Capital Market Tests of Risk Exposure of Loan Sales Activities of Large U.S. Commercial Banks

M. Kabir Hassan
University of New Orleans

Abstract

This paper documents further evidence of a capital market reaction to the riskiness of banks that originate and sell loans employing five capital market tests. This study employs a contingent claims valuation model to calculate implied asset risk from bank debt and equity. These implied asset risk measures are better than equity risk measures because they incorporate the nonlinearity of the contingent claims nature of debt and equity, impacts of deposit insurance, and regulatory closure rules. Two implied asset variances and subordinated debt default risk premia, in conjunction with systematic and equity risk, are regressed against on–balance accounting risk variables and off–balance sheet loan sales activities using pooled cross–section and time–series analysis. This research finds that subordinated debt holders price loan sales as risk–reducing, not risk–increasing, bank activities. It appears that loan sales activities may contribute to the overall diversification of the bank asset portfolio.

Introduction

This paper deals with the risk exposure of loan sales (LNPART) by large commercial banks in the United States. Commercial loan sales involve the sale of loans originated by banks. Loan sales are structured so that the selling bank continues to service the loan, although the purchaser of the loan is entitled to principal and interest payments. There has been a dramatic increase in loan sales activities by banks in recent years. Call report information indicates that loans sold increased from $50 billion in 1984 to $280 billion in 1988, a 460 percent increase over the five year period.

Since the early 1980s commercial banks, spurred by financial market changes, improved technology, and tighter regulatory capital standards, have increased their sales of loans greatly. More recently advances in legal contracting and new data processing technology have made it possible for a large group of loans to be pooled and sold as a tradeable security, a procedure called *securitization*. Regulators are concerned, however, about the risk that banks retain by providing loan purchasers at least partial recourse or implicit guarantee if problems develop with a loan. Current capital regulation discourages recourse for credit risk by including such loans' full value in banks' capital requirements (Haubrich, 1989).

0747-5535/91/1600-0027 $01.00

Previous research has investigated the determinants and riskiness of loan sales (Pavel, 1988; Pavel and Phillis, 1987; James, 1988). These studies explore the riskiness of loan sales either employing theoretical models or empirically regressing implied asset risk from equity and CD rates against on–balance sheet and off–balance sheet loan sales activities. This paper reports five capital markets tests: systematic risk, equity risk, subordinated debt default risk premia, implied asset risk calculated from the Ronn–Verma (1986) option pricing model, and implied asset risk from the Gorton–Santomero (1990) subordinated debt option pricing model. The purpose of these tests is to examine the riskiness of banks with off–balance sheet loan sales activities.

The first test regresses the systematic risk of banks against on–balance sheet risk measures and bank loan sales activities. The second test purports to find an association between equity risk and on–balance sheet risk measures and loan sales. The purpose of these two tests is to determine whether equity participants price loan sales by banks as risk–increasing or risk–reducing activities.

The third test relates the subordinated debt risk premia to LNPARTs and other accounting measures of bank risk. The underlying premise of this test is that subordinated debt holders are more exposed to the risk of bank failure than are CD holders. The fourth test regresses implied asset risk over LNPARTs along with other bank accounting risk measures, where implied asset risks are calculated from a risk premia option pricing methodology (Gorton and Santomero, 1990). This test contends that subordinated debts are contingent claims whose costs are not linear or monotonic functions of bank risk. Moreover, the underlying risk is contingent upon the regulatory closure rule. Without recognizing these complications, linear risk premia regressions may be inadequate in addressing the market discipline of LNPARTs. The motivation of this test is that the implied asset risk from the risk premia option pricing model is better than risk premia in proxying total risk because it considers both the nonlinear nature of the contingent claims model and the impact of closure rules.

The fifth test associates implied asset risk with LNPARTs in addition to on–balance measures of bank risk, where implied asset risks are calculated from market values of bank equity and fixed deposit insurance premia (Ronn–Verma, 1986). The equity risk used in previous studies ignores deposit insurance and the protection of too–big–to–fail regulation. This test measures risk in a way that incorporates fixed deposit insurance premia and regulatory audit rules. The appeal of this test is that asset risk, instead of equity risk, is a better measure of risk because both bank debt holders and equity holders benefit from the current flat deposit insurance policy.

The standard approach of market studies of bank activities is to regress the equity or debt costs and/or market risk measures over on–balance sheet and income statement measures of risk and return. The basic issue in these studies is

whether market measures of bank risk are related significantly to book measures of bank risk. If significant relationships are found, then the market appears to control these banking activities. This paper contributes to the existing market discipline studies of bank off–balance sheet loan sales activities by reporting five capital market tests.

The Association Between Market Measures of Risk and Loan Sales

Commercial loan sales involve the sale of loans originated by banks to third parties. Most commercial loans today are sold either in the form of loan participations or loan strips. Under a loan participation, a bank will sell its loan for a period equal to its time to maturity and the buyer of a participation has no recourse to the selling bank if the loan defaults. Loan strips are short–dated pieces of a longer–term loan in which the selling bank retains the risk of borrower default. The selling bank usually puts up funds to support the loan until it matures. The principal buyers of bank–originated loans are foreign and domestic banks, insurance companies, pension plans, savings banks, and mutual funds.

