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ABSTRACT

THE MARKET'S EVALUATION OF OFF-BALANCE SHEET BANKING RISK: A METHODOLOGICAL REEXAMINATION

The empirical literature, to date, has ignored the impact of Off-balance sheet (OBS) banking activities on the default-risk premia borne by bank subordinated debtholders. This paper examines the "market discipline" of OBS activities by employing a contingent claims pricing model to the default-risk premia on subordinated debt. The standard approach to determine if market prices of subordinated debt reflect the risk of default is to regress the yield spread against accounting measures of bank risk. This approach is inadequate because yield spreads are neither linear nor monotonic functions of bank risk. Moreover, this approach fails to account for the fact that banks are regulated. Observed yields on subordinated bank debt over equivalent maturity treasuries are used to compute implied asset variances. OBS banking activities appear to reduce both linear risk-premia and implied asset variances. These results suggest that bank regulators are overly concerned with the risk exposure of OBS activities. The risk-based capital requirement of OBS banking activities may be inappropriate.

I. INTRODUCTION

This paper deals with the "market discipline" of off-balance sheet (OBS) banking activities by employing a contingent claims pricing model to the default-risk premia on bank subordinated debt. Theory suggests that OBS guarantees may be related to bank risk in three ways. First, for a given bank and bank customer, a marginal OBS guarantee must increase bank risk because it obligates the bank to make a payment in the future under some circumstances in which it would prefer to refuse payment. Second, an OBS guarantee is likely to signal reduced risk of a bank customer. Third, OBS guarantees (for example, futures contract) may reduce bank risk if these guarantees are used to hedge rather than to speculate [Avery and Berger (1988)].

Off-balance sheet activities have been growing rapidly in recent years. Total off-balance items grew from 1.4 trillion dollars in 1984 to 5.7 trillion dollars in 1988. Moreover, OBS activities represented 58% of total bank assets in 1984 and grew to 176% of total bank assets in 1988 (Table 1).

As the volume of off-balance sheet items was increased, bank regulators have become concerned that the risks of OBS items could lead to sudden liquidity squeezes or surprise losses. Unlike balance-sheet assets, these potential obligations are not funded with balance sheet liabilities and are not considered in determining a bank's regulatory capital requirements. Therefore, conventional measures of financial health may not present an accurate picture of a bank's condition. This situation is likely to change because the Federal Reserve System has proposed supplemental risk-based capital requirements that specifically include off-balance sheet items such as loan commitments, standby letters of credit, and commercial letters of credit in the calculation of minimum acceptable risk capital.

A key rationale for OBS banking capital regulation is an assumed information asymmetry between bank managers and liability holders. The regulatory presumption is that such OBS activities are risky and the market fails to recognize the risk embodied in such OBS activities. The "market discipline" studies of OBS banking risk have addressed the question of whether market prices of bank liabilities reflect the risk of OBS activities. If "market discipline" exists and off-balance sheet activities are found to be risk-sensitive, bank liability holders can distinguish OBS banking risk. The assumed information asymmetry rationale for capital regulation of OBS activities, therefore, becomes less convincing.

The standard approach used to determine if market prices of uninsured liabilities reflect the risk of OBS activities is to regress the yield spread against on-balance and off-balance measures of risk. This approach is inadequate because uninsured bank liabilities are subordinated claims whose yield spreads are not linear or monotonic functions of bank risk. Moreover, this approach fails to account for the fact that banks are regulated. The fact that regulators may apply solvency rules in ways different from investors complicates the valuation of subordinated claims.

The purpose of this paper is to reexamine the impact of "market discipline" on OBS risk by modeling closure rules explicitly and using contingent claims pricing to compute the implied variance of bank assets. Specifically, by incorporating default-risk premia in a subordinated debt pricing model, the implied variance of bank assets will be calculated and regressed over on-balance and off-balance sheet activities. The underlying premise of this study is that bank subordinated debt-holders are more exposed to OBS risk than deposit-holders. Therefore, their assessment of the riskiness of OBS activities is realistically determined.

II. PREVIOUS RESEARCH

Pettway (1976, 1976a) investigated the accounting factors affecting the risk-premium of a bank's capital notes and found that dividend yield and earnings growth rate are significant explanatory variables. Cramer and Rogowski (1985) investigated the relationship between deposit costs and bank-specific risk measures, but failed to find any significant relationships. Baer and Brewer (1985) regressed CD rates over various accounting risk measures and found that these rates are positively related to risk measures over the period 1979-82. Hannan and Hanweck (1988) employed survey data on CD rates for five different maturities and found that variability of earnings and bank capital are significant determinants of CD risk-premia.

Goldberg and Lloyd-Davies (1985) explained CD rates as a function of the general level of interest rates and various measures of bank risk including standby letters of credit. They found that CD rates rose with increasing leverage from increases in SLCs but fell with increases in SLCs as a proportion of total risky assets. Since these two factors tend to cancel each other, the net effect on bank risk of an increase in bank's SLC exposure is negligible.

