Derivatives Usage and Interest Rate Risk of Large Banking Firms

LATHA SHANKER

INTRODUCTION

Financial derivatives used by commercial banks include both interest rate and currency futures, options, and swaps. Commercial banks' activity in these instruments arises because of two major functions that the banks perform. The first function arises from common commercial banking activities of lending, acquiring deposits, and managing the balance sheet. The banks use financial derivatives to hedge the interest rate and foreign exchange risk that arises due to this activity.

Banks may also utilize financial derivatives as intermediaries in arranging transactions between parties that take opposite positions in derivatives. Banks charge a fee for such services.

U.S. commercial banks have been allowed to use futures contracts since 1976. However, in that year only 15 banks were active in the futures markets. The vast majority of banks were reluctant to use them for various reasons, ranging from management reluctance to do so, lack of qualified personnel with knowledge of futures markets; institutional arrangements such as marking to market, which would have necessitated that the bank provide interim cash flows as required by margin calls, and a perception that these markets were extremely risky. Since that time, however, the larger commercial banks in the U.S. have increased their use of derivative financial instruments such as futures, options, and swaps.

■ *Latha Shanker is an Associate Professor in the Department of Finance, Concordia University.*

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Derivatives have had a great deal of negative publicity recently. A diverse list of companies have suffered losses from trading derivatives. Trading losses of $1.3 billion brought down a venerable and hitherto long-lived financial institution, Barings PLC, and depleted its $900 million in capital [Dwyer and Glasgall (1995)]. Derivative trading losses caused California's Orange County to default on its debt and caused huge losses to Procter and Gamble, Taiwan's Overseas Chinese Bank, and Indonesia's Sinar Mar Group [Silverman (1995)]. The collapse of Barings, especially, could lead to greater scrutiny of commercial banks in the areas of capital adequacy and risk management [Kerr (1995)]. This has focused attention on the role played by derivatives in speculative trading and turned attention away from the more respectable function that derivatives can and do perform—hedging risk.

A successful risk-management management program favorably affects a bank's profitability [Segerstrom and Meadows (1990)]. Measurement and management of interest rate risk has a high priority among all the different risk-management areas of banks, which include credit risk, liquidity risk, foreign exchange risk, et cetera [Saunders (1994) Chapter 4, pp. 73–84]. This functional area is a highly critical one, especially because interest rate volatility has increased over the 1950–1992 period [Saunders (1994), p. 86].

The objective of this article is to empirically investigate the effect of the use of financial derivatives on the interest rate risk of large U.S. commercial banks. The hedging effectiveness of futures, options, and swaps is studied. A significant contribution of the study is the development of a methodology, through the extension of previous research in banking, to detect the marginal effect of derivative usage upon the interest rate risk of the commercial banks.

LITERATURE REVIEW

Previous research has investigated the effect of the use of derivatives on bank performance. However, the research only addressed the use of financial futures, and it is dated, because most of it was conducted more than 10 years ago.

Veit and Reiff (1983) investigated the use of interest rate futures by 296 of the largest commercial banks in the U.S. over 1978–1980 and concluded that bank participation in the futures markets was limited and not more than moderately successful.

Kolb, Timme, and Gay (1984) theoretically compared macro with micro hedging using interest rate futures by commercial banks. Macro

hedging takes a global view of the bank's risk and hedges the risk left over, after netting out the separate sources of risk. Microhedging involves hedging each risk separately. Microhedging could actually cause an increase in the bank's overall risk if discretionary microhedging were employed by the various departments of the bank.[1] Macrohedging may require a large amount of information and usually will not provide the favorable accounting treatment accorded to the use of an interest rate futures contract that qualifies for hedge accounting.

Koppenhaver (1990) investigated the use of futures contracts by banks over the period 1983–1987. His results indicate that 10 of the largest banks reported 65–80% of all contracts outstanding in the banking industry at that time. The hedge ratio for the average hedging bank was less than 10% of the balance sheet interest rate risk. A bank was more likely to use futures contracts if it was in a highly concentrated market and also had positions in foreign exchange forwards and swaps.