The loan sales contracts are sold in participation forms so that the selling bank maintains a creditor–debtor relationship with the borrower. The selling bank retains servicing rights on any loans sold, enforces loan covenants, and monitors the financial condition of the borrower. The selling bank receives fees in the form of a spread for performing these services. The spread represents the difference between the rate paid by the borrower to the bank and the return promised to the purchaser of the loan.

The payments that a purchaser receives from a loan sale depend on the recourse provisions attached to the loan. In a loan sale without recourse, the purchaser receives contractual payments and, in loan default, receives whatever cash flows the loan generates. In a loan sale with recourse, the purchaser receives a put option that allows the buyer to sell a troubled loan to the selling bank. Loans are rarely sold with full recourse, however, because federal regulations require a bank selling loans with recourse to hold reserves against these loans and to count them as assets when calculating capital requirements.

The theoretical literature suggests different motivations and reasons for banks to originate and sell loans. The ability of banks to originate loans and then sell them appears to contradict the theoretical assertion that bank loans are nonmarketable securities. In an imperfect capital market with information asymmetries between borrower and lender, banks produce and sell information that the market participants cannot produce. If the market participants are willing to purchase loans originated by banks without recourse, then they could have bought these loans directly from borrowers and there would be no need for banks.

Gorton and Pennachi (1989) suggest that the ability of banks to originate and sell loans could be explained if such loan sales could guarantee the loans sold implicitly. Banks could guarantee the loans sold implicitly in two ways. First, the bank creditor–borrower relationship provides incentives to maintain loan quality and eliminates the need for any guarantee provided by the selling bank to the loan purchaser. As a result, the bank risk does not change because of loan sales. Second, the selling bank implicitly may give a put option to the loan buyer—the spread on loan sales should reflect the risk premium for probable default by selling banks. The empirical evidence suggests the hypothesis of implicit guarantees in the sense that yield spreads on loan sales are related significantly to the perceived riskiness of the selling bank.

Benveniste and Berger (1987) argue that loan sales may reduce a bank's cost of capital. Assuming a multiclass of borrowers with different degrees of risk–aversion, Benveniste and Berger argue that funding a group of risky assets with a single class of liabilities is suboptimal. A bank can reduce its cost of funding by issuing low risk securities to investors with a high degree of risk–aversion and high risk securities to those with a low degree of risk–aversion. Benveniste and Berger show that loans sold with recourse can provide a way of issuing low risk securities to risk–averse investors. Moreover, the remaining balance sheet assets can be funded by issuing high risk securities to less risk–averse investors.

Loan sales are principally defensive reactions by banks to regulation (Flannery, 1989; Greenbaum and Thakor, 1987; Pavel and Phillis, 1987; Pennachi, 1988). Banks have comparative advantage in originating loans but disadvantage in warehousing low risk, high value loans. Deposit insurance premia, foregone interest on reserve requirements, and capital requirements in excess of what banks would hold in the absence of such regulation make such loans costly to fund and thus unprofitable. A bank may sell loans in order to originate other loans. A riskier bank may sell a less risky loan if a bank has to issue risky debt and equity to fund the loan because the cost of funding the loan will exceed the return earned on the loan. James (1988) argues that if the benefits from holding a loan accrue to the depositors rather than to the shareholders, the loan will not be booked; it will be originated and then sold.

Flannery (1989) argues that bank regulators force banks to write off bad loans while appreciating loans must be carried at book value. This generates an understatement of bank equity that is available for loan losses. The bank sells appreciating low risk and high value loans in order to realize capital gains and correct the understatement of book equity capital. Flannery's model generates two conclusions. First, banks with low capital and high net charge–offs will sell more loans than those with high capital and low net charge–offs. Second, banks with high market–to–book equity values will sell more loans in order to bring

market values in line with book values than will banks with low market–to–book values.

Diversification has been cited as another reason for loan sales (Pavel and Phillis, 1987; Pavel, 1988). A bank may sell loans in order to buy or originate other loans for its portfolio, thus benefitting from portfolio diversification.

Rosenthal and Ocampo (1988) argue that loan securitization can allow banks not only to reduce risks through diversification, but also to reduce interest rate risk and provide more information about the loan pool to the securities market. They argue that the cost of a securitized loan is significantly less than a balance sheet loan.

Pavel and Phillis (1987) use multivariate logit and probit analyses to examine key determinants of loan sales. They find that regulatory taxes in the form of reserve and capital requirements have an impact on loan sales, but that a bank's comparative advantage in originating and servicing loans (measured by the ratio of noninterest expense to loans) and its level of diversification are the primary factors affecting loan sales by commercial banks. The results also indicate that banks are likely to start selling loans when capital ratios are low and loan charge–offs are high. Pavel (1988) analyzes three reasons for loan sales—funding, diversification, and capital—by empirically testing their relevance to, and implications for, bank risk. Significantly, Pavel uses implied asset risk calculated from the Ronn–Verma (1986) option pricing methodology. Funding, diversification, and regulation all seem to be factors motivating loan sales, but the use of loan sales to increase diversification or avoid regulation does not affect bank risk significantly any more than do other means to achieve these ends. Overall, loan sales have little effect on bank risk.

The various theoretical explanations of why banks sell loans are not mutually exclusive. The issue of which explanations have significant explanatory power is an empirical question on which there is limited evidence. The bank creditor–borrower relationship provides incentives to banks to monitor customers, specialize in credit evaluation, and maintain loan quality. This implies that banks will originate low risk loans to sell and to hold in their portfolios. In addition, banks may sell loans to originate other loans and hence diversify their asset portfolio. This research focuses upon the risk–reducing diversification potential of bank loan sales activities using five capital market tests of such activities.