In a paper by Avery, Belton and Goldberg (1988) a cross-sectioon study of subordinated debt pricing was conducted for both 1983 and 1984. Examining the spread over the comparable Treasury yields these authors were unable to demonstrate the effect of any balance sheet or income statement data on bank costs. Recently, Gorton and Santomero (1989) used a contingent pricing model and regulatory closure rule to examine the relationship between bank risk and accounting risk factors. They found credit and interest risk variables are significant in models in which bank debt is aassumed either homogeneous or heterogeneous (junior vs. senior) with one year maturity. They attribute this

finding to the methodological improvement of their research over previous studies. They argue that (i) the nonlinearity of contingent claims pricing may not be captured by linear regression; (ii) bank subordinated debt may sometimes behave like equity; and (iii) the effects of regulatory closure rules, while difficult to capture, are not modeled at all in previous literature. Although Avery, Belton and Goldberg (1988) and Gorton and Santomero (1989) studies do not include OBS items as explanatory vaariables, these two studies show the appropriateness of default-risk premia and implied asset variances methodologies in examining the "market discipline" of OBS banking risk.

This research reports on two capital market tests of OBS banking risk: the impact of OBS activities on the risk-premia of subordinated debt and implied asset variances calculated from risk-premia. This research improves upon the existing empirical literature in three ways.

First, the empirical literature, to date, has ignored the impact of OBS risk on the dafault-risk premia borne by the subordinated debtholders. Second, this study uses contingent claims pricing of subordinated debt to calculate implied variance. This procedure is superior to previous studies because it can assess directly whether OBS banking risk is correlated with market risk while avoiding direct use of the yield spreads which are neither linearly nor monotonically related to bank asset risk. Third, this research investigates the differential impact of various OBS items on bank risk.

III. METHODOLOGY TO CALCULATE OBS BANKING RISK

3.1 INTRODUCTION

One limitation of empirical research on OBS risk in banking is that equity risk has been used extensively as a proxy for bank risk, thus ignoring the impact of bank regulation on risk measurement. In fact, total asset risk is a

better measure of risk for regulated banking firms because both equity and debtholders of regulated banking firms benefit from deposit insurance and other regulatory practices. This study overcomes these drawbacks by using an explicit pricing formula for bank subordinated debt that incorporates a default risk-premia.

The empirical methodology used in this study is in the spirit of Gorton and Santomero (1989). Asset variances of banks are estimated by inverting an option pricing model of default risk-premia of subordinated debt. This approach to risk calculation considers the fact that subordinated debt sometimes behaves like equity and sometimes behaves like debt. This contingent claims pricing model of subordinated debt also considers the nonlinear relationship between market measures of risk and on and off-balance measures of risk. Moreover, subordinated debt pricing considers the fact that banks are regulated.

3.2 THE VALUATION OF ASSET VARIANCE FROM DEFAULT RISK-PREMIA

The contingent claims valuation model, derived by Black and Scholes (1973), was applied by Merton (1974) to liability pricing in the case of a single issue of nonconvertible debt. In reality, capital structures involve equity and multiple issues of callable non-convertible sinking fund coupon debt of different maturities and possibly different pricing mechanisms. The contingent claims valuation theory is not rich enough to capture many aspects of real world securities. Nonetheless, empirical tests in this research are based upon contingent claims pricing of subordinated debt as developed by Merton (1974).

If a firm finances itself solely with pure discount debt and equity, then Merton (1974) has shown that the default risk premium on the firm's debt, expressed as the spread between the yield on the risky debt (R) and the yield on riskless debt (R_f) of the same maturity is

$$R - R_f = - 1N[(V/B) \exp (R_f T) N (-d_1) + N (d_2)]/T \qquad (1)$$

where $d_1 = [1N(V/B) + (R_f + \sigma^2/2) T]/\sigma\sqrt{T}$

$d_2 = d_1 - \sigma\sqrt{T}$

where σ^2 is the volatility of the logarithm of assets of bank; R is the yield on subordinated debt and debentures; R_f is the yield on Treasuries of the same maturity; V is the value of the bank's assets; T is the maturity of subordinated debt (assumed to be 1); B is the face value of debt; $N(\cdot)$ is the univariate cumulative normal distribution function. Note that the risk premium, $R-R_f$, is a function of leverage (V/B), time to maturity (T) and asset variance (σ^2). In the case of a homogeneous debt issue, the greater the volatility of the firm's assets, the higher the default risk-premium.

Given the default-risk premium and other necessary information, the above pricing formula for subordinated debt is inverted to find the volatility, σ^2, implied by that default-risk premium. Two volatility measures will be calculated. The first volatility measure treats bank debt as homogeneous, imposes a one-year maturity and subordinated debt to assets minus insured debt as the leverage variable. The second volatility measure also treats bank debt as homogeneous, imposes a one-year maturity but uses subordinated debt plus OBS debt to assets minus insured debt as the leverage variable.

