1991

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M. Kabir Hassan
University of New Orleans

UNIVERSITY OF NEW ORLEANS

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Working Paper # 6-91

ECONOMICS AND FINANCE WORKING PAPER SERIES

Department of
Economics and Finance
University of New Orleans

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M. Kabir Hassan*

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* Assistant Professor of Finance, Department of Economics and Finance, University of New Orleans.

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Professor Nicholas Mercuro
Working Paper Series
Department of Economics and Finance
University of New Orleans
New Orleans, LA 70148
phone:(504) 286-6270

ABSTRACT

Off-Balance Sheet (OBS) activities of large U.S. commercial banks have been growing rapidly in recent years. These activities represented 58% of total bank assets in 1984 and grew to 176% of total bank assets in 1988. Bank regulators are concerned that OBS activities increase bank risk, and proposed that some OBS activities be included in the calculation of a risk-based capital requirement. This paper investigates the impact of OBS activities on market measures of risk. Specifically, this paper examines the risk-reducing diversification and risk-increasing effects of OBS activities by employing implied asset variances, in addition to, equity and systematic risks as proxies for market measures of bank risk. This research contends that asset variance is a better measure of risk for regulated banking industry. A Ronn-Verma (JF, 1986) option pricing methodology is employed to calculate implied asset variances. Systematic risk, equity risk and implied asset risk are regressed over various measures of OBS items and on-balance measures of risk in a Pooled Cross-section and Time-series sample. The results indicate that OBS activities, in general, reduce total risk, but do not affect systematic risk. The explanatory powers of the models are improved significantly when implied asset variances, instead of equity variances, are used to proxy for total risk. Because regulators are concerned with total risk and probability of bank failure, the risk-reducing potential of OBS activities indicates that additional capital requirement of OBS activities will penalize large banks.

I. INTRODUCTION

This paper investigates the relationship between off-balance sheet activities and market risk measures for large U.S. commercial banks. A number of competing hypotheses about risk-taking behavior of OBS items have been proposed in literature. This paper examines risk-reducing diversification and risk-increasing leverage effects of OBS activities by employing implied asset variances from option pricing models, in addition to standard equity and systematic risk. Previous literature employed equity risk as a proxy for total risk to test the risk-behavior of OBS banking activities. This paper contends that equity risk is an inappropriate proxy for total risk for regulated banking industry because both stockholders and regulatory agencies bear banking risks when such institutions fail. Regulatory agencies bear part of OBS risk because bank depositors are protected by de facto deposit insurance. Given the contingent claims nature of equity and deposit insurance, implied asset variances are calculated employing a Ronn-Verma (JF, 1986) option pricing and deposit insurance methodology. Such asset variances are used in a pooled cross-section and time-series sample to test the risk-taking behavior of OBS banking risk.

In recent years commercial banks have engaged in activities that do not appear on their balance sheets. These Off-balance sheet (henceforth OBS) activities are contingent claims or contracts that generate fee income for a bank. However, these OBS activities also create balance sheet or portfolio risk. A contingent claim involves an obligation to lend or provide funds should the contingency be realized. Therefore, it does not create a change in the balance sheet until the contingency is realized. While a loan is an asset on a bank's balance sheet, a promise to make a loan is a contingent liability which creates a potential funding obligation in the future. A bank also has limited

control over when its obligation to provide funds will be exercised. As a result of its off-balance sheet activity, a bank faces three general types of portfolio risk: credit risk on underwritten guarantees, interest rate risk due to asset and liability mismatches on commitment takedowns and interest rate swaps, and liquidity risk due to the over-extension of obligations.

Because of financial and technological innovations in the 1970s and increased competition in the financial services industry, banks have unbundled their traditional banking services, in particular, separating funding of assets by deposit liabilities from other services. Depending on the specific bank customer, low value-added services (such as bearing interest rate risk) are de-emphasized and high value-added services (such as underwriting the direct placement of debt) are emphasized without impairing the provision of services to other bank customers. This unbundling is the primary force behind the significant growth in off-balance sheet banking activities and fee income as a source of profitability, especially at large commercial banks.