Analysis of Methodology

Justification of Empirical Model Specification

The following linear model is estimated over cross–section and time–series data using the generalized least squares (GLS) technique to test the risk behavior of bank loan sales activities. The expected signs of partial derivatives appear on each independent variable.

$$\begin{matrix} & & ? & + & - & + & + & - & - \\ \text{(1) Market Risk Measure} & = & \text{f(LNPART,} & \text{LEV,} & \text{DIV,} & \text{LOSS,} & \text{GAP,} & \text{SIZE,} & \text{POR)} \end{matrix}$$

where the five alternative market risk measures are:

- Beta (systematic risk);
- Standard deviation of equity return;
- Default risk premium of subordinated debt;
- Bank implied asset risk (Ronn–Verma option pricing methodology);
- Bank implied asset risk (Gorton–Santomero subordinated debt pricing methodology;

and where:

LNPART	=	Dollar volume of loan sales deflated by total assets;
LEV	=	Ratio of total liabilities to total assets;
DIV	=	An index of diversification of the bank's loan portfolio;
LOSS	=	Ratio of loan–loss reserves to total assets;
GAP	=	(Total market rate assets – total market rate liabilities) over total assets;
SIZE	=	Logarithm of bank assets;
POR	=	Cash dividends over net income.

These five capital market measures of risk are used to examine how both equity and debt holders react to bank loan sales activities. Equity risk includes both financial and business risk. The two measures of asset risk reflect fundamental business risk after controlling for the impact of deposit insurance subsidies and the regulatory examination rule. These two asset risk measures allow examination of the differences in risk of the bank assets rather than potential differences in risk–sharing between stockholders, bondholders, and the deposit insurance agency.

LEV, DIV, LOSS, GAP, SIZE, and POR are proxies for the leverage ratio, diversification index, credit risk, interest rate risk, operating risk, and dividend

payout ratio. This study also uses the ratio of nonperforming loans to total assets and the ratio of net charge–offs to total assets as alternative proxies for credit risk. The results from these two proxies are similar to those obtained from the use of LOSS.

These balance sheet and income statement variables are accounting measures of bank risk and are used as control variables in this research. The primary focus is the coefficient of the LNPART off–balance sheet variable. It is argued that the signs and statistical significance of the LNPART variable will help test the diversification potential of off–balance sheet sales activities after accounting for such effects by on–balance sheet control variables. The expected relationship between dependent and independent variables is rationalized as follows.

Commercial banks use a high degree of financial leverage. Because a higher degree of leverage increases financial risk, LEV is expected to be related positively to market measures of risk. DIV is a Herfindahl index and is calculated as:

$$DIV = \frac{1}{\sum_{i=1}^{10} L_i^2}$$

where:

L_i = Loan to asset ratio for loan type i at the end of the year, 1984 through 1988.

Like Pavel (1988), ten loan categories from schedule C of the report of condition are used. The construction of a diversification index implies that the larger the diversification index, the greater is the level of diversification in the loan portfolio. Therefore, DIV is expected to be related inversely to market measures of risk.

LOSS represents the probability of future defaults that may be expected to reduce earnings and dividends. Other things equal, a higher LOSS reflects a higher degree of expected loss in the loan portfolio. Therefore, LOSS is expected to be related positively to market measures of risk. Dividend stabilization policy states that firms tend to follow a stable dividend policy and are reluctant to cut dividends once a certain level is established. Consequently, banks with a high degree of earnings variability distribute lower dividends. Therefore, high dividend payouts are associated with low risk and, hence, POR is expected to be related inversely to market measures of risk.

SIZE is an indirect measure of operating risk. Banks with higher asset bases are likely to be more able to diversify the operating risk associated with either product lines or market lines. Large banks also are more able to utilize personnel

with specialized skills to engage in, and benefit from, the diversification potential of off–balance sheet LNPART activities. Therefore, SIZE is expected to reduce market–related risk measures.

GAP is the difference between market rate assets and liabilities with maturities less than or equal to one year. A positive GAP value indicates a bank is asset sensitive, and a negative value indicates a bank is liability sensitive. Positive GAP values indicate the bank is exposed to the risk that interest rates will fall, and negative values indicate that the bank is exposed to the risk that interest rates will rise. The greater the absolute value of GAP, the more the bank is exposed to unexpected changes in interest rates. Therefore, GAP is expected to be related positively to market–related risk measures.

These on–balance accounting measures of bank risk have been used in previous studies. Beighley, Boyd, and Jacobs (1975) find that dividend payout, earnings growth, size, loan loss rate, and leverage are the most important determinants of the market prices of bank equities. Lee and Brewer (1987) determine that leverage, loan–loss, dividend payout, and gap variables are related significantly to market measures of bank risk. Jahankhani and Lynge (1980) find similar variables are related significantly to systematic risk and equity risk. Pettway (1976) finds that dividend and earnings are significant in explaining total and systematic risk. Baer and Brewer (1986) regress CD rates over various accounting risk measures and find that these rates are related positively to accounting risk measures over the period 1979 to 1982. Avery, Belton, and Goldberg (1988) conduct a cross–section study of subordinated debt pricing 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 Gordon and Santomero (1990) used a contingent pricing model and regulatory closure rule to examine the relationship between bank risk and accounting risk factors. They find that credit and interest risk variables are insignificant in models in which back debt is assumed homogeneous with one year maturity.

