substantial reductions in cost.

When users are sorted into capital categories using the leverage ratio of 5.5 percent of total assets as the regulatory minimum, an interesting pattern emerges.[6] About 51 percent of the observations for small BHC users are less than 200 basis points above the 5.5 percent guideline. For small nonusers, about 45 percent of the observations are less than 200 basis points above the guidelines. On the other hand, approximately 31 percent and 40 percent of the users' and nonusers' observations, respectively, show capital ratios more than 200 basis points above the 5.5 percent guideline. A similar pattern is observed for mid-sized banks. The percentages of the observations with capital ratios no more than 200 basis points above the guidelines are 68 percent and 20 percent for mid-sized BHC users and nonusers, respectively. The percentages of the observations with capital ratios greater than 200 basis points above the guidelines are 23 percent and 71 percent for users and nonusers, respectively. Because over 95 percent of large BHC observations are for derivative users, we were not able to meaningfully sort them into different capital categories. Nevertheless, the results for the two smaller banking categories suggest that derivative usage affords banking organizations the opportunity to operate with less excess capital than they otherwise would need.

Because derivative usage allows BHCs to cope with interest rate risk, BHCs may decide to hold more loans to earn more income from their lending activity. This activity involves services in which the banking subsidiaries of BHCs have a comparative information advantage. For example, banking subsidiaries are often perceived as having a comparative advantage over other intermediaries in the loan market because they have special access to timely information about their loan customers since they clear customers' transactions. Deposit accounts provide early warning of deterioration in borrowers' cash flows. By monitoring the total amount of checks clearing through the bank, the banker can gauge a client's sales relatively accurately without waiting for quarterly reports from accountants. If derivative usage allows banks to reduce interest rate exposure and expand their lending activity, which entails default risk, then users should have higher loan to asset ratios. Table 2 shows that nonusers have higher loan to asset ratios than users. For instance, the average small nonuser had 61 cents of each dollar of assets invested in loans, while the average small

user had 59 cents of each dollar of assets in loans. A similar pattern is evident at the other two groups of BHCs. The difference is significant at all BHCs. One factor acting to raise the loan to asset ratios of nonusers relative to users is the higher capital ratio at the former institutions.

If, as is often perceived, loans are illiquid and subject to the greatest default risk of all bank assets, then nonusers are more exposed to loan losses than users. Because the ratio of loans to total assets measures the corrosive effect of potential loan losses on assets and equity, a high ratio could have a negative effect on the level of earnings and the volatility of earnings. The ability to use derivative instruments to reduce the volatility of earnings is another justification for their use by BHCs. A BHC that has a high volatility of earnings tends to have low debt capacity and high probability of failure. High earnings volatility increases the chances that earnings will fall below the level needed to service the BHC's debt, raising the probability of bankruptcy. Derivative usage can lower earnings variability. A reduction in earnings variability should improve debt capacity and reduce the probability of bankruptcy. The volatility of equity returns is frequently used to proxy for earnings volatility. Higher volatility of equity implies greater risk, and lower volatility of equity implies less risk. With the exception of the large BHC category, table 2 shows that volatility of equity is higher for nonusers than for users. However, this difference is statistically significant only for small BHCs. Consistent with the higher loan to asset ratio, the higher volatility of equity suggests, at least for small BHCs, that nonusers tend to be on average riskier than users. But the higher capital ratios at nonusers tend to mitigate the effects of these factors.

To capture the probability of bankruptcy more directly and the possibility that losses (negative earnings) will exceed equity, we employ an insolvency index used in the banking literature (see Brewer, 1989). See box 1 for a discussion of this measure of risk. Table 2 indicates that only small BHCs realize a significant difference in the insolvency index between nonusers and users. Nonusers have an insolvency index, the Z-score, of 51.3, compared with 57.9 for users. It seems, then, that small users tend, ex ante, to pose less risk than small nonusers to investors and insurers. The insolvency index is roughly the same for both nonusers and users in the mid-sized BHC category. While large nonusers have a lower probability of insolvency than large users, the difference is not significant.