RESEARCH METHODOLOGY AND RESULTS

The Data

This study focuses on the period 1986–1993. The initial sample of banks consists of all banks with data available on the CRSP daily stock returns tape within this period. Data on the banks' daily stock returns, as well as for the value-weighted return for NYSE/AMEX stocks for the above period, which serves as the index of stock market returns, are used to calculate weekly bank stock returns and stock market returns for each Friday in 1986–93. Weekly data on the price of 30-year GNMA 8% coupon bonds, the bond equivalent yield of 3-month, 6-month, and 1-year T-bills, and a bond equivalent yield index of 5-year, 7-year, and 10-year Treasury bonds are obtained for the same period from DRI–McGraw-Hill.

Call reports are obtained from the Disclosure Group of the Federal Deposit Insurance Corporation (FDIC) for each of the banks in the sample. Of the bank holding companies, only those with an identifiable lead bank are included in the sample, so that the balance sheet items obtained from the lead banks' call reports reflect those of the holding company.

[1]Kolb, Timme, and Gay illustrated this by considering a simple example of a bank with two departments, A and B. The futures position that minimized risk using a macrohedging approach was to be long five futures contracts. The equivalent microhedging approach was for department A to be short one contract, and department B to be long six contracts. Full microhedging would be equivalent to the macrohedging approach. However, if discretionary microhedging were used within the bank, and department A hedged while department B did not hedge, then the bank's overall risk position would be increased.

Schedule RC-J of these call reports contains data on the value of the banks' assets and liabilities maturing in 3 months or less, in 3–6 months, in 6–12 months, and in 1–5 years, for the years 1986 and 1987. Schedules RC-C and RC-E contain the same data for 1988–1993. These call reports include data on both domestic and foreign operations of these banks.

Banks are eliminated from the sample for each of the years 1986–1993 if

1. they either have incomplete or no data on stock returns for the year. The reasons the banks having incomplete or no data on stock returns are one of the following: (i) lack of trading, (ii) the bank merged with another bank, (iii) the bank ceased to exist, and (iv) the bank stock was not listed on the NYSE or the AMEX.
2. if the bank is a bank holding company and does not have an identifiable lead bank that further filed call reports that include schedules RC-J for 1986 and 1987 and schedules RC-C and RC-E for 1988–1993.

Complete data on stock returns and interest-rate-sensitive assets and liabilities are obtained for 35 banks in 1986, 37 banks in 1987, 46 banks in 1988, 49 banks in 1989, 54 banks in 1990, 49 banks in 1991, 46 banks in 1992, and 44 banks in 1993. Table I lists the names of the 55 banks in the sample. The total assets of the banks or lead banks (in case the parent was a bank holding company) in the sample in 1986 represents 34% of the total assets of domestically chartered banks in the United States as reported by the Federal Reserve Bulletin, Financial and Business Statistics. The corresponding statistics for 1987, 1988, 1989, 1990, 1991, 1992, and 1993 are 34%, 32%, 34%, 37%, 36%, 35%, and 36% respectively. All but three of the banks on the list, Citizens First Bancorp, Union Bank, and Wells Fargo, are bank holding companies.

The number of banks included in this study is a small proportion of the number of banks in the U.S. However, these banks are the only banks for which the needed data on stock returns are available. In addition, Richardson and Reerink (1993) reported statistics from the Office of the Comptroller of the Currency that 91.2% of the notional amounts of derivative contracts held by banks and trust companies as of June 30, 1993 were held by 10 banks. Those 10 banks are included in this study. The remaining 8.8% were held by 606 other banks and trusts.

Use of Derivatives by Banks

Most of the banks in the sample used interest rate derivatives over the period 1986–1993, whether these were futures, options, or swaps. The