Although these balance sheet and income statement variables have been used mostly in explaining bank systematic risk, equity risk, and liability costs, the same variables can be used in explaining subordinated debt risk premia and implied asset risk. For example, the dividend payout ratio affects equity risk, and equity risk is used as an input in the calculation of asset risk. Therefore, dividend payout is expected to be related to implied asset risk. Similarly, banks with a high degree of earnings variability tend to lower dividend payments. As a result, the higher the dividend payout, the lower is the overall risk exposure of the banking firm; therefore, the subordinated debt holders are exposed to less risk. Therefore, dividend payout is expected to be related to the risk premium.

This research employs similar bank accounting risk variables in addition to the dollar volume of loan sales to examine the riskiness of LNPARTs and the existence of market discipline. All these variables have been deflated by total assets to avoid heteroskedasticity in the regression analysis.

Discussion of Bank Market Measures of Risk

Five market measures of bank risk are used in this research.

Beta or Systematic Risk

The following market model is estimated for each bank over the study period to calculate beta:

$$(2)\ R'_{it} = \alpha_i + \beta_i R'_{Mt} + e_{it}$$

where:

$R'_{it} = R_{it} - R_{ft}$ = *Ex post* return for the ith bank over period t in excess of the risk free rate of return;

$R'_{Mt} = R_{Mt} - R_{ft}$ = *Ex post* return on the market portfolio over period t in excess of the risk free rate of interest;

α_i = Intercept

e_{it} = ith bank–specific factor that is independent of R'_{Mt};

β_i = Slope of the linear relationship between bank i's return and the market return. This slope is called beta.

The beta estimates reflect differing investor expectations about the relationship between each bank's return and the market return. Each beta estimate is a market measure that incorporates all information about the bank as digested by market participants.

Standard Deviation of Bank Equity Return

Because sample equity returns data over the study period are available, the standard deviation of equity returns will be estimated using this formula:

$$\sigma_{RE} = \sqrt{\sum_{t=1}^{n} (\bar{K}_t - \bar{K}_{Avg})^2}$$

where:

$\bar{K}_t$ = *Ex post* equity return in period t;
$\bar{K}_{Avg}$ = Average annual return during the year.

Default Risk Premium of Subordinated Debt

Subordinated debt holders are subject to a larger degree of loss than are uninsured depositors. Market discipline by uninsured depositors appears limited by the depositors' ability to withdraw funds quickly once a problem situation becomes apparent and 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 generally is not assumed by the purchasing bank in a purchase and assumption technique. Thus, subordinated debt holders are generally subject to greater risk than are uninsured depositors. The potential of subordinated debt to enhance market discipline is examined empirically by calculating the yield spread between subordinated debt and Treasury securities of identical maturities and regressing over LNPARTs.

The risk premia for noncallable bank holding company (BHC) subordinated debt are calculated directly as the difference between their yields to maturity and those of Treasury securities with the same maturity. The risk premium used in this research is the average risk premium outstanding for each BHC for each year end 1984 through 1988. Therefore, these risk premia do not suffer from the confounding effects from callability of bonds. Similar methods also are used by Avery, Belton, and Goldberg (1988) and Gorton and Santomero (1990).

Bank Implied Asset Risk Under the Ronn–Verma Option Pricing Methodology

The first measure of asset risk in this study is the risk–based deposit insurance premium estimated by Ronn and Verma (1986). Ronn and Verma demonstrate that empirical estimation of risk and deposit insurance premium is tractable when time–series data on the market value of a bank's equity and the book value of its debt are available. They model market perceptions of the FDIC bailout policy in their construction to eliminate the bias in implied asset values and their variances.

The equity of a bank can be written as:

$$(4)\ E = VN(x) - \rho BN\left(x - \sigma_v\sqrt{T}\right)$$

where:

$$(5)\ x = \frac{\left[\ln\frac{V}{\rho b} + \frac{\sigma_v^2 T}{2}\right]}{\sigma_v\sqrt{T}}$$

$$\sigma_v = \sigma_E \frac{E}{VN(x)}$$

where:

E	=	Market value of equity;
σ_E	=	Instantaneous standard deviation of equity return;
V	=	Unobserved postinsurance value of bank assets;
B	=	Book values of debt liabilities;
σ_v	=	Instantaneous standard deviation of asset return;
T	=	Time until the next audit of bank assets.

Equations (4) and (5) can be solved simultaneously for two unknowns, v and σ_v, for each observed E and σ_E. An exogenously determined closure rule is required to solve these simultaneous equations. Banks are audited each year, and at audit time a bank is closed if $V_T < \rho B$ where V_T is the terminal value of assets at time T and $\rho \leq 1$ is a policy parameter. Therefore, the maturity of debt is assumed to be 1. Ronn and Verma show that a ρ of .97 yields an aggregate deposit premium weighted average of about 1/12 of 1 percent, the flat premium historically charged by the FDIC. Once implied asset variances (σ_v) are calculated, they will be regressed over LNPARTs to test for their risk behavior.

Bank Implied Asset Risk Under the Gorton–Santomero Subordinated Debt Pricing Methodology

The second measure of bank risk is the implied asset volatility calculated from the subordinated debt risk premia option pricing methodology (Gorton and Santomero, 1990). Gorton and Santomero demonstrate that these implied asset volatilities are better than risk premia in proxying total risk because they consider both the nonlinear nature of the contingent claims model and the impact of closure rules.