A banking organization's risk profile is also reflected in its interest rate risk exposure as measured

TABLE 2

Univariate tests of financial characteristics and derivative usage, 1986–94

	Small BHCs			Mid-sized BHCs			Large BHCs		
	Nonusers	Users	T-ratio	Nonusers	Users	T-ratio	Nonusers	Users	T-ratio
Size									
Total assets ($ billions)	2.09	3.23	–17.04 (0.0001)	6.14	7.27	–6.02 (0.0001)	12.98	39.92	–15.03 (0.0001)
Capitalization									
Book capital/total assets	0.0721	0.0682	3.76 (0.0002)	0.0779	0.0679	3.72 (0.003)	0.0664	0.0630	2.10 (0.0400)
Capital category (percent)									
Less than or equal to 5.5%	15	17	—	9	9	—	—	—	—
Between 5.5 and 7.5%	45	51	—	20	68	—	—	—	—
Greater than 7.5%	40	31	—	71	23	—	—	—	—
Market capital/total assets	0.0908	0.0939	–1.40 (0.1624)	0.1257	0.0881	6.89 (0.0001)	0.0708	0.0767	–1.99 (0.0511)
Risk									
Loans/ total assets	0.6062	0.5878	3.55 (0.0004)	0.6545	0.6330	3.62 (0.0004)	0.6400	0.6200	2.87 (0.0052)
Loan loss allowance/ gross loans	0.0193	0.0199	–1.03 (0.3020)	0.0176	0.0191	–1.27 (0.2056)	0.0157	0.0265	-6.88 (0.0001)
Dollar maturity gap/ total assets	0.0638	0.0876	–2.28 (0.0226)	0.0942	0.0601	2.34 (0.0210)	–0.0207	0.0542	–5.64 (0.0001)
Standard deviation of daily stock returns	0.0253	0.0229	2.62 (0.0088)	0.0188	0.0167	1.23 (0.2216)	0.0166	0.0181	–0.90 (0.3711)
Z-score	51.3814	57.9317	–5.52 (0.0001)	71.6853	70.7329	0.42 (0.6762)	73.2001	66.5701	1.96 (0.0547)
Profitability									
Return on assets	0.0042	0.0039	0.64 (0.5217)	0.0045	0.0048	–0.31 (0.7572)	0.0045	0.0044	0.09 (0.9293)
Return on equity	0.0442	0.0645	–0.88 (0.3793)	0.0603	0.0639	–0.09 (0.9291)	0.1329	0.0614	1.25 (0.2161)
(Gross interest income – gross interest expense)/total assets	0.0245	0.0234	2.20 (0.0279)	0.0237	0.0230	0.74 (0.4628)	0.0240	0.0214	1.81 (0.0750)
(Noninterest income – noninterest expense)/total assets	–0.0157	–0.0142	–3.85 (0.0001)	–0.0125	–0.0128	0.51 (0.6110)	–0.0149	–0.0109	–4.30 (0.0001)
Efficiency ratio	0.3964	0.4067	–2.19 (0.0289)	0.3741	0.3668	0.87 (0.3859)	0.3723	0.3680	0.75 (0.4562)

Notes: Sample period is June 30, 1986–December 31, 1994. Subsample classification is by average assets during the full sample period. Small institutions are those with assets averaging less than $5 billion. Mid-sized are those with average assets between $5 billion and $10 billion. Large are those with assets averaging over $10 billion. The t-ratio tests the difference in the values of derivative users and nonusers. The number in parentheses under the t-ratio is the level of statistical significance. For example, for small BHCs, the value of difference in the total assets row is –17.04 and the number in parentheses indicates that this is significantly different from zero at a level of better than 1 percent.
Source: Authors' calculations using Federal Reserve FRY-9C data.

by the duration gap. The presumption is that the higher the duration gap, the more the banking organization is exposed to unanticipated interest rate changes. Data limitations require most researchers to measure a bank's interest rate risk exposure with the so-called dollar maturity gap measure—the difference between the dollar value of short-term on-balance-sheet assets and liabilities (where short-term is typically defined as maturities less than a year). The dollar maturity gap position is taken as a percentage of total assets to express the degree of interest rate sensitivity relative to the banking organization's total size. This dollar gap position as reported does not include the impact of derivative activity on a banking organization's interest rate risk exposure. Thus, banking firms that are derivative users should have a larger dollar maturity gap than nonusers. The results in table 2 support this prediction. Notice that the dollar maturity gap as percent of total assets presented in table 2 for small BHCs is higher for users (0.0876) than for nonusers (0.0638).