TABLE I

Sample of Large Banking Firms over 1986–1993

1. Amsouth Bancorporation
2. BSD Bancorp Inc.
3. Baltimore Bancorp
4. Banc One Corp.
5. Bank of Boston Corp.
6. Bank of New England Corp.
7. Bank of New York Co. Inc.
8. Bank of San Francisco
9. Bank America Corp.
10. Bankers Trust
11. Barnett Banks Inc.
12. Chase Manhattan
13. Chemical Banking
14. Citicorp
15. Citizens First Bancorp
16. City Trust Bancorp Inc.
17. Continental Bank Corp.
18. Eldorado Bancorp
19. First Bank System Inc.
20. First Chicago Corp.
21. First City Bancorp
22. First Empire State Corp.
23. First FID Bancorporation
24. First Interstate Bancorporation
25. First National Corp.
26. First Union Corp.
27. First Virginia Banks Inc.
28. First Wachovia Corp
29. Firstar
30. Fleet/Norstar Finl. Group Inc.
31. Guardian Bancorp
32. Hibernia
33. Keycorp
34. MNC Financial Inc.
35. Manufacturers Hanover Corp.
36. Mellon Bank Corp
37. Morgan (J.P.) and Co.
38. NCNB Corp.
39. NBD Bancorp Inc.
40. National City Corp.
41. PNC Financial Corp.
42. Republic New York Corp.
43. Security Pacific Corp.
44. Shawmut National Corp.
45. Signet Banking Corp.
46. Southeast Banking Corp.
47. Southwest Bank
48. Sovran Financial Corp.
49. Sterling Bancorp
50. Sun Trust Banks Inc.
51. UJB Financial Corp.
52. Union Bank
53. Wells Fargo and Co.
54. West America Bancorporation
55. Worthen Banking Corp.

Call Reports provided by the FDIC provide data on the following: (a) The dollar value of the commitments under interest rate futures and forwards. From 1990 onwards this item is not available separately for long and short futures/forward positions. (b) The dollar value of the commitments to purchase and to sell under option contracts. (c) The notional value of interest rate swaps.

Table II shows the mean and standard deviation of the following measures of derivatives usage by the banks:

$$\text{Futures ratio (FR)} = \frac{\begin{array}{c}\text{Dollar value of the}\\ \text{commitments to sell and purchase}\\ \text{under interest rate}\\ \text{futures/forward contracts}\end{array}}{\text{Total assets}}$$

TABLE II

Mean and Standard Deviation of Measures of Derivative Usage and Interest Rate Risk for the Years 1986 through 1993

	Year							
Measure	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*
Derivative usage (%)								
Futures Ratio	5.834	8.367	24.427	19.259	27.436	41.723	45.611	59.357
FR	9.358	14.034	68.883	33.749	49.394	84.953	104.443	156.481
Purchased options ratio	1.008	1.738	2.272	3.817	13.393	14.605	18.845	21.709
POR	2.032	4.381	7.080	12.874	38.582	27.662	53.501	42.131
Written options ratio	0.582	0.559	0.964	2.988	11.885	15.308	16.939	24.990
WOR	1.332	1.406	2.346	8.950	25.441	33.775	44.127	74.354
Swaps ratio	16.145	29.549	66.606	93.748	53.894	58.092	62.324	78.946
SWR	24.066	47.151	234.136	331.357	106.265	101.189	122.440	150.386
Interest rate risk								
$\lvert\beta_{FTB}\rvert$	190.548	89.767	105.583	125.047	93.100	141.641	29.255	25.336
	161.678	64.519	110.073	91.231	67.781	142.565	22.510	18.889
$\lvert\beta_{FT7}\rvert$	83.129	152.040	135.597	129.441	108.061	72.174	155.380	88.622
	65.441	133.159	116.189	99.627	94.444	73.028	135.669	61.026
$\lvert\beta_{GN}\rvert$	0.636	0.831	0.627	0.448	1.009	1.121	0.840	0.856
	0.498	0.443	0.596	0.364	0.726	1.453	0.935	0.611
$\lvert\beta_{TB}\rvert$	3.396	4.769	3.847	2.181	6.428	6.584	4.113	5.656
	2.692	3.462	4.859	1.576	5.874	9.965	4.567	5.869
$\lvert\beta_{T7}\rvert$	0.264	0.433	0.325	0.195	0.680	0.472	0.281	0.172
	0.196	0.276	0.330	0.175	0.516	0.531	0.217	0.145
IGAPI	0.176	0.157	0.324	0.259	0.235	0.249	0.280	0.319
	0.133	0.125	0.117	0.132	0.145	0.140	0.144	0.136
Total assets (million $)	25,109	23,627	19,289	20,201	20,340	22,363	23,775	26,866
	34,004	32,777	28,316	28,745	29,258	31,007	35,466	39,064
Number of banks in sample	35	37	46	49	54	49	46	44

$$\text{Written options ratio (WOR)} = \frac{\text{Dollar value of the commitments to sell under options contracts}}{\text{Total assets}}$$

$$\text{Purchased options ratio (POR)} = \frac{\text{Dollar value of the commitments to purchase under options contracts}}{\text{Total assets}}$$

$$\text{Swaps ratio (SWR)} = \frac{\text{Notional value of interest rate swaps}}{\text{Total assets}}$$