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 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.[1]

To formulate public policy concerning bank use of off-balance sheet items, it is necessary to understand the risk embodied in off-balance activities and the motivation behind off-balance sheet decisions. Given the recent attention paid to bank off-balance sheet activities and their risks, surprisingly little has been written about the measurement of off-balance sheet banking risk. The literature on off-balance sheet activities and their risk is limited and, due to data availability problems, primarily theoretical. The risk-based capital guidelines recently proposed by Federal Reserve explicitly assume that standby letters of credit are as risky as loans, commercial letters of credit are as risky as municipal security investments, and loan commitments are as risky as the sale of federal funds. Whether or not such assumptions are warranted remains an open question.

The purpose of this paper is to analyze and empirically test the effects of OBS activities on the risk-taking behavior of commercial banks. Section II contains a review of the literature pertinent to the relationships between risk-taking behavior of OBS banking activities. The empirical methodology along with hypothesis dealing with OBS banking risk are discussed in Section III. Section IV analyzes data and presents the empirical results. A summary of major conclusions and policy evaluation appears in Section V.

II. OFF-BALANCE ACTIVITIES AND BANK RISK-TAKING BEHAVIOR

A number of competing hypotheses concerning risk-taking behavior of OBS items have been proposed in literature. A bank's activity in the market for off-balance sheet credit enhancement is a function of its willingness to accommodate the needs of its customers, the market's perception of a bank's quality as reflected in balance sheet decisions and the incentives provided by the regulators. Theories of financial intermediation suggest that OBS banking activities are designed to provide credit enhancement services to its customers. By guaranteeing funds availability, the intermediary has an incentive to efficiently monitor the borrowers, produce information and signal its credibility, and specialize in credit evaluation. OBS banking activities thus represent substitute methods for allocating credit with complementaries in production. The risk-return trade-off between selling information services and warehousing assets will induce a bank to divide its business between both balance and off-balance sheet financial activities. Therefore, OBS activities do not affect fundamental business risk of banking firms. Because part of business risk is diversifiable, the remaining market risk is also unaffected by OBS activities. The diversification hypothesis implies that banks engage in OBS activities to diversify its asset portfolio in order to achieve within firm diversification and to avoid the wrath of disappointed bank shareholders [see Diamond (1984), Pavel (1987, 1988)]. This hypothesis suggests a negative relationship between total bank risk and OBS activities.

The Leverage Hypothesis states that fixed rate deposit insurance together with capital requirements provide incentives to increase financial leverage through the issuance of OBS activities that are not subject to capital requirements. By increasing financial leverage in this way, a bank can enhance

whatever subsidies it receives from deposit insurance. This hypothesis thus predicts a positive relationship between total bank risk and OBS activities [see Pyle (1985), Benveniste and Berger (1986)].

The empirical evidence of the risk-behavior of OBS banking activities is inconclusive. Lynge and Lee (1987) found that the coefficients of independent variables incorporating OBS banking activities are significantly negative in a model explaining total risk, but insignificant in a model explaining systematic risk. Brewer, Koppenhaver and Wilson (1986) found that SLCs reduce systematic risk but loan commitments and commercial letters of credit do not affect systematic risk. Pavel (1987) found that loan sales have little impact on bank risk. Avery and Berger (1988) regressed three bank performance measures against OBS activities and found that SLCs are associated with poor bank performance but loan commitments are associated with better bank performance.

The empirical literature of OBS banking risk contains a number of limitations, which this research seeks to rectify. By measuring OBS banking risk in a more theoretically appealing way, bank regulators and investors can gain a better understanding of the size of the risks that are involved and policies that might make effective control possible.

First, this study distinguishes between risk-reducing diversification and risk-increasing hypotheses of OBS banking risk. This is important because the largely undiversified bank regulators are more concerned with total risk and probability of bank failures, and diversified investors are concerned with systematic risk. If risk-reducing diversification effect of OBS activities dominates risk-increasing effects of OBS activvities, then the risk-adjusted capital requirement of OBS banking activities may be inappropriate.

The empirical research also ignored the impact of regulation on bank risk measurement. The equity risk used in previous studies ignores the fact that banking is a regulated industry. This research measures risk in such a way that incorporates the effect of deposit insurance and the regulatory closure rules. A bank's total asset risk, rather than equity risk, explicitly captures the impact of deposit insurance because both bank debtholders and equityholders benefit from deposit insurance subsidies.