The dollar maturity gap results in table 2 suggest that a 100 basis points decrease in interest rates will cause net interest margin to fall by 0.0638 percentage points for small BHC nonusers. The same interest rate change would cause net interest margin to fall by 0.0876 percentage points for small BHC users, but this may be partly or completely offset by their derivative position. Thus, when derivatives are present, their use tends to increase the amount of on-balance-sheet interest rate risk exposure an average small bank holding company is willing to accept. A similar pattern is observed for large BHCs. The gap position is larger, in absolute value, for large users than for large nonusers. For mid-size users, the dollar gap position is smaller than for mid-size nonusers.

Does derivative usage allow banking organizations to earn higher accounting profits?

We use two profitability measures to answer this question: return on book value of assets and return on book value of capital. Return on book value of assets (ROA) is an indicator of managerial efficiency. It is calculated in this study as the ratio of net income divided by total assets. ROA indicates the extent of success realized by bank management in converting the assets of the bank into net earnings. Return on book value of equity (ROE) is a measure of the rate of return flowing to the institution's shareholders. We calculate ROE as net income divided by the total book value of bank equity. ROE approximates the rate of return the stockholders have received for investing their capital (that is, placing their funds at risk in the hope of earning suitable profits). Table 2 shows that for the smallest and largest asset size categories

derivative users have lower ROA than nonusers, while for the mid-size group of BHCs derivative users have a higher ROA than nonusers. However, these differences are not statistically significant. Similarly, the difference in ROE between derivative users and nonusers is not significant. Thus, derivative users, on average, do not appear to earn higher (or lower) accounting profits than nonusers.

On the other hand, net interest margin as measured by the difference between gross interest income and gross interest expense divided by total assets is smaller for users. Net interest margin is a comprehensive measure of management's ability to control the spread between interest revenues and interest costs.[7] With the exception of mid-sized BHCs, nonusers appear to be able to control the spread better than users.

BOX 1

Insolvency index

The insolvency index is a comprehensive measure of risk that includes three pieces of information (capital ratio, returns, and variability of returns) into a single number and captures the probability of failure (see Brewer, 1989). That is,

Probability of failure = Probability (Earnings < –Equity).

Dividing both terms of the inequality in the parentheses by equity, the probability of failure can be expressed as being equal to the probability that the rate of return on equity, $r_E = (Earnings/Equity)$, is less than negative one:

1)   *Probability $(r_E < -1)$.*

Assuming that the return on equity is distributed as a normal random variable, and standardizing the terms in equation 1, the probability of failure is equal to

Probability $[(r_E - \bar{r}_E)/\sigma_E < z]$,

where $\bar{r}_E$ is the expected rate of return on equity, equals $[(-1 - \bar{r}_E)/\sigma_E]$, and σ_E is the standard deviation (volatility) of equity returns. The variable z is the standard normal variate, representing how far, in standard deviations, the rate of return would have to fall below its expected value for the bank to fail. To be consistent with the banking literature, we will use the negative of z and denote it as an insolvency index. Thus, a higher value of this index indicates a lower probability of failure.

In the small BHC category, for every dollar of assets, derivative nonusers are able to generate a return of about 2.45 percent, compared with 2.34 percent for derivative users. The difference is greater between large users and large nonusers. For nonusers, every dollar of assets is able to generate a return of about 2.4 percent, while for users it is able to generate a return of about 2.14 percent. In the mid-sized BHC category, every dollar of assets generates about a 2.30 percent return for users and a 2.37 percent return for nonusers.

Banking organizations also earn noninterest income from deposit service charges, other service fees, and off-balance-sheet activities; and incur noninterest costs in the form of salaries and wages expense and repair and maintenance costs on bank equipment and facilities. Net noninterest rate margin as measured by the difference between noninterest revenue and noninterest expense divided by total assets captures the banking organization's ability to generate noninterest revenue to cover noninterest expenses. For most banking organizations net noninterest margin is negative, with noninterest costs generally outstripping fee income. The less negative this profitability measure is, the better the banking organization is at generating noninterest income to cover noninterest expenses. Table 2 shows that, with the exception of mid-sized BHCs, derivative users have a less negative net noninterest margin than nonusers. In the small BHC category, for every dollar of assets, derivative users incurred a net cost of about 1.42 percent, compared with 1.57 percent for derivative nonusers. In the large BHC category, derivative users incurred a net cost of 1.1 percent for every dollar of assets, compared with 1.49 percent for nonusers. However, in the mid-size BHC category, the difference was not significant at conventional levels. These results suggest that, with the exception of mid-size BHCs, derivative users have better control over noninterest expenses relative to noninterest income than nonusers. This could reflect lower noninterest expense and/or higher noninterest income.