The futures ratio includes activity both in interest rate futures and forward markets. The option ratios include the bank's activity under all types of option contracts—currency as well as interest rate options. However,

the data are only available as such from the FDIC call reports and further breakdown of the bank's activity in the area of interest rate futures and interest rate options is not possible for the period studied. However, Richardson and Reerink reported that 53.1% of the notional amounts of derivative contracts held by banks and trust companies as of June 30, 1993 were in futures/forwards, 26.4% were in swaps, and 20.4% were in options. Of this 20.4%, 14.6% were in interest rate options, 5.1% were in foreign exchange options, and 0.7% were in other options. Thus, in the period of this study, banks' activity in options is dominated by interest rate options. Table II indicates that the usage of futures, options, and swaps by the sample of banks increases over the period, as indicated by the means of the above ratios. However, Table II also indicates great variation in the use of these instruments among the sample of banks.

Further analysis shows that interest rate futures contracts are used by 22, 21, 29, 31, 29, 28, 27, and 26 banks in 1986, 1987, 1988, 1989, 1990, 1991, 1992, and 1993, respectively. Options are used by 17, 14, 20, 26, 31, 32, 29, and 32 banks in 1986, 1987, 1988, 1989, 1990, 1991, 1992, and 1993, respectively. Swaps are used by 24, 24, 32, 35, 41, 37, 33, and 34 banks in 1986, 1987, 1988, 1989, 1990, 1991, 1992, and 1993, respectively.

Effect of Derivative Usage upon Interest Rate Risk

The use of derivatives will have the effect of reducing the interest rate risk of the banks if the derivatives are used for hedging purposes and the hedge is effective. On the other hand, the use of derivatives will expose the bank to greater interest rate risk if (a) the financial intermediary services provided by the bank in the area of derivatives exposes the bank to greater interest rate risk or (b) the derivatives are used for hedging purposes, but the hedge is ineffective.

Measure of Interest Rate Risk

A measure of interest rate risk that captures both balance-sheet exposure and off-balance-sheet activity is the sensitivity of the value of the bank to unexpected changes in interest rates. The banks in the sample raise funds, on average, over the period 1986–1993, in the following proportions: short-term deposits 87%, equity capital 10%, and long-term debt 3%. The measure of interest rate risk is estimated as the relationship between bank stock returns and the measure of interest rates, for the following two reasons:

1. Short-term deposits are not traded; hence, it is difficult to estimate how their values respond to changes in interest rates.
2. The proportion of capital raised through long-term debt is small relative to that raised through equity.

The following regression is conducted.

$$R_{jt} = a_0 + a_1 R_{mt} + a_2 R_{It} + \varepsilon_t, \tag{1}$$

where

R_{jt} = stock return of bank j in week t
R_{mt} = return from the stock market in week t
R_{It} = measure of unexpected interest rates in week t
ε_t = error term

In estimation of eq. (1), neither the index of market return, R_{mt}, or the index of interest rates, R_{It}, is orthogonalized. Giliberto (1985) pointed out that if the index of market return were orthogonalized as in previous studies of bank interest rate sensitivity, then all the coefficients in eq. (1) except a_1 would be biased. An unbiased estimator of a_2 could be determined by orthogonalizing R_{It} or estimating eq. (1) without orthogonalizing any of the independent variables, R_{mt} and R_{It}. Thus, by not orthogonalizing R_{mt} and R_{It}, it is ensured that the estimator of a_2 is unbiased. However, because of correlation between R_{mt} and R_{It}, it is difficult to determine if the estimator a_2 is statistically significant.