Calculations of implied asset variances require the usual assumptions made by Black-Scholes. A maintained assumption of the Black-Scholes option pricing model is that σ^2 is constant and normally distributed. The applicability of contingent claims model in discrete time has been demonstrated by Gorton and Santomero (1989) in their "market discipline" study of bank risk. Moreover, the interest rate is assumed to be nonstochastic. Ronn and Verma (1986) show that relative contribution of interest rate variance to overall variance appears small.

In addition, the following assumptions are used for calculations of implied variances.

1. Deposit insurance is fairly priced;

2. Aggregation of a bank's multiple issues of subordinated debt by weighted average of yields and maturities is a good approximation.

3. Insured bank debt has the same maturity as subordinated debt.

The assumption that deposit insurance is fairly priced has received empirical support from Pennachi (1987). The fact that some banks have multiple issues of debt with different maturities necessitates the second assumption. The maturity assumption is necessitated by the fact that the banks in the sample have widely varying average maturities of their subordinated debt. Core deposits are perpetual and the remainder debt has an estimated maturity based on turnover measures (Flannery and James, 1984). Although some measure of the maturity of insured deposits is acceptable, there is no standard maturity measure for subordinated debt.

3.3 REGULATORY CLOSURE RULE AND MATURITY OF DEBT

An empirical examination of the bank subordinated debt pricing model is complicated by the fact that banks are regulated by authorities that have broad discretionary powers. The FDIC may keep a troubled bank open or it may liquidate the bank and pay off depositors. The FDIC may also use the purchase and assumption technique of dealing with a troubled bank. An exogenously given closure rule can be adopted about the behavior of regulatory authority. Merton (1978) assumed that banks are audited each year and banks will be closed if, at audit time, its assets to deposit ratio is below one. Ronn and Verma (1986) also assume an annual audit with an exogenously given assets-to-deposits ratio below which the bank is closed. The maturity of debt, used in this study, is

effectively one year because banks are audited each year. At examination time, the stockholders have the choice of satisfying the regulatory criteria or forfeiting the bank to the regulators.

IV. EMPIRICAL RESULTS

4.1 INTRODUCTION

Subordinated debtholders are subject to a larger risk of loss than uninsured depositors. Market discipline by uninsured depositors appears limited by (a) these depositors' ability to withdraw funds quickly once a problem situation becomes apparent, and (b) by the fact that they typically receive de facto insurance coverage when the FDIC uses the method of purchase and assumption to resolve a problem situation. In contrast, subordinated debt can be a source of funding that cannot be withdrawn during adversity and is generally not assumed by the purchasing bank in a purchase and assumption transaction. Thus, subordinated debtholders are generally subject to greater risk than uninsured depositors.

The potential of subordinated debt to enhance market discipline is examined empirically by analyzing the interest rate spread between subordinated debt and treasury securities, and asset variances implied by the risk-premia. Both default-risk premia and implied asset variances are modeled as functions of various on-balance and off-balance measures of risk.

4.2 MODEL SPECIFICATIONS

The following risk-premia models are estimated over cross-section and time-series data using the generalized least squares (GLS) technique to examine the risk-behavior of OBS banking activities. The expected signs of partial derivatives appear on each independent variable:

$$R - R_f = f(\overset{-}{OBS}, \overset{+}{LEV}, \overset{-}{DIV}, \overset{+}{ALOSS}, \overset{+}{AGAP}, \overset{-}{ASIZE}, \overset{-}{POR}) \quad (2)$$

$$\sigma = f(\overset{-}{OBS}, \overset{+}{LEV}, \overset{-}{DIV}, \overset{+}{ALOSS}, \overset{+}{AGAP}, \overset{-}{ASIZE}, \overset{-}{POR}) \quad (3)$$

where

$R - R_f$ = Default-risk premia;

σ = the implied asset variances;

OBS = Seven off-balance sheet variables constructed from 19 items included in the RC-L schedule of the FDIC tapes;

LEV = ratio of total liabilities over total assets;

DIV = an index of portfolio diversification (the higher the diversification index is, the higher the level of diversification is in the loan portfolio);

ALOSS = ratio of loan loss reserves over total assets;

AGAP = ratio of net position (total market rate assets minus market rate liabilities) to total assets;

ASIZE = logarithm of assets of banks;

POR = cash dividends over net income.

Leverage (LEV), diversification (DIV), Credit risk (ALOSS), Interest rate risk (AGAP), Operating risk (ASIZE) and dividend payout (POR) are all on-balance measures of risk, and have been used extensively in "market-discipline" studies of bank financial policies. These variables have been scaled down by size in order to avoid heteroskedasticity problem.