Are derivative users more efficient than nonusers?

One way to measure efficiency is to compare noninterest expenses to total operating income (the sum of interest and noninterest income). The lower is this ratio, the greater the efficiency. The results in table 2 suggest that in the smallest category derivative users are less efficient than nonusers. For example, in the small BHC category derivative users spend about 41 cents per dollar of operating income on personnel, occupancy, and equipment expenses, while nonusers spend 40 cents. Thus, the 15 basis points difference

in net noninterest income between small users and small nonusers is primarily caused by higher noninterest income at users. Mid-size users spend about the same amount of their operating income on noninterest expenses (37 cents) as nonusers. The same 37 cents per dollar of operating income was spent on noninterest expense by both users and nonusers at large BHCs. Thus, users in the small BHC category tend to be less efficient than nonusers, while those in the mid- and large-size BHC categories appear to be as efficient as nonusers.

Lending and derivative usage of BHCs

The study by Brewer, Minton, and Moser (2000) shows that banks using interest rate derivatives experienced greater growth in their C&I loan portfolio than banks that did not use these financial instruments. Here, we reexamine the notion that firms' use of interest rate derivatives allows them to continue to provide credit by applying the Brewer, Minton, and Moser (2000) methodology to a sample of BHCs over the period from the fourth quarter of 1986 to the fourth quarter of 1994.

As in Brewer, Minton, and Moser (2000), the association between BHCs' lending and their use of derivatives can be measured by examining the relationship between the growth in BHC business loans and their involvement in interest rate derivative markets. The base model relates C&I lending to previous quarter capital to total assets ratio and C&I chargeoffs to total assets ratio.[8] We next add to the base model indicator variables for participation in any type of interest rate derivative contract. Table 3 reports the results of these pooled cross-sectional time series regressions. The results show that the previous quarter ratio of capital to total assets is positively related to growth in BHC business lending. The chargeoff rate is negatively related to lending, and the relationship is statistically significant at the standard levels. When the indicator variable for interest rate derivative usage is added to the base model, the results show a significant positive relationship between lending and derivative activity. The base model was also estimated using two alternative indicator variables of derivative usage: interest rate swap and futures contracts. Both of these indicator variables are positively correlated with lending. Overall, these results are consistent with those in Brewer, Minton, and Moser (2000), suggesting that derivative usage complements business lending. These empirical results show that banking organizations that employ interest rate derivative instruments tend to increase their business loan portfolio at a faster rate than other banking organizations. These results are consistent with the derivative users employing interest

rate derivative instruments to hedge their exposure to interest rate risk as a result of their financial intermediation activity. The additional lending resulting from this activity expands banking organizations' level of financial intermediation in that area where some researchers claim banks can generate returns above the competitive rate. But this lending could raise a bank's exposure to another type of risk—credit risk. Thus, while a bank may decrease its exposure to interest rate risk through the use of interest rate derivatives, the rise in lending as a result of derivative usage may increase its exposure to credit risk. The net effect of these changes on banks' overall risk and on the return a bank must earn to compensate stockholders for bearing this risk can only be determined empirically by examining stock market returns.

Risk sensitivity of BHC stock returns

Finance theory suggests that bank risk sensitivity can be measured by analyzing stock market returns. Financial economists typically consider the total variance of historical stock returns (or its standard deviation) as an appropriate measure of the overall volatility associated with the asset risk of a firm. This measure

of risk can be separated into 1) the risk associated with movements in the overall stock market and interest rates, and 2) risk associated with the specific operations of the firm. Bank equity values are sensitive to all the factors that affect the overall stock market as well as to factors specific to the banking industry. For example, banks are sensitive to "earning risk" through possible defaults on their loans and investments, changes in loan demand, and potential variability in growth and profitability of their nonloan portfolio operations. Bank equity values are also sensitive to movement in interest rates because, as we have noted above, banks typically fail to match the interest rate sensitivity of their assets and liabilities. As a result, changes in interest rates affect the market value of both sides of the bank's balance sheet and its net worth (or capital) and stock values.