The measures of unexpected interest rates in eq. (1) are calculated with the use of two approaches. In the first approach, the implied forward rate is used as the measure of expected interest rates. For example, an implied forward rate for the 6-month T-bill (or the 7-year Treasury bonds) is calculated from the yields on the 3-month T-bill and the 1-year T-bill (or the 5-year and 10-year Treasury bond). The difference between the actual rate on the 6-month T-bill in the next period (or the 7-year Treasury bond) and the forecast rate is used as the measure of unexpected interest rates. The values of a_2 (calculated with the use of the above measures of unexpected interest rates in eq. (1) in two separate regressions per bank) are termed β_{FTB} and β_{FT7} for the T-bill and T-bond rates, respectively.

In the second approach, measures of expected interest rates are calculated by fitting an autoregressive integrated moving average (ARIMA) model separately to each of the following series—the weekly holding period return[2] on 30-year GNMA 8% coupon bonds, the weekly holding

[2]The weekly holding period return does not include coupon payments because coupon payment dates are not available for the series from DRI–McGraw-Hill.

period return on 1-year T-bills, and the weekly percentage yield relative to the index of 7-year Treasury bonds over the 1986–1993 period. These series were used by Flannery and James (1984) to study the effect of balance-sheet maturity mismatch upon the interest rate sensitivity of bank common stock returns.

A plot of the above three weekly series against time show that these are stationary. The autocorrelations and partial autocorrelations of the series are examined to determine the appropriate ARIMA model. An ARIMA model of order (7,0,7) is fit separately to each of the series. In an ARIMA model of order (p, d, q), p stands for the order of the autoregressive process, d for the number of times the series is differenced to make it stationary, and q for the order of the moving average process. The autocorrelations and partial autocorrelations of the residuals that remain after the above models are fit to the above time series are checked to determine if the residuals could be characterized as white noise. The residuals have autocorrelations and partial autocorrelations that are not significantly different from zero at any lags. Therefore, these residuals are used as the measures of unexpected interest rate changes.

The sensitivity of the banks' stock returns to unexpected changes in interest rates are calculated by using the series separately in place of R_{1t} to estimate eq. (1) in three separate regressions per bank. The respective estimated values of a_2 are denoted, β_{GN}, β_{TB}, and β_{T7}. Thus, β_{FTB}, β_{FT7}, β_{GN}, β_{TB} and β_{T7} are different estimates that represent the interest rate exposure of the bank to unexpected changes in interest rates.

If the estimated value of β_{FTB} (or β_{FT7} or β_{GN} or β_{TB} or β_{T7}) is 0, this indicates that the bank has no exposure to interest rate risk. However, if β_{FTB} (or β_{FT7} or β_{GN} or β_{TB} or β_{T7}) has some value, whether it is positive or negative, this indicates the presence of interest rate risk. Thus, the greater the absolute value of β_{FTB} (or β_{FT7} or β_{GN} or β_{TB} or β_{T7}), the greater the exposure of the bank to changes in interest rates. These market measures of interest rate risk are based upon the information disclosed by the banks. To the extent that this information is limited, it may be difficult for the market to evaluate this risk. As a result, the market measures of interest rate risk may not correctly reflect the true interest rate risk of the banks.

Table II shows the mean and standard deviation of the interest rate risk measures for the sample of banks with complete data on the variables of interest for each of the years 1986–1993. These are means across the bank regressions described in the next subsection and standard deviations within the sample. The differences in magnitude of the measures of interest rate risk are due to the differences in the magnitudes of the measures of unexpected interest rates calculated with the use of the two approaches.

Relationship between Measure of Interest Rate Risk and Derivative Usage

The measures of interest rate risk β_{FTB}, β_{FT7}, β_{GN}, β_{TB}, and β_{T7} should capture the effect of both the balance-sheet exposure of the bank to changes in interest rates, as well as the off-balance-sheet exposure due to the use of futures, options, and swaps. Flannery and James (1984) found that the interest rate sensitivity of bank common stock returns was related to the size of the maturity difference between the bank's nominal assets and liabilities in a study of 67 banks over the period 1976–1981. The Flannery and James analysis is extended below to determine the effect of the use of interest rate derivatives upon the sensitivity of the banks' stock returns to changes in interest rates.

The following cross-sectional regression is conducted initially.