Two main effects of OBS banking activities on risk, namely diversification and leverage effects, are rationalized in theoretical literature. However, on a priori , it is difficult to say which effect dominates. The negative sign of DIV variable indicates that diversification by bank loan portfolio reduces total risk. The positive sign of LEV variable indicates that leverage ratios of banks

increase total risk. In addition, the negative signs of OBS variables in equations (2) and (3) imply that, after controlling for on-balance leverage and diversification effects, risk-reducing diversification effect of OBS activities dominates risk-increasing effects on OBS activities.

Table 2 reports 19 OBS activities from the RC-L schedule of bank call and income reports. Seven off-balance variables have been constructed from these 19 OBS items.

4.3 DATA ANALYSIS

This research focuses on the 100 largest U.S. banks and BHCs, as these are only ones with publicly traded subordinated debt and debentures. Data on yield measures were gathered on all BHC for bank subordinated debt, debentures and capital notes which were publicly traded in the NYSE, AMEX, NASDAQ with quoted sale and bid prices from Moody's and Standard and Poor's bond manuals as of year ends 1984 through 1988. To make each BHC debt issue as homogeneous as possible, all zero coupon issues and floating rate issues were dropped from the sample. This produced 171 issues for 50 BHCs in 1984, 137 issues for 49 BHCs in 1985, 160 issues for 48 BHCs in 1986, 174 issues for 43 BHCs in 1987 and 223 issues for 49 banks in 1988. Virtually all of these bonds were issued against the BHCs rather than the bank. There was a fair amount of heterogeneity in terms of maturity, coupons and issue size. Acquisitions or name changes of banks have been confirmed from Moody's Bank and Finance Manual in order to maintain continuity in data collection.

The risk-free rates of Treasury Securities identical in maturity to each debt issue were collected from Moody's Bond Record. Yields of multiple issues of a bank's subordinated debts are aggregated to calculate an average yield. Risk-premiums were calculated by simply subtracting risk-free rates of identical

maturity from the yield measure. The risk-premium used in this study is the average premium of all outstanding issues for each BHC for each year. The on-balance and off-balance measures of risk are constructed as defined earlier, from variables available in the FDIC Call and Income Report for the years 1984 through 1988. The risk-premia of each BHC is matched against on-balance and off-balance measures of risk, and this resulted in a final sample of 32 banks and BHCs for each year. The relative size of market risk meaasures, accounting measures and OBS variables are show in Table 3. These risk-premia are then used as the dependent variables in regression analysis of on-balance and off-balance measures of bank risk.

4.4 ESTIMATION OF ASSET VARIANCE

The average risk-premium for each BHC for each year is used as the input in calculating each BHC's asset volatilities. Values of bank assets are market values of equity and book values of debt. The pricing formula (equation 1) is simply inverted to find asset volatility implied by the risk-premia. A Fortran program was written to solve for unknown asset variance in the non-linear equation of the subordinated debt pricing model. These implied variances were then used as the dependent variable in the regression analysis of on-balance and off-balance measures of bank risk.

Two asset variances were calculated. SIGMA1 treats bank debt as homogeneous, imposes a one-year maturity and uses subordinated debt to assets less insured debt as the leverage variable. SIGMA2 is the same as SIGMA1, except that the leverage variable is subordinated debt plus OBS debt to assets minus insured debt, because not all risks assumed by a bank appear on its balance sheet. Results are presented using both measures of risk, and they are generally consistent.

4.5 ANALYSIS OF RESULTS

Table 4 provides the coefficient estimates of a basic risk-premia model. This can be used for comparison purposes to the implied variance models. Seven equations were estimated, one for each off-balance sheet group, using pooled cross-section and time-series data for 32 banks and bank-holding companies over the years 1984-88. All off-balance sheet items have expected negative signs. Three of these coefficients are significant at the 1% level (APART, ACLC, AOBS), two are significant at the 5% level (AOB, ASWAP) and one is significant at the 10% level (ACOMM). The coefficient of SLC is not significantly different from zero. This result is consistent with the results of Goldberg and Lloyd-Davies (1985) for Standby Letters of Credit (SLCs) but extends these results to other categories of OBS items.

Variations in the risk-premia on uninsured bank debt are significantly correlated with off-balance sheet variables, suggesting the presence of a "market discipline." Moreover, bank liability holders view OBS variables as risk-reducing. The pricing signal that the banking industry receives from the subordinated debt market appears to be at odds with the regulatory prescription about off-balance sheet variables. Those prescriptions require certain OBS items be included in the risk-based capital requirement. The risk-reducing potential of off-balance sheet variables indicates that bank regulators may be overly concerned about these banking activities and should not penalize banks for these OBS activities by requiring additional capital.