We use a widely accepted two-index market model to characterize the return generating process for bank common stocks.[9] This model is an extension of the common single-index market model in which capital market risk sensitivity can be represented by the equity "beta," or the measured sensitivity of the firm's equity return with respect to the return on the market-wide

	TABLE 3		
	Univariate multiple regression coefficient estimates for the determinants of quarterly changes in C&I loans		
Independent variables	Basic model, including bank-specific determinants of lending and a local economic condition factor	Basic model, adding the derivative indicator variable	Basic model, adding separate derivative indicator variables
Previous quarter ratio of capital to total assets	0.2088 (0.0000)	0.2073 (0.0000)	0.2116 (0.0000)
Previous quarter ratio of commercial and industrial chargeoffs to total assets	–1.9264 (0.0000)	–1.9853 (0.0000)	–2.0104 (0.0000)
Indicator variable for derivative usage		0.0035 (0.0000)	
Indicator variable for interest rate swap usage			0.0023 (0.0001)
Indicator variable for interest rate futures usage			0.0019 (0.0001)
Adj. R^2	0.0913	0.0936	0.0951
Observations	4,130	4,130	4,130

Notes: The dependent variable is the quarterly change in C&I loans relative to last period's total assets. The estimates are measured relative to last period's total assets. All regression equations contain time period indicator variables. Sample period is 1986:Q4 to 1994:Q4. The numbers in parentheses below the regression coefficients are the significance levels. For example, a value of 0.001 would indicate a statistical significance at the 1 percent level.
Source: Authors' calculations using Federal Reserve FRY-9C data.

portfolio of risky assets. We examine one other determinant of bank stock returns: unanticipated changes in interest rates.

Our two-index market model takes the following form

1) $\quad RET_{j,t} = \beta_0 + \beta_1 RMKT_t + \beta_2 RTBOND_t + \varepsilon_{j,t},$

where $RET_{j,t}$ is the rate of return on equity; $RMKT_t$ is the rate of return on a stock market index; $RTBOND_t$ is a measure of the unanticipated change in interest rates; and $\varepsilon_{j,t}$ is a stochastic error term.

The value of β_1 measures the riskiness of a BHC stock relative to the market as a whole; and β_2 measures the effect of changes in interest rates on the stock returns of the jth firm given its relation to the market index.

Equation 1 was estimated over the period January 1986 through December 1994 using daily stock returns data (adjusted for dividends and stock splits) for our sample of 154 BHCs. There are 2,250 daily stock return observations over this period. Based on the asset sizes used in the previous section, we formed three groups: large, mid-size, and small banking organizations. As mentioned earlier, there are 57 large BHCs (average total assets of more than $10 billion), 35 mid-size BHCs (average total assets between $5 and $10 billion), and 62 small BHCs (average total assets less than $5 billion). Within each group, we formed portfolios based on derivative usage. Because there are only a few derivative nonusers in the large BHC group, we formed one portfolio for this asset group. Thus, we formed five equally weighted portfolios. The sample period was divided into two subperiods: January 1986 to December 1990 and January 1991 to December 1994. There are 1,249 daily stock return observations in the first subperiod and 1,001 in the second subperiod. We select these two subperiods in recognition that over a representative business cycle there may be a shift in the relationship between BHC stock returns and our two-index market model.

The relationship between stock returns and the return on the market portfolio and return on a short-term Treasury security is estimated for each of the five portfolios over the two subperiods. The return on the market portfolio is measured by the return on a value-weighted portfolio of the firms on the New York Stock Exchange and American Stock Exchange obtained from the Center for Research in Security Prices (CRSP) database. The return on the short-term Treasury security is computed by taking the percentage change in the yield on a one-year security instrument.

The results of estimating the relationship between stock returns and the return on the market portfolio and the return on the one-year Treasury security are shown in table 4 for the entire sample period and in table 5 for each of the two subperiods. Tables 4 and 5 also show the total risk (standard deviation of stock returns) and the portfolio-specific risk for each of the five portfolios.