Measure of interest rate risk =

$$b_0 + b_1 |\text{GAP}| + b_2 \cdot \text{FR} + b_3 \cdot \text{WOR} + b_4 \cdot \text{POR} + b_5 \cdot \text{SWR} + \text{error term.} \quad (2)$$

The measure of interest rate risk in the left-hand side of eq. (2) includes, in turn, $|\beta_{FTB}|$, $|\beta_{FT7}|$, $|\beta_{GN}|$, $|\beta_{TB}|$, and $|\beta_{T7}|$. GAP is the balance-sheet exposure of each of the banks to changes in interest rates. This is calculated as

$$\text{GAP} = \frac{\text{short assets} - \text{short liabilities}}{\text{total assets}},$$

where

short assets = total value of the loans, leases, debt securities and other interest-bearing assets, repricing in 1 year or less;

short liabilities = total time deposits and nondeposit interest-bearing liabilities, repricing in 1 year or less

A similar ratio was used by Flannery and James to measure the balance-sheet exposure of the bank. Assets and liabilities excluded from this measure mature in more than 1 year and are termed long-term assets and liabilities. The 1-year cutoff period used to distinguish between short- and long-term assets and liabilities is arbitrary. If GAP is positive, then short-term assets would exceed short-term liabilities and long-term assets would be lower than long-term liabilities. If interest rates fall, such a bank would be hurt because long-term liabilities would go up in value relative to long-term assets. If GAP is negative, then short-term assets would be

lower than short-term liabilities and long-term assets would exceed long-term liabilities. If interest rates rise, such a bank would be hurt because interest expenses on short-term liabilities would exceed the interest income on short-term assets. Thus, the larger the absolute value of GAP, ceteris paribus, the more vulnerable the bank would be to changes in interest rates, whether these are increases or decreases in rates. Table II shows the mean and standard deviation of the measure, GAP, for the sample of banks over the period 1986–1993.

In estimating eq. (2) a Breusch-Pagan test for heteroscedasticity is conducted by regressing the squared residuals from eq. (2) on the squared values of the independent variables as well as the products of the independent variables taken two at a time. The chi-squared statistics indicate heteroscedasticity. Therefore, to correct for heteroscedasticity, eq. (2) is estimated by weighted least squares with the use of the standard errors of the betas, β_{FTB}, β_{FT7}, β_{GN}, β_{TB}, and β_{T7}, that are estimated in eq. (1) as the corresponding deflator in eq. (2). This correction in the second stage regression also corrects for errors in estimation of the betas in the first stage by eq. (1). This technique was also used by Flannery and James.

Estimation of eq. (2) suffers from the effects of multicollinearity. This is detected by conducting regressions of each of the independent variables upon all the other independent variables. The R^2's of these regressions are considerably higher than those of eq. (2) indicating multicollinearity. [See Greene (1990), p. 280]. This is because the variables FR, WOR, POR, and SWR are highly correlated. This correlation could be due to two reasons. The first is the use of the total assets of the bank as a deflator in calculating the derivative usage ratios. The second is that banks may hedge an exposed position in a market such as interest rate swaps with an opposite position in another derivative market, such as interest rate futures. Thus, the banks' activity in these markets could be highly correlated. This limits the ability of regression eq. (2) to detect the separate effects of the banks' off-balance-sheet activity in interest rate futures, options, and swaps upon the banks' interest rate risk.

Therefore, a t test is used to test for differences in the mean value of the measure of interest rate risk (both the balance-sheet exposure as well as the sensitivity of bank stock returns to changes in interest rates) between the group of banks that use the derivative instrument of interest and the group of banks that do not use the derivative instrument. Table III shows the results of the t tests. The mean value of |GAP| is significantly higher for the group of banks that use option contracts than for the group of banks that do not use option contracts. Thus, the balance-sheet exposure of the group of banks that use options is higher than for the group