Second, the leverage and diversification effects of OBS banking risk is investigated by measuring asset risk of banks, which is based upon a risk-based deposit insurance premium developed by Ronn and Verma (1986). A beta risk model is also used to investigate whether equityholders take into account the effects of OBS banking activities.

Third, this study will employ an extended data set ranging from 1984 to 1988 and will examine risk behavior of all 19 OBS items from Call and Income Report of the FDIC tapes. These OBS banking items are grouped into seven categories (OB, SLC, CLC, COMM, PART, SWAP, OBS) depending upon their similar characteristics to investigate their differential impact on bank risk.

III. HYPOTHESES TESTING AND METHODOLOGY

3.1 HYPOTHESES TESTING

The first research question to be investigated is the relationship between OBS banking activities and market risk. Because theory suggests that OBS banking activities are not concern for well-diversified investors, the following hypothesis is tested to examine the market risk of OBS activities.

Hypothesis One: OBS banking activities do not affect market risk.

Total risk can be decomposed into three parts:

Total risk = market risk + diversifiable risk + financial risk.

The diversification potential of OBS activities is expected to decrease diversifiable risk and the leverage potential of OBS activities is expected to increase financial risk. Because leverage potential of OBS activities is realized only when such guarantees are exercised, the following hypothesis is tested to examine the total risk of OBS activities.

Hypothesis Two: The diversification effects of IBS activities outweigh leverage potentials, and result in a reduction of total risk.

3.2 MODEL SPECIFICATIONS

To test hypothesis 1 and hypothesis 2, the following two accounting-based risk models are estimated over cross-section and time-series data using the generalized least squares (GLS) technique. The expected signs of partial derivatives appear on each independent variable.

$$\beta = f\ (\overset{-}{OBS},\ \overset{+}{LEV},\ \overset{-}{DIV},\ \overset{+}{ALOSS},\ \overset{+}{AGAP},\ \overset{-}{ASIZE},\ \overset{-}{POR}) \qquad (1)$$

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

where

OBS = seven variables constructed from all OBS banking activities included in the RC-L schedule of the FDIC tapes;

LEV = ratio of total liabilities over total assets;

DIV = an index of diversification of the bank's 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.

Seven off-balance sheet variables are constructed from the 19 off-balance sheet items of the RC-L schedule of bank call and income reports. These variables are AOB, ACOMM, APAPT, ASLC, ACLC, ASWAP and AOBS and scaled down by total assets. Since off-balance sheet items constitute a heterogeneous collection of participations, commitments, and other arrangements, it is difficult to represent the influence of these items in any simple way. These independent variables attempt to group items with similar characteristics. Similar off-balance sheet groupings are also done by Lynge and Lee (1988). These variables are reported in Table 2. LEV, DIV, ALOSS, AGAP, ASIZE and POP are proxies for leverage ratio, diversification index, credit risk, interest rate risk, operating risk and dividend payout ratio. These on-balance accounting risk variables have also been extensively used in studies of bank risk literature. Lee and Brewer (1986) used similar variables to investigate commercial bank financial policies and their impact on market determined measures of risk. The authors found leverage, loan-loss, dividend payout, gap variables are significantly related to market measures of risk. Jahankhani and Lynge (1980) also used similar variables in their bank risk study and found similar results. Pettway (1976) investigated accounting factors affecting total risk and systematic risk, and found that dividend and earnings are significant variables.

Koppenhaver (1987), Pavel (1988), and Pavel and Philis (1987) used a diversification index to examine the diversification potential of SLCs and loan sales. The higher the diversification index is, the higher the diversification potential is in the loan portfolio, and the lower the risk is.

This research exploits these previously tested accounting risk variables in order to examine the principal research questions of the risk-taking behavior of off-balance sheet banking activities. All these variables have been normalized by total assets in order to eliminate heteroskedasticity problem in the statistical estimation.

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 equation (2) implies that, after controlling for on-balance leverage and diversification effects, risk-reducing diversification effect of OBS activities dominates risk-increasing effects of OBS activities.