Entire period: January 1986 – December 1994

For small BHCs, the results indicate that the market risk of both the average derivative user and non-user was about 0.44. This suggests that, over the nine years of the sample interval, changes in the stock market as a whole were associated with less than one-for-one changes in the average small BHC stocks. The interest rate risk coefficient is negative for both derivative users and nonusers, suggesting that a rise in holding period return on one-year Treasury securities will lead to lower stock returns. For example, a 100 basis point rise in the holding period return on one-year Treasuries will lead to an 83 basis point (0.8353 × 100) decline in the stock return of the average small derivative nonuser. The number in the difference row (0.2201) suggests this change in holding period return will have roughly the same impact on both derivative users and nonusers.

The two groups of mid-size BHCs all exhibited generally higher values for market risk than small-size BHCs. A 100 basis point increase in stock market returns leads to an approximately 57 basis point increase in the stock return on the average mid-size BHC, while the same change in market returns leads to a 44 basis point increase in the stock return of the average small BHC. Thus, the stocks of the mid-sized BHCs are more sensitive to stock-market-related risk than those of smaller banking organizations. Like the results for small BHCs, the interest rate risk coefficient is negative for both derivative users and nonusers. However, the coefficient is only statistically significant for derivative users.

For large BHCs, the market risk coefficient is higher than that for smaller BHCs, and it is close to one. A value of this coefficient that is close to one for large BHCs is reasonable because they are expected to hold diversified portfolios of loans and other assets whose returns should mimic the behavior of the broader market. As in the other cases, the interest rate risk coefficient is negative, but it is not statistically significant.

While the estimates in table 4 contain important information about BHC equity risks during the nine–year period ending in 1994, they also conceal

substantial time-series variation in BHC stocks' responses to stock market and interest rate risks. There may be several reasons for time-variations in BHC risk sensitivity. For example, an important source of BHC stock return variability over time is related to earnings variability due to the business risk of a banking organization represented by the demand and supply shifts for its services and inputs, specifically loans, deposits, and transactions services. BHC stock returns are related to future cash flows from changing levels of bank activities, such as lending. The present value of the loan business may change, in part, with expected changes in economic activity. Business expansions increase the quantities of bank loans, securities, and deposits. These factors are thought to have a positive impact on the expected earnings stream and, as a result, BHC stock returns. Conversely, business recessions may affect the performance of the existing loan portfolio and decrease the quantities of bank loans, securities, and deposits. This would tend to have a negative implication for BHC stock returns.

Alternatively, monetary policy is likely to shift over the business cycle. As the Federal Reserve System shifts, for example, from tight to easy monetary policy during the business cycle, this may lead to a shift in the relationship between BHC stock returns and the market index. To capture the time-variation in market and interest rate risk sensitivities, we estimate the

two-factor market model over two subperiods: January 1986 to December 1990 and January 1991 to December 1994. Over the first subperiod, the average volatility of one-year Treasury security return was more than 25 percent of the average volatility over the second subperiod. This difference is statistically significant at the 5 percent level. The lower volatility in the second subperiod may have shifted the relationship between BHCs stock returns and interest rates.

Subperiod: January 1986 – December 1990

For small BHCs, the standard deviation of stock returns is greater for users (0.0085) than for nonusers (0.0075). The equity values of derivative users are equally exposed to market risk as those of nonusers. For derivative users, the regression results indicate that for every 1 percent change in the return on the market portfolio, bank returns will change 0.40 percent. Although derivative users are equally sensitive to market risk, their equity values are significantly less exposed to interest rate risk. The coefficient for the interest rate factor is significantly negative for both derivative users and nonusers.