TABLE III

Effect of Derivative Usage upon Interest Rate Risk from 1986 to 1993

	Effect of Futures Usage			*Effect of Options Usage*			*Effect of Swaps Usage*		
	Mean, Standard Deviation, and Sample Size for Banks			*Mean, Standard Deviation, and Sample Size for Banks*			*Mean, Standard Deviation, and Sample Size for Banks*		
Measure of Interest Rate Risk	*Using Futures*	*Not Using Futures*	*t Statistic for Difference in Means/Degrees of Freedom*	*Using Options*	*Not Using Options*	*t Statistics for Difference in Means/Degrees of Freedom*	*Using Swaps*	*Not Using Swaps*	*t Statistics for Difference in Means/Degrees of Freedom*
$\lvert\beta_{FTB}\rvert$	92.1533	107.3084	−1.32	87.4464	112.1149	−2.18*	92.8642	112.5832	−1.57
	93.493	124.212	358	93.795	115.239	358	96.755	129.993	358
	213	147		201	159		260	106	
$\lvert\beta_{FT7}\rvert$	102.5683	133.9228	−2.83*	105.8404	127.4201	−1.96*	108.4302	133.4185	−2.05*
	92.198	117.376	358	93.795	115.239	358	96.063	121.601	358
	213	147		201	159		260	100	
$\lvert\beta_{GN}\rvert$	0.7070	0.9455	−2.75*	0.7842	0.8299	−0.53	0.7838	0.8577	−0.77
	0.617	1.024	358	0.703	0.940	358	0.741	0.984	358
	213	147		201	159		260	100	
$\lvert\beta_{TB}\rvert$	3.9663	5.7286	−2.91*	4.1031	5.4227	−2.19*	4.2109	5.9210	−2.57*
	4.446	7.027	358	4.182	7.123	358	4.814	7.424	358
	213	147		201	159		260	100	
$\lvert\beta_{T7}\rvert$	0.3223	0.4183	−2.39*	0.3316	0.3992	−1.70*	0.3525	0.3849	−0.73
	0.323	0.438	358	0.316	0.440	358	0.346	0.447	358
	213	147		201	159		260	100	
IGAPI	0.2568	0.2493	0.48	0.2663	0.2378	1.87*	0.2530	0.2555	−0.14
	0.136	0.155	358	0.134	0.155	358	0.133	0.169	358
	213	147		201	159		260	100	

*Significant at the 95% confidence level.

of banks that do not use options. There is no difference in the mean values of the measure, |GAP|, between the group of banks that use futures (or swaps) and the group of banks that do not use futures (or swaps).

Table III indicates that the means of the absolute values of the sensitivity of bank stock returns to changes in interest rates, $|\beta_{FT7}|$, $|\beta_{GN}|$, $|\beta_{TB}|$, and $|\beta_{T7}|$, are significantly lower for the group of banks that use futures than for the group that do not. The mean values of $|\beta_{FTB}|$, $|\beta_{FT7}|$, $|\beta_{TB}|$, and $|\beta_{T7}|$ are significantly lower for the group of banks that use options than for the group of banks that do not. The mean values of $|\beta_{FT7}|$ and $|\beta_{TB}|$ are significantly lower for the group of banks that use swaps than for the group of banks that do not use swaps. The balance-sheet exposures of the banks to changes in interest rates are either the same or greater for the group of banks that use derivatives than for the group of banks that do not use derivatives. The sensitivity of banks' stock returns to unexpected changes in interest rates, which should capture the effect of the balance-sheet risk exposure as well as the off-balance-sheet activity in derivatives, are significantly lower for the group of banks that use derivatives. These results are confirmed by four of the five measures of interest rate risk for futures and options and two of the five measures for swaps.

Thus, the evidence is consistent with the conclusion that the use of derivatives reduces the interest rate risk of the banks.

Effect of Size

What is the effect of the size of the banks upon the results reported? As noted by previous research, the use of derivatives is dominated by large banks. The mean value of total assets for all the observations in the sample is $22,500 million, with a minimum value of $34 million and a maximum value of $175,712 million. The observations are classified into 10 different size categories, with each category having a range of size equal to $17,571.200 million (equal to 1/10 of the maximum value of total assets in the sample). Category 1 contains observations with a value of total assets over $0 and less than $17,571.200 million, Category 2 contains observations with a value of total assets greater than or equal to $17,571.200 million and less than $35,142.400 million, Category 3 contains observations with a value of total assets greater than or equal to $35,142.400 million and less than $52,713.600 million and so on, with Category 10 containing observations with a value of total assets greater than $158,140.800 million. Category 1 contains a total of 232 observations, of which 86 observations are associated with the use of futures, 83