The risk premium has been modeled as an option in the following way:

$$(6)\ R - R_f = \frac{-\ln\left[\frac{V}{B}\exp(R_f T)\, N(-d_1) + N(d_2)\right]}{T}$$

where:

$$d_1 = \frac{\left[\ln\frac{V}{B} + \left(R_f + \frac{\sigma^2}{2}\right) T\right]}{\sigma\sqrt{T}}$$

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

where:

σ^2 = Instantaneous asset variance;
R = Yield on subordinated debt and debenture;
R_f = Yield on Treasury securities of the same maturity;
V = Value of bank assets;
T = Maturity of subordinated debt (assumed to be 1);
B = Face value of debt;
N(•) = Univariate cumulative normal distribution function.

It can be seen that the greater the volatility of a bank's assets, the higher the default risk premia.

Given the default risk premium and other necessary information, the above pricing formula is inverted to find the volatility of assets, σ^2, implied by that default risk premium. The maturity of debt 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 regulators. Once implied asset risks are calculated, they will be regressed over LNPARTs to examine their risk behavior.

Calculations of both implied asset variances (Ronn and Verma and Gorton and Santomero) 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 models in discrete time has been demonstrated by Gorton and Santomero (1990) and Ronn and Verma (1986) in their market studies of bank risk. Moreover, the interest rate is assumed to be nonstochastic. Ronn and Verma (1986) show that

the relative contribution of interest rate variance to overall variance appears to be small.

Data and Empirical Results

Data Analysis

This research focuses on the largest U.S. banks and BHCs, as these have publicly traded stock and subordinated debt and debentures. The sample is restricted to lead BHC banks that account for the majority of bank holding company assets. The sample banks account for 60 percent to 80 percent of BHC assets. Therefore, it can be argued that data from the BHC's lead bank reasonably proxy for the financial condition of the entire BHC, even though many of these BHCs have nonbank assets.

Market values of equity for each bank or bank holding company are collected from Compustat yearly tapes. Daily bank stock returns and market returns are collected from the Center for Research in Security Prices (CRSP) and the NASDAQ daily tapes. Data on yield measures are gathered on all BHCs for bank subordinated debt, debentures, and capital notes that are traded publicly on the NYSE, AMEX, and NASDAQ with quoted bid and sale prices from Moody's and Standard & Poor's bond manuals at the end of the year from 1984 to 1988. To make each BHC debt issue as homogeneous as possible, all zero coupon issues and floating rate issues are dropped from the sample. This produces 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 BHCs in 1988. Virtually all of these bonds were issued against the BHCs rather than against the bank. There is a fair amount of heterogeneity in terms of maturity, coupons, issue size, and callability. About one–fourth of these debt issues are not callable. 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 BHC noncallable debt are collected from *Moody's Bond Records*. The risk premium of each issue of BHC noncallable debt is the difference between the yields of debt and Treasury securities of identical maturity. The risk premium (RPRM) used in this study is the average premium of all outstanding issues for each BHC for each year.

The different on–balance sheet accounting risk variables are constructed, as defined earlier, from the reports of condition and reports of income filed by the banks with the FDIC. The LNPART variable is from schedule RC–L of the FDIC call and income reports. These reports exclude loans sold with the reporting bank's endorsement or guarantee. The risk premia and market values of

equity for each BHC are matched against on–balance measures of risk and LNPARTs from the FDIC reports. This results in a final sample of 32 banks and BHCs for each year.

Betas (β) are calculated from daily security returns for each bank for which 200 or more trading days are available each year from CRSP and the NASDAQ tapes. The standard market model is used in this study to estimate betas, and the market index used is an equally weighted market index. The standard deviation of equity return (σ_{RE}) is the annualized standard deviation of daily equity returns. σ_{RE}s are calculated for those banks for which 200 or more trading days are available on the CRSP and NASDAQ tapes.

σ_{RA1} is defined as the standard deviation of asset return and is calculated for each bank for each year 1984 through 1988 using the Ronn–Verma option pricing methodology. A system of two nonlinear simultaneous equations (equations (4) and (5) above) are solved for two unknowns, asset value (V) and the standard deviation of asset return (σ_{RA1}), by a numerical routine for each observed yearly market value of equity and annualized standard deviation of equity return (σ_{RE}). A subroutine, NEQNF, in the International Mathematical and Statistical Library (IMSL), is used to solve the simultaneous equation system. The initial estimates used for V are the sum of the market value of equity and face value of debt. The initial estimates for σ_{RA1} are σ_{RE} scaled down by leverage ratios. The cumulative normal distribution function is calculated using a polynomial approximation developed by Cox and Rubinstein (1985). The convergence of the solution is not sensitive to initial estimates.

σ_{RA2} is the implied asset risk calculated from the Gorton–Santomero model. The pricing formula (equation (6) above) is inverted, with all necessary input given, to calculate asset risk. A Fortran program was written to solve for unknown standard deviations of asset returns implied by the Gorton–Santomero nonlinear subordinated debt option pricing model. Both σ_{RA1} and σ_{RA2} are used as the dependent variables in the regression analysis. The descriptive statistics of five market measures of risk, on–balance accounting measures of bank risk, and LNPARTs are given in Table 1.