A negative coefficient on the interest rate variable indicates that higher than anticipated interest rates will cause bank holding company equity values to decline. This implies that over the estimation period, the BHCs in our sample held on average more interest rate

			TABLE 4		

**Risk sensitivity of bank holding company stock returns,
January 1986–December 1994**

Derivative participation	Total risk (standard deviation of stock returns)	Market risk	Interest rate risk	Unsystematic risk
		Small BHCs (62)		
Users (33)	0.0078	0.4253	−0.5008	0.0068
Nonusers (29)	0.0078	0.4379	−0.8353	0.0068
Difference		0.4931	0.2201	
		Mid-size BHCs (35)		
Users (30)	0.0082	0.5899	−0.9425	0.0062
Nonusers (5)	0.0120	0.5661	−0.6041	0.0108
Difference		0.3346	0.3507	
		Large BHCs (57)		
All	0.0109	0.9278	−0.0144	0.0070

Notes: Subsample classification is by average assets during the full sample period. Small institutions are those with assets averaging less than $5 billion. Mid-size are those with average assets between $5 billion and $10 billion. Large are those with assets averaging over $10 billion. Difference in the table is the level of statistical significance of the difference in the values of derivative users and nonusers. For example, for small BHCs, the value of difference in the interest rate risk column is 0.02201, indicating that the market risk sensitivity of derivative users is significantly different from that of nonusers at the 22.01 percent level.
Source: Authors' calculations using daily data from the Center for Research in Security Prices database.

TABLE 5

Risk sensitivity of BHC stock returns, two subperiods

Derivative participation	Total risk (standard deviation of stock returns)	Market risk	Interest rate risk	Unsystematic risk
Sample Period: January 1986–December 1990				
Small BHCs (62)				
Users (33)	0.0085	0.4036	–0.9274	0.0073
Nonusers (29)	0.0075	0.3841	–1.5013	0.0063
Difference		0.3675	0.0946	
Mid-size BHCs (35)				
Users (30)	0.0084	0.5477	–1.5872	0.0060
Nonusers (5)	0.0136	0.5443	–1.3502	0.0123
Difference		0.6325	0.9147	
Large BHCs (57)				
All	0.0111	0.8553	–0.4666	0.0062
Sample Period: January 1991–December 1994				
Small BHCs (62)				
Users (33)	0.0069	0.5044	0.3277	0.0061
Nonusers (29)	0.0081	0.6375	0.3577	0.0072
Difference		0.0005	0.9477	
Mid-size BHCs (35)				
Users (30)	0.0078	0.7459	0.2504	0.0062
Nonusers (5)	0.0094	0.6446	0.8978	0.0084
Difference		0.0206	0.2164	
Large BHCs (57)				
All	0.0106	1.1987	0.6424	0.0075

Notes: Subsample classification is by average assets during the full sample period. Small institutions are those with assets averaging less than $5 billion. Mid-size are those with average assets between $5 billion and $10 billion. Large are those with assets averaging over $10 billion. Difference in the table is the level of statistical significance of the difference in the values of derivative users and nonusers. For example, for small BHCs covering the January 1986 to December 1990 subperiod, the value of difference in the interest rate risk column is 0.0946, indicating that the interest rate risk sensitivity of derivative users is significantly different from that of nonusers at the 9.46 percent level.

Source: Authors' calculations using daily data from the Center for Research in Security Prices database.

sensitive assets than interest rate sensitive liabilities. This follows from four facts. First, declining interest rates raise holding period returns on bonds. Second, the returns on interest rate sensitive assets and the cost of interest rate sensitive liabilities decrease when market interest rates decrease. Third, a BHC's net interest income decreases when gross revenues from its assets decline by a larger amount than interest expenses on its liabilities. And, fourth, this change in net interest income is priced in BHC equity values. However, small derivative nonusers have a larger negative coefficient than users, suggesting that nonusers have significantly more exposure to interest rate risk.

For mid-size BHCs, the standard deviation of stock returns is less for users (0.0084) than for nonusers (0.0136). However, there is little, if any difference in the market and interest rate sensitivities of users' and nonusers' stock returns. Thus, there is little

difference in the sensitivity of both types of BHCs to economy-wide movements in both market returns and interest rates.

Subperiod: January 1991 – December 1994

For small BHCs, the standard deviation of stock returns is less for users (0.0069) than for nonusers (0.0081). However, the equity values of derivative users are relatively less exposed to market risk than those of nonusers. For derivative users, the regression results indicate that for every 1 percent change in the return on the market portfolio, derivative-users' stock returns will change 0.50 percent, while nonusers returns' will change 0.64 percent. Thus, nonusers are more exposed to economy-wide movements than users. There is little statistical difference in the interest rate sensitivity of derivative users and nonusers.