TABLE IV

Effect of Derivative Usage upon Interest Rate Risk from 1986 to 1993 for Size Category 1

	Effect of Futures Usage			*Effect of Options Usage*			*Effect of Swaps Usage*		
	Mean, Standard Deviation, and Sample Size for Banks			*Mean, Standard Deviation, and Sample Size for Banks*			*Mean, Standard Deviation, and Sample Size for Banks*		
Measure of Interest Rate Risk	*Using Futures*	*Not Using Futures*	*t Statistic for Difference in Means/Degrees of Freedom*	*Using Options*	*Not Using Options*	*t Statistics for Difference in Means/Degrees of Freedom*	*Using Swaps*	*Not Using Swaps*	*t Statistics for Difference in Means/Degrees of Freedom*
$\lvert\beta_{FTB}\rvert$	87.1490	107.9086	−1.33	79.1907	111.9237	−2.09*	90.8420	112.5832	−1.43
	96.499	124.426	230	87.330	126.737	230	101.886	129.993	230
	86	146		83	149		132	100	
$\lvert\beta_{FT7}\rvert$	94.7360	133.9840	−2.74*	96.7321	132.0819	−2.44*	108.8418	133.4185	−1.74*
	79.605	117.777	230	83.542	116.087	230	93.086	121.601	230
	86	146		83	149		132	100	
$\lvert\beta_{GN}\rvert$	0.6803	0.9496	−2.20*	0.8570	0.8458	0.09	0.8437	0.8577	−0.12
	0.637	1.026	230	0.807	0.964	230	0.852	0.984	230
	86	146		83	149		132	100	
$\lvert\beta_{TB}\rvert$	3.8107	5.7178	−2.17*	3.8554	5.6545	−2.03*	4.3214	5.9210	−1.86*
	5.305	7.050	230	4.630	7.290	230	5.658	7.424	230
	86	146		83	149		132	100	
$\lvert\beta_{T7}\rvert$	0.3007	0.4196	−2.18*	0.3137	0.4100	−1.75*	0.3684	0.3849	−0.31
	0.326	0.440	230	0.298	0.450	230	0.370	0.447	230
	86	146		83	149		132	100	
|GAP|	0.2330	0.2491	−0.82	0.2565	0.2357	1.06	0.2338	0.2555	−1.14
	0.121	0.156	230	0.118	0.156	230	0.121	0.169	230
	86	146		83	149		132	100	

*Significant at the 95% confidence level.

observations with the use of options, and 132 observation with the use of swaps. Category 2 contains a total of 55 observations, of which 54 are associated with the use of futures, 49 with the use of options and 55 with the use of swaps. Category 3 contains 23 observations, of which all are associated with the use of futures and swaps and 19 are associated with the use of options. Categories 4, 5, 6, 7, 8, 9, and 10 contain 22, 12, 4, 2, 2, 4, and 4 observations, respectively, of which all are associated with the use of futures and options and swaps.

The *t* tests are repeated for Category 1. Table IV shows the results of the *t* tests for Category 1. The sample of observations on banks that do not use derivatives is almost the same as in Table III. The sample of observations on banks that use derivatives is smaller than the sample in Table III and closer in size to the banks that do not use derivatives. The results of the *t* tests are very similar to those reported in Table IV. Thus, the conclusion is that in this size category, the use of derivatives effectively reduces the interest rate risk of banks.

It is not possible to conduct the *t* tests for the other nine size categories because there are an insufficient number of observations on banks that do not use futures or options or swaps.

CONCLUSIONS

Derivatives have received bad publicity recently owing to the spectacular losses suffered by a varied list of companies that were engaged in speculative trading in these instruments. Some of these companies were forced into bankruptcy as a result of their huge losses. This article focuses on the use of derivatives for risk management.

Specifically, the effect of the use of interest rate derivatives (futures, options, and swaps) upon the interest rate risk of commercial banks is investigated. The results indicate that derivatives are effective in reducing the interest rate risk of banks.

Future research could be extended to a larger sample of banks, by including those banks whose stocks are not traded. This would involve formulating an alternative measure of interest rate risk that captures the effect of both balance-sheet and off-balance-sheet activity.

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