The on-balance measures of risk, generally, obtain their expected signs. Both leverage and diversification (LEV and DIV) variables have the expected signs and are significant at the 5% level. The significant negative coefficients of OBS items along with expeted signs of leverage and

diversification (LEV and DIV) variables also suggest that risk-reducing diversification impacts of OBS activities dominate their risk-increasing impacts. The interest rate risk (AGAP) is positive and significant at the 10% level. The credit risk variable (ALOSS) is, however, significantly negative. Here multicollinearity between credit risk and interest rate risk (ALOSS and AGAP) may be the cause of this perverse sign. The dividend payout ratio (POR) variable has an insignificant positive coefficient. The size (ASIZE) variable has, in general, negative coefficients and, in one case, is significant at the 1% level. These results are consistent with studies by Pettway (1976), and Lee and Brewer (1987).

Table 5 reports the results of regression coefficients when the dependent variable is the direct risk measure. SIGMA1 is the implied asset variance derived from a subordinated debt option pricing model. Again all of the off-balance sheet variables have negative coefficients. Four out of seven estimated coefficients are significant at the 1% level (AOB, ASLC, ASWAP, AOBS), one is significant at the 5% level (APART), one is significant at the 10% level (ACOMM), and the coefficient of ACLC is not significantly different from zero. These results again support the risk-reducing nature of OBS banking activities. The expected positive coefficient for leverage (LEV) and expected negative coefficient for diversification (DIV) along with negative coefficients of OBS variables also suggest that risk-reducing diversification impacts of OBS activities dominates risk-increasing impact of these activities.

All coefficients of the on-balance measures of accounting risk variables except one have the expected sign. The coefficients on interest rate risk (AGAP) are significantly positive. The coefficients on credit risk (ALOSS) have the wrong sign and this is likely due to the multicollinearity between credit

risk and inteest rate risk (ALOSS and AGAP) variables. The coefficients on size (ASIZE) are significantly negative. The coefficients on dividend payout ratio (POR) are not significantly different from zero.

Table 6 presents the coefficient estimates of off-balance and on-balance measures of bank risk using SIGMA2 as the dependent variable. SIGMA2 is similar to SIGMA1 except that the leverage variable was augmented by OBS debt in the subordinated debt option pricing model. The coefficients of all OBS variables except one have negative signs. Two of these coefficients are significant at the 1% level (ASLC, ACLC). The coefficients of five OBS variables (AOB, ACOMM, APART, ASWAP, AOBS) are not significantly different from zero. These results suggest that at least some of the OBS variables are risk-reducing. All estimated coefficients of on-balance measures of risk have the expected signs; and all but two are statistically significant at the 5% level.

The regression results for both measures of asset risk (SIGMA1 and SIGMA2) are consistent with the results of Gorton and Santomero (1989) for on-balance measures of risk but extends these results to off-balance measures of risk. The results are very similar to the risk-premia model and suggest that a market discipline exists for OBS banking activities, and subordinated debtholders view these OBS activities of large commercial banks as risk-reducing.

V. CONCLUSIONS AND POLICY IMPLICATIONS

"Market discipline" studies of OBS banking risk have addressed the question of whether market prices of bank liabilities reflect the risk of OBS activities. The standard approach to determine whether market prices of uninsured debt contain individual bank risk-premia is to regress the yield spread against on-balance and off-balance measures of risk. To date these results have been mixed. The uninsured bank debt liabilities are subordinated claims which are

not linear or monotonic functions of bank risk premia. Moreover, the underlying risk is dependent upon the regulatory closure rule. Without recognizing these complications linear risk-premia regressions may be inadequate in addressing the "market discipline" question.

The "market discipline" of OBS banking activities has been reexamined by using a contingent claims valuation to derive an explicit pricing model which incorporates regulatory closure rules for bank subordinated debt (Gorton-Santomero, 1989). Specifically, implied variances have been calculated by incorporating default risk-premia into a subordinated debt pricing model. These implied asset variances are better than risk-premia in proxying total risk because they consider both the nonlinear nature of contingent claims model and the impact of closure rules.

A pooled cross-section and time-series model, instead of simple OLS, was employed to perform the econometric analysis for two reasons. Cross-section or time-series data alone (32 cross-sections and 5 time-periods) do not yield sufficient degrees of freedom in regression analysis.

The major empirical findings of this study can be summarized as follows. All seven off-balance measures of risk in this study are risk-reducing depending on the proxy used for total risk. Four off-balance sheet items (AOBS, ACLC, ASLC and ACOMM) are always risk-reducing regardless of the proxy used for total risk.

Several on-balance measures of accounting risk also show statistically significant correlations with market measures of risk. The pooled cross-section and time-series analysis of OBS banking risk provides better coefficient estimates (increased t-statistics) and increases the statistical significance of models (increased F-statistics).

The existing policy proposal to regulate OBS banking risk by bringing them into a risk-based capital requirement can be analyzed in the light of empirical findings of this research. The results indicate that off-balance sheet activities, in general, reduce total risk. While bank regulators are concerned with total risk and the probability of bank failures, the risk-reducing potential of OBS activities indicates that additional capital requirement of OBS banking activities will penalize large banks.