Bank risk will be measured three different ways. The first measure of risk is the standard deviation of equity return (ROE). The second measure of risk is based upon a risk-based deposit insurance premium developed by Ronn and Verma (JF, 1986). The third measure of risk is systematic risk and is proxied by beta.

3.3 METHODOLOGY

3.3.1 INTRODUCTION

The measure of asset risk used in this research 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's value of bank's equity and the book value of its debt are available. Market perceptions of the FDIC bailout policy are explicitly modeled so as to eliminate the bias in inplied values of assets and their volatilities.

3.3.2 THE VALUATION OF ASSET VARIANCE UNDER DEPOSIT INSURANCE

Ronn and Verma applies Black-Scholes (1973) option pricing model to calculate a 'fair' per dollar deposit insurance premium that takes into consideration the FDIC's bailout policy. Ronn and Verma (1986) start with the following notation:

V = the unobserved post-insurance value of the bank's assets;

B = face value of total debt liabilities;

σ_V = the instantaneous standard deviation of the rate of return on the value of the bank's assets;

T = time until next audit of bank's assets;

δ = dividend per dollar of value of the assets, paid n times per period.

Under the assumption of a constant variance for the rate of return on the bank's assets, Merton's (1977) insurance premium per dollar of deposits, d, is given by

$$d = N\,[Y + \sigma_V \sqrt{T}] - (1-\delta)^n\,(V/B)\,N(Y) \qquad (3)$$

where

$$Y = [\ln \{B/V\,(1-\delta)^n\} - \sigma_V^2 T/2] \;/\; \sigma_V \sqrt{T}$$

$N(\cdot)$ is the cumulative density of a standard normal random variable; σ_V is the standard deviation of the rate of return on BHC's assets; T is the time to expiration, i.e., the time until the next audit of the BHC (assumed to be 1); V is the value of the BHC's assets adjusted for stock-splits and dividends; B is the value of the BHC's debt.

Two variables in the above equation are not empirically observable: V and σ_V. They can, however, be solved for by representing the equity of a bank holding company as a call option on the assets of the firm with the same

maturity as debt and the striking price equal to the maturity value of the debt (Black and Scholes, 1973).

Ronn and Verma (1986) point out that the FDIC does not liquidate a bank as soon as it observes that its net worth is negative. Rather the FDIC tries to revive the bank. The FDIC is concerned about containing the disruptive effect of an individual bank failure to ensure that it never reaches the magnitude of a bank run. These concerns not only have the effect of allowing a bank to operate up to a certain point beyond complete erosion of net worth, but also are perceived by the market to have such an effect. They assume, however, that some hypothetical limit of erosion of value exists such that revival becomes too costly. This hypothetical limit can be expressed as a percentage of total debt of the bank. This also alters the boundary condition to be applied to the equity, construed as a call option. The closure rule is therefore modeled as follows: the FDIC liquidates a bank if $V_T < \rho B$ where V_T is the terminal value of assets at time T and $\rho <= 1$ is a policy parameter. Given this modified closure rule and the standard options-theoretic relationship between the instantaneous variances of the derivative and underlying assets, the equity of the bank holding company can be written as:

$$E = V\,N(x) - \rho B N(x - \sigma_V \sqrt{T}) \tag{4}$$

$$\text{where } x = \frac{[1N\,(V/\rho B) + \sigma_V^2\,T/2]}{\sigma_V \sqrt{T}} \tag{5}$$

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

where E is the market price of equity and σ_E is the instantaneous standard deviation of the return on E. Here equity is a fully dividend-protected call because being the recipient of dividends, equity is in fact dividend-protected.

Equations (4) and (5) can be solved simultaneously for the two unknowns, V and σ_V, for each observed E and σ_E. Ronn and Verma show that a ρ of .97 yields an aggregate deposit premium weighted average of about 1/12 percent, the flat rate premium.

3.3.3 REGULATORY CLOSURE RULE AND MATURITY OF DEBT

The maturity of debt (T) is assumed to be one year in empirical calculation of models (4) and (5). The equity value refers to the maturity of debt while the deposit insurance refers to periodicity of audit by the insurer. In a regulatory environment, the rational investor would link the debt maturity to audit periodicity. These two maturities cannot be separated in the context of banks because insured deposits account for a large part of the bank's debt and new deposits made with a bank before the expiration of the insurance are automatically covered by the insurance. At audit time, if the FDIC decides to dissolve the bank, all depositors are paid off. It is therefore reasonable to argue that the time until next audit should be the proper value of maturity (assumed to be 1) in both equations (4) and (5).