Analysis of Results

Table 2 presents correlation coefficients among all accounting risk variables and five market measures of risk. Three conclusions can be drawn from these coefficients. First, the five market measures of risk are not highly correlated, implying that they represent different measures of risk. Second, the correlations between the LNPART variable and two measures of market risk from debt holders' perspectives (RPRM, σ_{RA2}) are negative and statistically significant. The correlations between the LNPART variable and three measures of risk from

equity holders' perspectives (β, σ_{RE}, and σ_{RA1}) are low and not statistically significant. Third, the correlations among on–balance accounting risk variables and off–balance sheet LNPART are generally low, indicating that the multicollinearity problem is not serious and that these variables proxy different aspects of bank balance and off–balance sheet risk. Only GAP and LOSS are significantly negatively correlated with each other, implying a multicollinearity problem.

To further investigate whether the five capital market risk measures are different from each other, two statistical tests are employed. First, an F–test that tests the null hypothesis that the means of all five risk measures are equal is rejected at the 1 percent significance level (F = 642). Second, Bartlett's homogeneity of variance test that tests the null hypothesis that the variances of all five market risk measures are equal also is rejected at the 1 percent significance level ($\chi^2 = 3281$).

These correlation coefficients indicate only bivariate relationships and do not account for the presence of other variables in the equation. Therefore, a multivariate analysis is performed using multiple regressions. Table 3 presents the coefficient estimates of regression model (1) using the five different market measures of risk as dependent variables. A pooled cross–section and time–series model instead of simply ordinary least squares (OLS) was employed to perform econometric analysis for two reasons. First, cross–section or time–series data alone (32 cross–sections and five time periods) do not yield sufficient degrees of freedom in regression analysis. Second, regression based on cross–section data cannot be used to account for shifts in market measures of risk and accounting data through time. Time–series analysis alone cannot be used to conduct interbank relationships and comparisons. A pooled cross–section and time–series analysis allows for simultaneous consideration of intertemporal movements and cross–sectional differences.

The coefficients of LNPART are insignificant in explaining systematic risk and equity risk. These results indicate that the equity market does not affect bank loan sales activities. Moreover, the coefficient of loan sales is insignificant in explaining the Ronn–Verma implied asset risk measures (σ_{RA1}). This finding is consistent with Pavel's (1988) discovery that loan sales have an insignificant effect on bank risk.

The coefficients of LNPART, however, are significantly negative in explaining subordinated debt risk premia and the Gorton–Santomero implied asset risk. These results indicate that bank loan sales are priced as risk–reducing, not risk–enhancing, activities of banks by subordinated debt holders. This finding is also consistent with the idea that LNPARTs may contribute to the overall diversification of the bank asset portfolio. This may reduce the probability of bank failure (and hence bank risk) which induces subordinated debt holders to reduce their risk premia on these loan sales activities. This result is also consis-

tent with the idea that a market discipline of off–balance sheet loan sales activities exists. These regression results support the results of Gorton and Santomero and extend these results to LNPART activities.

The accounting measures of risk variables generally retain their expected signs. The DIV variable is significantly negative in explaining all five market measures of risk. The LEV variable has the expected positive sign and is statistically significant in all but one of the risk measure models. The coefficient of payout ratio variable has the expect negative sign, but is statistically significant only for the equity risk model. The SIZE variable has the expected significant negative coefficients for the implied asset risk and equity risk models.

The coefficient of credit risk is positive and significant for models explaining beta, equity risk, and implied asset risk calculated from the Ronn–Verma methodology. This variable is significantly negative, however, for models explaining the risk premium and the Gorton–Santomero measure of risk. The coefficient of interest rate risk variable is positive and significant for the risk premium model. This variable has, however, unexpected significant negative signs for the equity risk and the Ronn–Verma measure of implied asset risk models. The perverse signs of these two accounting risk measures (LOSS and GAP) may be the result of multicollinearity between these variables. One possible explanation for the unexpected negative coefficient of LOSS is that investors may have a preference for banks that exhibit aggressiveness in their lending practices, despite its short–term detrimental effects. Similarly, one explanation for the unanticipated negative coefficient of the GAP variable is that banks may use high GAP values to hedge their asset portfolios and hence reduce risk. The coefficients of on–balance measures of accounting risk variables generally agree with the earlier studies of Pettway (1976), Lee and Brewer (1987), and Jahankhani and Lynge (1980).

The equity risk model has higher $\bar{R}^2$s than does the systematic risk model (.23 versus .14). Because equity risk consists of both systematic risk and company–specific risk, certain on–balance measures of risk such as credit risk and off–balance sheet loan sales are expected to affect mostly company–specific risks rather than systematic risks. The Ronn–Verma asset risk model has a higher $\bar{R}^2$ than does the equity risk model (.44 versus .23). Similarly, the Gorton–Santomero model has a higher $\bar{R}^2$ than does the risk premia model (.72 versus .65). These results imply that both implied asset risk variables are better than either equity or risk premia models in proxying total risk because these two asset risk measures explain a larger portion of total risk. Moreover, the pooled cross–section and time–series analysis of LNPART banking risk provides better coefficient estimates (increased t–statistics) and increases the statistical significance of models (increased F–statistics).