There is clear evidence of a "market discipline" of OBS banking risk. Market participants price these OBS activities as risk-reducing. Therefore, regulatory interference in the form of additional capital requirement of OBS activities are likely to create distortions in the financial intermediation market.

TABLE 1

AGGREGATE VOLUME OF OFF-BALANCE-SHEET COMMITMENTS AND CONTINGENCIES
U.S. COMMERCIAL BANKS
ANNUAL DATA AS OF DECEMBER, IN BILLIONS OF DOLLARS

	1984	1985	1986	1987	1988
Commitments to Lend	495.6	542.4	570.4	611.6	654.9
Futures and forward contracts (exclude FX)					
Commitments to buy	40	57.2	99.7	122.7	174.3
Commitments to sell	28.3	40.5	79.6	137.6	234.4
When issued securities					
Commitments to buy	4.3	4.4	9.8	2	6.8
Commitments to sell	3.5	3.3	6.2	2.1	6.6
Standby contracts & other option contracts					
Obligations to buy under option contracts	2.8	10.7	27.8	48.9	67.3
Obligations to sell under option contracts	1.7	5	11.8	16.4	29.4
Commitments to buy FX (incl. $US), spot & forward	584	735.2	890.8	1,504.1	1,683.2
Standby L/C and foreign office guarantees					
To U.S. addressees	109.8	134.8	132.1	134.5	135.6
To Non-U.S. addressees	34	38.2	35.8	33.7	33.2
(Amount of these items sold to others via participations)	15	18.2	18.5	19.6	19.2
Commercial L/C	30	28.4	28.4	30.5	30.2
Participations in acceptances sold to others	8.4	8.4	5.4	4.2	3.9
Participations in acceptances bought from others	1.5	0.9	0.8	1.5	0.5
Securities borrowed	2.7	3.5	5.4	5.9	6.7
Securities lent	2.2	3.1	4	4.5	3.9
Other significant commitments & contingencies	24.5	57.7	70.5	84.3	128.1

Table 1, continued

	1984	1985	1986	1987	1988
Memoranda:					
Loans originated & sold during period ending this quarter	50.1	75.6	107.7	192.1	280.4
Loans purchased during period ending this quarter	n/a	n/a	n/a	15.7	18.7
Notational value of all outstanding interest rate swaps	n/a	186.1	366.6	714.9	928.6
Mortgages sold, with recourse					
FNMA & FHLMC residential mortgage loan pools					
O/S principal bal. of mortgages sold or swapped	n/a	n/a	n/a	n/a	n/a
Amount of recourse exposure on these mortgages	n/a	n/a	n/a	n/a	n/a
Private residential mortgage loans	n/a	n/a	n/a	n/a	n/a
O/S principal bal. of mortgages sold	n/a	n/a	n/a	n/a	n/a
Amount of recourse exposure on these mortgages	n/a	n/a	n/a	n/a	n/a
Farmer Mac agricultural mortgage loan pools					
O/S principal bal. of mortgages sold	n/a	n/a	n/a	n/a	n/a
Amount of recourse exposure on these mortgages	n/a	n/a	n/a	n/a	n/a
Total, excluding memoranda items	1,438.4	1,953.6	2.471.3	3,686.8	4,445.9
Total assets (on-balance-sheet items)	2,492.5	2,707.6	2,907.5	2,955.2	3,064.2

Source: Call Reports (OCC, Ogilvie, October 1990).

Notes:
1. FX = foreign exchange
2. L/C = Letter of credit
3. O/S principal bal. = outstanding principal balance

Table 2

OBS Items (Schedule RC-L Off-Balance Sheet Variables)

1. Securities borrowed
2. Securities lent
3. Commitments to purchase when issued securities
4. Commitments to sell when issued securities
5. Notational value of interest rate swaps
6. SLC to U.S. addresses
7. SLC to non U.S. addresses
8. SLC participated to others
9. Commercial letters of credit
10. Commitments to purchase foreign currencies
11. Unused loan commitments
12. Commitments to purchase futures and forward contracts
13. Commitments to sell futures and forward contracts
14. Obligation to purchase under option contracts
15. Obligations to sell under options contract
16. Participations in acceptances conveyed to others
17. Participations in acceptances conveyed from others
18. Other significant commitments or contingencies
19. Loan sold or participated to others

The off-balance sheet variables consist of the following items:

OB	= 3+6+7-8-9+10+11
COMM	= 12+13+14+15+18
PART	= 8+16+17+19
SWAP	= 5
SLC	= 6+7-8
CLC	= 9
OBS	= OB + COMM + PART + SWAP + SLC + CLC

TABLE 3

Summary Statistics for Accounting Risk Variables,
Off-Balance Sheet Variables and Market Measures of Risk Variables[a]