3.3.4 CONCLUSION

The implied variance of bank assets captures the riskiness of a bank and is the underlying driving variable in this study. Ronn and Verma (1986) pricing equations can be extended in the context of OBS banking activities by including OBS items into total debt because not all risks assumed by a bank appear on its book. The implied variances will be regressed over bank on-balance and off-balance sheet activities to test for their risk-taking potential.

IV. DATA AND EMPIRICAL RESULTS

This section presents the data, provides empirical estimation of the effects of off-balance and on-balance sheet items on the three market measures of risk of commerical banks and analyzes the empirical results.

4.1 DATA ANALYSIS

Extensive data on bank off-balance sheet activities (OBS) are available beginning in 1984. The initial sample utilized in this study consists of the 100 largest banks based on asset size which have continuous data over the years 1984 through 1988. Market values of equity (EQUITY) for each bank or bank holding company are collected from COMPUSTAT yearly tapes. Daily bank stock returns and market returns are gathered from the CRSP and the NASDAQ daily tapes. Data on off-balance sheet items are taken from the FDIC Call and Income Reports for the lead bank of the holding company. The sample is restricted to those bank holding companies (BHC) whose lead bank accounts for the majority of consolidated holding company assets. The accounting risk variables defined in the previous section (LEV, DIV, AGAP, ALOSS, POR and ASIZE) are constructed from data collected from the FDIC yearly tapes. Data from the FDIC tapes, the COMPUSTAT tapes, the CRSP tapes and the NASDAQ tapes are merged together, and this resulted in a final sample of 32 banks and bank holding companies for 1984 through 1988. The relative size of market risk measures, accounting risk measures and OBS variables are shown in Table 3.

4.2 CALCULATION OF MARKET MEASURES OF RISK

Equity risk is proxied by the standard deviation of equity return. SIGMAE is the annualized standard deviation of daily equity return. SIGMAEs are calculated for those bank holding companies for which 200 or more trading days are available on CRSP and NASDAQ tapes. It can be noted that only 63 bank

holding companies have equity return available on CRSP tape and 82 BHCs have similar data available from the NASDAQ tape.

BETAs are calculated from daily equity returns for each bank holding company for which 200 or more trading days are available from the CRSP and the NASDAQ TAPES. The standard market model is used in this study to estimate betas and the market index used is equally-weighted market index. Hence, these beta estimates are different from Scholes-Williams betas reported in the new CRSP tapes. Scholes and Williams (1977) calculated betas from nonsynchronous data using a methodology different from market model methodology.

SIGMA1 is defined as the standard deviation of asset return and is calculated for each BHC for each year 1984 through 1988 using the RONN-VERMA option pricing methodology. A system of two non-linear simultaneous equations (equations (4) and (5) in Section 4) are solved for two unknowns, asset value (V) and the standard deviation of asset return (SIGMA1), by a numerical routine for each observed yearly EQUITY and annualized standard deviation of equity return (SIGMAE). A subroutine, NEQNF, in the International Mathematical and Statistical Library (IMSL) is used to solve the simultaneous equation system. The initial estimates used for the value, V, was the sum of the market value of equity and book value of debt, while that for σ_V was σ_E scaled down by the leverage ratio. The cumulative normal distribution function is calculated by using a polynomial approximation developed by Cox and Rubinstein (1985). Total liabilities, instead of insured debt liabilities, of BHCs are used for B in equations (4) and (5). This may be justified for two reasons. First, existing FDIC purchase and assumption policies extend, at least for larger banks, defacto

insurance to all liabilities of an insured bank. Second, all debt is of equal seniority at time of bank closure.

SIGMA2 is calculated in the same way as SIGMA1, except that the leverage ratio is augmented by OBS debt. The mean value of SIGMA2 is smaller than that of SIGMA1. This can be explained by the call feature of equity value. As the face value of debt is augmented by OBS items, the value of equity decreases at the closure date. Because the call value is directly related to asset variance, a lower asset variance is associated with a decreased call value.