For mid-size BHCs, similar to the results covering the January 1986 to December 1990 subperiod, the standard deviation of stock returns is less for derivative users (0.0078) than for nonusers (0.0094). Unlike the earlier subperiod, the market risk sensitivity of derivative users is more significant than that for nonusers.

Conclusion

In this article, we examine the major differences in the financial characteristics of banks that use derivatives relative to those that do not. We find that banking organizations that use derivatives also increase their business lending faster than banks that do not use derivatives. So, derivative usage appears to foster relatively more loan making, or financial intermediation.

We also find that banking organizations that use derivatives to manage interest rate risk hold lower levels of (expensive) capital than other institutions. This implies that derivative usage (and interest rate risk management in general) allows banks to substitute (inexpensive) risk management for (expensive) capital.

Our results strongly suggest that large banks are much more likely than small banks to use derivatives. This is in agreement with the idea that there is a fixed cost associated with initially learning how to use derivatives. Large banks are more willing to incur this fixed cost because they will more likely use a larger amount of derivatives. Thus, this fixed cost can be spread across more opportunities to actually use derivatives, thereby lowering the average usage cost.

Our stock return results suggest that for the group of banking organizations for which there is a substantial variation in usage of interest rate derivative instruments, users tend to have less exposure to interest rate risk than nonusers and they also tend to have the same sensitivity to stock market risk. This suggests that derivative users overall tend to have less systematic risk than nonusers. This is an important observation because the derivative losses in the mid-1990s caused regulators and others to express grave concerns about the risk exposure of commercial banks operating in the derivative markets.

Regulators seem mainly concerned that losses on derivative trading could force the failure of some of the institutions serving as dealers, which would send shock waves not only through the derivative markets, but also through money and exchange rate markets to which derivative trading is closely linked through complex arbitrage strategies (Phillips, 1992). Our results suggest that derivative users are less risky than nonusers, and the introduction of stiffer regulations of the use of derivative instruments by federally insured depository institutions could have unintended consequences for the risk exposure of the deposit insurance agency. Moreover, any regulatory or accounting (for example, Financial Accounting Standard No. 133, "Accounting for derivative instruments and hedging activities") initiatives affecting hedging behavior and risk exposures may have negative implications for lending and banking organizations' stock market valuation.

NOTES

[1] In this article, we use banks and banking organizations interchangeably to refer to institutions for which banking is an important line of business.

[2] This concept is similar to standard payback ratios in corporate finance with the cash flows being adjusted to their present values.

[3] See Loomis (1994) for an insightful discussion about the risk exposure of firms using derivative instruments.

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

[5] In the early 1980s, bank regulators announced minimum "primary capital ratios" for banks and bank holding companies. Primary capital included common and preferred equity, mandatory convertible debt instruments, perpetual debt instruments, and loan-loss reserves. After a phase-in period, the minimum primary capital ratio was set at 5.5 percent of total assets. In the second half of the 1980s, regulators introduced a plan for risk-based capital requirements. The risk-based capital ratio measures a bank's capital with respect to the default risk of its on- and off-balance-sheet credit exposures. In addition, regulators tightened the old primary capital standard and added it to the risk-based requirements. The result is the leverage ratio. Published regulations indicated that most banking organizations

will be required to maintain an equity (the sum of common equity, certain preferred stock, and minority interests in consolidated subsidiaries less goodwill) to total assets ratio of at least 4 percent to 5 percent (Baer and McElravey, 1993). We use an equity to total assets ratio of 5.5 percent as the minimum required by regulators. This is probably more stringent than the actual standard during the first part of our sample period (because we do not include certain items) and weaker than the actual standard during the last part of our sample period (because we do not exclude goodwill), but it should represent a middle ground that will allow us to investigate the capital management behavior of derivative nonusers and users.

[6] See Baer and McElravey (1993) for an excellent discussion of this type of analysis.

[7] Unfortunately, these booked gains/losses would not capture the unbooked gains/losses from the derivative position.

[8] We do not include the growth rate in state employment because the holding company is likely to operate in several different states.

[9] See, for example, Stone (1974), Lloyd and Shick (1977), Lynge and Zumwalt (1980), Chance and Lane (1980), Flannery and James (1984), Kane and Unal (1988), and Kwan (1991).

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