Variable	Symbol	Mean	Standard Deviation
Risk Premium	RPRM	.01500	.00665
Asset Risk (GS)	SIGMA 1	1.55564	.35084
Asset Risk (GS)	SIGMA 2	.01470	.05095
Off-balance sheet groups	AOB	.97779	.94551
Commitments	ACOMM	.16469	.24067
Participations	APART	.09618	.27160
National Value of Swaps	ASWAP	.32129	.52079
Commercial Letters of Credit	ACLC	.01523	.01095
Standby Letters of Credit	ASLC	.07394	.04687
Total Off-Balance Items	AOBS	1.58013	1.69662
Financial Leverage	LEV	.94938	.01317
Diversification Index	DIV	1.74527	.67445
Credit Risk	ALOSS	.01341	.00956
Interest Rate Risk	AGAP	.05955	.13878
Dividend Payout Ratio	POR	.50910	.74757
Logarithm of Assets	ASIZE	16.65717	.99929

[a]: For a sample of 32 commercial banks and bank holding companies over 1984-1988 periods.

TABLE 4
POOLED TIME-SERIES AND CROSS-SECTION RESULTS
(DEPENDENT VARIABLE: RPRM)

Equations No.	Constant	AOB	ACOMM	APART	ASLC	ACLC	ASWAP	AOBS	LEV	DIV	AGAP	ALOSS	POR	ASIZE	$\bar{R}^2$	F(8,152)
1	-0.08 (-1.88)**	-0.001 (-1.91)**	---	---	---	---	---	---	0.09 (2.15)**	-0.0007 (-1.30)*	0.00002 (2.04)**	-0.173 (-3.26)***	.000008 (.09)	.0003 (.47)	.21	5.6***
2	-0.08 (-2.07)**	---	-0.002 (-1.32)*	---	---	---	---	---	0.10 (2.44)***	-0.0009 (-1.56)*	.00002 (1.94)**	-0.19 (-4.45)***	.00002 (.20)	-0.00007 (-0.15)	.20	5.4***
3	-0.11 (-3.20)***	---	---	-0.004 (-10.72)***	---	---	---	---	0.14 (3.57)***	-0.0009 (-1.72)**	.00001 (1.86)**	-0.20 (-5.64)**	-0.000006 (-0.06)	-0.00005 (-0.15)	.65	39.80***
4	-0.11 (-2.15)**	---	---	---	-0.011 (-0.64)	---	---	---	0.14 (2.68)***	-0.0012 (-1.77)**	.00001 (1.47)*	-0.23 (-4.90)***	.00009 (1.0)	-0.0003 (-0.30)	.18	4.82***
5	-0.09 (-2.49)**	---	---	---	---	.12 (3.06)***	---	---	.13 (3.37)***	-0.0004 (-.78)	.00002 (2.23)**	-.19 (-5.21)***	.00003 (.33)	-.00012 (-2.49)***	.24	6.67***
6	-.078 (-1.20)	---	---	---	---	---	-.0017 (-1.66)**	---	.09 (2.31)**	-0.0009 (-1.50)*	.00001 (2.05)**	-.17 (-3.39)***	.00002 (.11)	.00006 (.14)	.18	4.84***
7	-.083 (-2.05)**	---	---	---	---	---	---	-.0009 (2.74)***	.09 (2.15)**	-0.0008 (-1.35)*	.00002 (2.09)**	-.15 (-2.96)***	.000009 (.09)	.0006 (1.15)	.22	6.03***

NOTES:
1) RPRM is the annual default-risk premia on subordinated debt;
2) AOB, ACOMM, APART, ASLC, ACLC, ASWAP and AOBS represent seven off-balance sheet variables;
3) LEV, DIV, AGAP, ALOSS, POR and ASIZE represent financial leverage, diversification index, interest rate risk, credit risk, dividend payout and logarithm of assets respectively;
4) Numbers in the parentheses are t-statistics;
5) Significance level: * = 10%; ** = 5%; *** = 1%.

TABLE 5
POOLED TIME-SERIES AND CROSS-SECTION RESULTS
(DEPENDENT VARIABLE: SIGMA1)