4.3 ANALYSIS OF RESULTS

Table 4 presents estimates of explanatory variables using BETA as the dependent variable. The estimated coefficients of all OBS items have expected negative signs, and all but one are not statistically significant. These results suggest that most OBS activities have no effect on systematic bank risk. The results are consistent with Pettway (1976) and Lynge and Lee (1987). Standby Letters of Credit (ASLC) is significantly negative at the 5% level, implying that well-diversified investors price this banking activity as risk-reducing. This result validates a similar finding by Brewer, Koppenhaver and Wilson (1986) that equity market prices Standby Letters of Credit (ASLC) as risk reducing.

The coefficients on the on-balance measures of risk have expected signs. Leverage (LEV) is significantly positive at the 1% level and Diversification (DIV) is significantly negative also at the 1% level. Credit Risk (ALOSS) is also significantly positive at the 1% level. Dividend payout ratio (POR) is not statistically significant. Although interest rate risk and size (GAP and ASIZE) have the wrong signs, but they are not statistically significant.

Table 5 presents estimates of the explanatory variables using standard deviation of equity return (SIGMAE) as the dependent variable. The off-balance sheet variables are grouped into seven classes according to their similar characteristics as set forth in the previous section. All off-balance sheet variables possess negative coefficients. One of these coefficients is significant at the 1% level (ASLC), four are significant at the 5% level (AOB, ACOMM, AACLC, AOBS) and one is significant at the 1% level (ASWAP). The coefficient of APART is not significantly different from zero. These results suggest that at least some of the off-balance sheet variables are risk-reducing. These results support the findings of Lynge and Lee (1987) that off-balance sheet items reduce total risk.

The hypothesis that risk-reducing diversification potential of OBS items dominates the risk-increasing potential of OBS items can be tested by comparing the estimated coefficient signs of leverage and diversification (LEV and DIV) variables. The significant negative sign of diversification coefficient (DIV) indicates an inverse relationship between diversification and risk. Therefore, banks can achieve higher level of diversification by engaging in off-balance sheet activities and consequently reduce risk. The coefficients of LEV and DIV possess expected signs. The significant positive coefficient of leverage (LEV) variable indicates a direct relationship between leverage employed and risk. Therefore, banks can increase leverage by engaging in off-balance sheet activities and consequently increase risk. Given that leverage and diversification variables are on-balance sheet measures, the significant negative coefficients of some off-balance sheet items, therefore, imply that diversification potential of OBS items dominates leverage potential after

accounting for such effects by on-balance sheet variables, and hence result in an overall reduction of risk.

The credit risk and dividend payout ratio (ALOSS and POR) variables have the expected positive and negative signs respectively, and are statistically significant. The positive coefficient of credit risk (ALOSS) variable indicates a direct relationship between customer default-risk and overall riskiness of banks. The negative coefficient of dividend payout ratio (POR) variable implies an inverse relationship between bank risk and dividend payout ratio. The size (ASIZE) variable has an unexpected positive coefficient; but here size (ASIZE) is also highly correlated with off-balance measures of risk, perhaps pointing towards a simultaneity between size and off-balance sheet items. These results are, however, consistent with previous studies of market-determined and accounting-determined measures of bank risk variables (Pettway, 1976).

Models using the total risk (SIGMAE) as the dependent variables have higher average R^2 compared to models using systematic risk (BETA) as the dependent variables (.18 versus .14). The fact that on-balance and off-balance measures of risk explain a larger portion of total risk than systematic risk is not surprising. Total risk includes both systematic risk and specific risk. Certain diversifiable accounting measures of risk such as credit risk (ALOSS) are expected to affect mostly specific risk rather than systematic risk.

Table 6 presents estimates of explanatory variables using SIGMA1 as the dependent variable. SIGMA1 is the standard deviation of asset return calculated from Ronn-Verma option pricing methodology. All but one of the estimated coefficient of on-balance measures of risk have the expected signs. Leverage, diversification, credit risk and size (LEV, DIV, ALOSS and ASIZE) are statistically significant at the 1% level. Dividend payout ratio (POR) is not

statistically significant. These results again are consistent with previous studies.