Summary and Conclusions

The purpose of this paper has been to examine the capital market reaction to bank off–balance sheet loan sales activities. The capital market perception of LNPARTs has been reexamined using implied asset risks calculated from the option pricing model, in conjunction with systematic risk, equity risk, and default risk premia. The results from five capital market tests show that LNPARTs do not affect bank systematic risk, equity risk, and Ronn–Verma implied asset risk and that LNPARTs reduce significantly risk premia borne by subordinated debt holders and implied asset risk calculated from the Gorton–Santomero subordinated debt option pricing methodology. Several accounting bank risk variables also show statistically significant correlations with market measures of risk.

The finding of this research is consistent with the existence of market discipline of bank loan sales activities. The uninsured subordinated debt holders, who are subject to a larger risk of loss than are equity holders and deposit holders, view loan sales as risk–reducing, not risk–increasing, activities of banks. It appears that loan sales contribute to the overall diversification of the bank asset portfolio. Therefore, it may be inappropriate to restrict loan sales activities severely by government regulation.

References

1. Avery, Robert B., Terrence M. Belton, and Michael A. Goldberg, "Market Discipline in Regulating Bank Risk: New Evidence From the Capital Markets," *Journal of Money, Credit and Banking*, 20 (November 1988), pp. 597-610.

2. Baer, Herbert, and Elijah Brewer, "Uninsured Deposits as a Source of Market Discipline: Some New Evidence," *Economic Perspectives*, Federal Reserve Bank of Chicago, 11 (September/October 1986), pp. 23-31.

3. Beighley, H. Prescott, John H. Boyd, and Donald P. Jacobs, "Bank Equities and Investor Risk Perceptions: Some Entailments to Capital Adequacy Regulation," *Journal of Bank Research*, 6 (Autumn 1975), pp. 190-201.

4. Benveniste, Lawrence M., and Allen N. Berger, "Securitization With Recourse: An Investment That Offers Uninsured Bank Depositors Sequential Claims," *Journal of Banking and Finance*, 11 (September 1987), pp. 403-424.

5. Chang, Hui-Shyong, and Cheng-Few Lee, "Using Pooled Time-Series and Cross-Section Data to Test the Firm and Time Effects in Financial Analyses," *Journal of Financial and Quantitative Analysis*, 12 (September 1977), pp. 457-471.

6. Flannery, Mark J., "Capital Regulation and Insured Banks' Choice of Individual Loan Default Risks," *Journal of Monetary Economics*, 24 (September 1989), pp. 235-258.

7. Gorton, Gary, and George Pennachi, "Are Loan Sales Really Off-Balance Sheet?" *Journal of Accounting, Auditing and Finance*, 4 (Spring 1989), pp. 125-145.

8. Gorton, Gary, and Anthony M. Santomero, "Market Discipline and the Valuation of Bank Subordinated Debt," *Journal of Money, Credit and Banking*, 22 (February 1990), pp. 118-128.

9. Greenbaum, Stuart, and Anjan V. Thakor, "Bank Funding Modes: Securitization Versus Deposits," *Journal of Banking and Finance*, 11 (September 1987), pp. 379-402.

10. Hassan, M. Kabir, "Off-Balance Sheet Items and Risk-Taking Behavior of Commercial Banks," working paper presented at the 1990 annual meetings of the Financial Management Association.

11. Haubrich, Joseph G., "An Overview of the Market for Loan Sales," *Commercial Lending Review*, 4 (Spring 1989), pp. 39-47.

12. Jahankhani, Ali, and Morgan J. Lynge, "Commercial Bank Financial Policies and Their Impact on Market-Determined Risk," *Journal of Bank Research*, 11 (Autumn 1980), pp. 169-178.

13. James, Christopher, "The Use of Loan Sales and Standby Letters of Credit by Commercial Banks," *Journal of Monetary Economics*, 22 (1988), pp. 395-422.

14. Kmenta, J., *Elements of Econometrics*, 2nd edition (New York: MacMillan, 1986).

15. Lee, Cheng-Few, and Elijah Brewer, "The Association Between Bank Stock Market-Based Risk Measures and the Financial Characteristics of the Firm: A Pooled Cross-Section and Time-Series Approach," *Proceedings of a Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, 1987, pp. 285-315.

16. Lynge, Morgan, and Cheng-Few Lee, "Total Risk, Systematic Risk, and Off-Balance Sheet Risk for Large Commercial Banks," working paper, University of Illinois at Urbana-Champaign, 1987.

17. Pavel, Christine A., and David Phillis, "Why Commercial Banks Sell Loans: An Empirical Analysis," *Economic Perspectives*, Federal Reserve Bank of Chicago, 11 (May/June 1987), pp. 3-14.

18. Pavel, Christine, "Loan Sales Have Little Effect on Bank Risk," *Economic Perspectives*, Federal Reserve Bank of Chicago, 12 (March/April 1988), pp. 23-31.

19. Pennachi, George, "Loan Sales and the Cost of Bank Capital," *Journal of Finance*, 43 (June 1988), pp. 375-396.

20. Pettway, Richard H., "Market Tests of Capital Adequacy of Large Commercial Banks," *Journal of Finance*, 31 (June 1976), pp. 865-875.

21. Pyle, D., "Regulation of Off–Balance Sheet Banking Discussion," *The Search for Financial Stability: The Past Fifty Years*, Federal Reserve Bank of San Francisco (1985), pp. 185-189.

22. Ronn, Ehud, and A.K. Verma, "Pricing Risk–Adjusted Deposit Insurance: An Option–Based Model," *Journal of Finance*, 41 (September 1986), pp. 871-895.