Equations No.	Constant	AOB	ACOMM	APART	ASLC	ACLC	ASWAP	AOBS	LEV	DIV	AGAP	ALOSS	POR	ASIZE	$\bar{R}^2$	F(8,152)
1	3.66 (3.31)***	-.048 (-2.95)***	---	---	---	---	---	---	.67 (.59)	-.24 (-12.42)***	.0004 (2.68)***	-5.95 (-4.28)***	.0034 (1.47)*	-.10 (-5.51)***	.79	69.20 ***
2	3.48 (2.63)***	---	-.11 (-1.37)*	---	---	---	---	---	.038 (.02)	-.24 (-11.39)***	.00023 (.78)	-6.89 (-4.32)***	.0017 (.75)	-.13 (-5.88)***	.73	49.90 ***
3	3.25 (2.50)***	---	---	-.10 (-2.10)**	---	---	---	---	.27 (.20)	-.24 (-11.04)***	.00025 (.85)	-6.90 (-4.46)***	.0018 (.80)	-.13 (-6.40)***	.72	46.53 ***
4	2.22 (1.64)**	---	---	---	-1.27 (-2.66)***	---	---	---	.85 (.63)	-.23 (-10.91)***	.0002 (.72)	-7.66 (-5.20)***	.002 (.95)	-.10 (-3.48)***	.76	56.25 ***
5	4.53 (3.94)***	---	---	---	---	-.63 (-.64)	---	---	.97 (.80)	-.24 (-12.18)***	.0003 (2.37)***	-7.28 (-5.55)***	.0028 (1.24)	-.14 (-9.31)***	.80	72.18 ***
6	5.08 (4.82)***	---	---	---	---	---	-.12 (-3.87)***	---	1.94 (1.68)**	-.23 (-12.68)***	.0004 (2.73)***	-3.77 (-2.36)***	.0028 (1.21)	-.12 (-7.53)***	.82	84.22 ***
7	3.39 (2.72)***	---	---	---	---	---	---	-.038 (-3.18)***	.37 (.27)	-.23 (-11.83)***	.0002 (.92)	-4.71 (-2.73)***	.0018 (.81)	-.11 (-4.37)***	.75	55.83 ***

NOTES:
1) SIGMA1 is the annualized standard deviation of asset returns calculated from Gorton-Santomero (1989) subordinated debt option pricing methodology;
2) AOB, ACOMM, APART, ASLC, ACLC, ASWAP and AOBS represent seven off-balance sheet variables;
3) LEV, DIV, AGAP, ALOSS, POR and ASIZE represent financial leverage, diversification index, interest rate risk, credit risk, dividend payout and logarithm of assets respectively;
4) Numbers in the parentheses are t-statistics;
5) Significance level: * = 10%; ** = 5%; *** = 1%.

TABLE 6
POOLED TIME-SERIES AND CROSS-SECTION RESULTS
(DEPENDENT VARIABLE: SIGMA2)

Equations No.	Constant	AOB	ACOMM	APART	ASLC	ACLC	ASWAP	AOBS	LEV	DIV	AGAP	ALOSS	POR	ASIZE	$\bar{R}^2$	F(8,152)
1	.17 (1.55)*	-.0007 (-.51)	—	—	—	—	—	—	.12 (1.13)	-.0038 (-1.53)*	.0001 (1.82)**	.0097 (.12)	.0000012 (.012)	-.0033 (-1.69)**	.16	4.36 **
2	.11 (1.78)**	—	-.00041 (-.14)	—	—	—	—	—	.15 (1.31)*	-.0043 (-1.67)**	.00012 (2.00)**	.0034 (.037)	-.0000002 (-.002)	-.003 (-2.01)**	.19	5.36 **
3	.19 (1.73)**	—	—	-.00033 (-.21)	—	—	—	—	.14 (1.26)	-.0038 (-1.56)*	.00012 (1.91)**	-.00099 (-.01)	-.000001 (-.01)	-.0037 (-2.00)**	.18	4.74 **
4	.10 (.99)	—	—	—	-.14 (-2.76)***	—	—	—	.10 (1.03)	-.0039 (-1.49)*	.00013 (2.05)**	-.075 (-.84)	.00015 (1.13)	-.00008 (-.04)	.23	6.62 **
5	.25 (2.13)**	—	—	—	—	-.28 (-2.44)***	—	—	.19 (1.62)*	-.0046 (-2.19)**	.00014 (2.43)***	-.033 (-.33)	-.00002 (-.28)	-.004 (-2.35)***	.27	8.00 **
6	.21 (1.77)**	—	—	—	—	—	.0002 (.10)	—	.15 (1.27)	-.0049 (-1.79)**	.00013 (2.08)	.0027 (.025)	.0000001 (.001)	-.0042 (-2.14)**	.23	6.19 **
7	.19 (1.70)**	—	—	—	—	—	—	-.0003 (-.56)	.14 (1.27)	-.0042 (-1.67)**	.00012 (1.92)**	.019 (.21)	.000002 (.031)	-.0035 (-1.82)**	.19	4.97 **

NOTES:
1) SIGMA2 is the annualized standard deviation of asset returns calculated from Gorton-Santomero (1989) subordinated debt option pricing methodology when the on-balance debt is augmented by off-balance debt;
2) AOB, ACOMM, APART, ASLC, ACLC, ASWAP and AOBS represent seven off-balance sheet variables;
3) LEV, DIV, AGAP, ALOSS, POR and ASIZE represent financial leverage, diversification index, interest rate risk, credit risk, dividend payout and logarithm of assets respectively;
4) Numbers in the parentheses are t-statistics;
5) Significance level: * = 10%; ** = 5%; *** = 1%.

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