23. Rosenthal, James A., and Juan M. Ocampo, "Analyzing the Economic Benefits of Securitized Credit," *Journal of Applied Corporate Finance*, 1 (Fall 1988), pp. 32-44.

Table 1
Descriptive Statistics and Expected Signs of Variables to be Used in Regression Analysis

Variable	Average Value	Standard Deviation	Expected Relationship With Risk Measures
Systematic Risk (β)	.85337	.40162	
Equity Risk (σ_{PE})	.01828	.01124	
Risk Premium (RPRM)	.015	.00665	
Asset Risk 1 (σ_{RA1})	.00155	.00179	
Asset Risk 2 (σ_{RA2})	1.55564	.35084	
Loan Sales (LNPART)	.09618	.27160	?
Financial Leverage (LEV)	.94938	.01317	+
Diversification Index (DIV)	1.74527	.67445	-
Credit Risk (LOSS)	.01341	.00956	+
Interest Rate Risk (GAP)	.05955	.13878	+
Dividend Payout Ratio (POR)	.50910	.74757	-
Logarithm of Assets (SIZE)	16.65717	.99929	-

Table 2
Correlation Coefficients
N = 160

	RPRM	β	σ_{RE}	σ_{RA1}	σ_{RA2}	LNPART	LEV	DIV	GAP	LOSS	POR	SIZE
RPRM	1.000											
β	-.1239	1.000										
σ_{RE}	-.1899	.3765	1.000									
σ_{RA1}	-.1192	.0589	-.0266	1.000								
σ_{RA2}	.3572	.0372	-.0567	.2685	1.000							
LNPART	-.7012	.0030	.0146	-.0932	-.4073	1.000						
LEV	.0788	.0828	.0700	.1870	.4558	.1467	1.000					
DIV	-.0035	-.0128	-.0517	-.0804	-.4626	-.0215	-.1787	1.000				
GAP	.0946	.0027	-.1080	-.0211	.1547	-.0486	-.1697	.1586	1.000			
LOSS	.1728	.0661	.2156	.2025	-.4561	.2210	.5438	-.1383	-.7573	1.000		
POR	.0338	-.0643	-.0481	-.0035	.0761	-.0125	-.0517	-.0059	.0175	-.0815	1.000	
SIZE	-.1594	.0805	.1428	-.3031	-.4969	.2940	.1773	.0176	-.1045	-.3031	.2340	1.000

Table 3
Coefficient Estimates of Empirical Models

Independent Variables (On–Balance and Off–Balance Sheet Items	Dependent Variables (Market Measures of Risk) Beta (β)	Equity Risk (σ_{RE})	Risk Premium (RPRM)	Asset Risk 1 (σ_{RA1})	Asset Risk 2 (σ_{RA2})
LNPART	-.02 (-.16)	-.0022 (-1.11)	-.004 (-10.72)***	.0001 (.80)	-.10 (-2.10)**
LEV	10.53 (4.75)***	.13 (2.67)***	.14 (3.57)***	.034 (5.10)***	.27 (.20)
DIV	-.087 (-2.55)***	-.0015 (-1.53)*	-.0009 (-1.72)**	-.0002 (-2.34)***	-.24 (-11.04)***
GAP	-.00002 (-.45)	-.00001 (-1.55)*	.00001 (1.86)**	-.000003 (-2.04)**	.00025 (.85)
LOSS	9.18 (3.48)***	.28 (4.85)***	-.20 (-5.64)**	.025 (3.64)***	-6.90 (-4.46)***
POR	-.0047 (-.68)	-.00009 (-2.01)**	.000006 (-.06)	-.000004 (-.68)	.0018 (.80)
SIZE	-.021 (-.78)	.0011 (2.53)***	-.00005 (-.15)	-.0005 (-9.07)**	-.13 (-6.40)***
Constant	10.54 (4.76)***	.12 (2.53)***	-.11 (-3.20)***	.043 (6.63)***	3.25 (2.50)***
$\bar{R}^2$	.14	.23	.65	.44	.72
F (8,152)	3.54***	6.47***	39.80***	17.26***	46.53***

Two tail t–tests are reported for LNPART
One tail t–tests are reported for on–balance measures of bank risk (LEV, DIV, GAP, LOSS, POR, SIZE)
Numbers in parentheses are t–statistics

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Table 4
List of Sample Banks

1. First National Bank of Boston
2. Bank of New England
3. Shawmut Bank
4. Fleet National Bank
5. First Fidelity Bank
6. Midlantic National Bank
7. Bankers Trust
8. Chase Manhattan Bank
9. Chemical Bank
10. Citibank
11. Manufactures Hanover Trust
12. Morgan Guaranty Trust of New York
13. Republic National Bank of New York
14. Mellon Bank
15. First Union National Bank
16. NCNB Corp.
17. Sovran Bank
18. Dominion Bank
19. Barnett Bank of South Florida
20. Southeast Bank
21. Citizens and Southern National Bank
22. Continental Illinois National Bank
23. First National Bank of Chicago
24. Northern Trust
25. Boatmens National Bank of St. Louis
26. Mercantile Trust
27. First National Bank of Minneapolis
28. Norwest Bank of Minneapolis
29. Texas American Bank
30. Valley National Bank of Arizona
31. Security Pacific National Bank
32. U.S. Bank Corp.