The coefficients of four off-balance sheet variables (AOB, ACOMM, APART and ASWAP) have unexpected positive signs but they are not statistically significant. The coefficients of two off-balance sheet variables (ASLC and ACLC) are significantly negative at the 5% and 1% levels respectively. It appears that risk-reducing diversification effects of Standby Letters of Credit (ASLC) and Commercial Letters of Credit (ACLC) dominate risk-increasing effects when SIGMA1 is used as the market measure of risk. The coefficient of total off-balance sheet items (AOBS) is, however, significantly positive at the 5% level. Therefore, it appears that total off-balance sheet items (AOBS) variable is risk-increasing with this particular risk measure.

Table 7 presents estimates of explanatory variables using SIGMA2 as the dependent variable. SIGMA2 measures standard deviation of asset return from Ronn-Verma option pricing model when the leverage variable is increased by OBS variable. All but two coefficients of on-balance measures of risk have their expected signs. Leverage (LEV) is significantly positive at the 1% level. Size (ASIZE) is significantly negative at the 1% level. Interest rate risk and credit risk (AGAP and ALOSS) variables have unexpected negative signs but they are not significant.

All coefficients of off-balance measures of risk have expected negative signs and Commercial Letters of Credit (CLC) is significant at the 5% level.

Both measures of asset variances (SIGMA1 and SIGMA2) yield superior results compared to equity variance (SIGMAE). When equity variance (SIGMAE) is used as the Market measure of risk, the on and off-balance financial ratios explains about 28% of the variability in total risk among the sample banks. When asset

variances are used as the risk measures, on and off-balance measures of risk explain about 43% of the variability of asset variances. These results suggest that asset variance is superior to equity variance in proxying total risk. In addition, financial variables correlate better with asset variances than equity variances as is evidenced by significant improvement in F-statistics (8.42 versus 15.90).

V. CONCLUSIONS AND POLICY EVALUATIONS

The purpose of this paper has been mainly to examine the relationship between off-balance sheet activities and market measures of risk for large commercial banks. The risk-reducing diversification and risk-increasing hypotheses of OBS banking risk have been examined in this paper. Implied asset variances from option pricing models, in addition to standard equity risk and systematic risk, have been used to test the risk-reducing potential of OBS banking activities.

The theoretical analysis of OBS banking activities suggests that OBS activities provide diversification benefits to bank-stockholders, and at the same time, increase financial risk by augmenting leverage. The risk-based capital requirements of OBS items implicitly assumes that OBS activities are risk-increasing. Whether OBS banking activities increase or decrease risk is an empirical question.

A Ronn-Verma (1986) methodology has been employed to calculate implied asset variances from option pricing models. Previous studies of OBS banking risk have focused on systematic and equity risk and hence did not explicitly incorporate the impact of regulation on bank risk measurement. Flat deposit insurance premium makes deposits equally risk-free across banks. This explicit

pricing structure encourages moral hazard behavior because there is no explicit penalty in the form of higher insurance premiums for excess risk-taking. Under this scheme, high-risk banks are subsidized by low-risk banks. To discourage excessive risk-taking and to price its insurance contract more fairly, the FDIC uses regulatory interferences to extract implicit premiums from high-risk banks. Usually, the regulators impose asset and capital regulation, by requiring banks to limit portfolio risk or calling for an infusion of capital.

Ronn-Verma (1986) point out that FDIC does not close a bank as soon as it observes that its net worth is negative. They argue that there is a hypothetical limit, expressed as a percentage of total debt, beyond which revival of a bank becomes too costly and closes the bank. Otherwise, the FDIC calls for an infusion of additional capital. The isomorphic relationship between equity as a call option, modified to build into it the market's perception of the implementation of closure rule, can be used to invert market prices of equity for asset values and variances. These asset variances incorporate the impact of deposit insurance and regulatory closure rules explicitly. Therefore, asset variances are better than equity variances in proxying total risk in the regulated banking industry.

A pooled cross-section and time-series model, instead of simple OLS, was employed to perform the econometric analysis for two reasons. First, cross-section or time-series data alone (32 cross-sections and 5 time-periods) are not sufficient to extract enough degrees of freedom in regression analysis. Second, cross-sections and time-series relationships of OBS banking decisions are better captured by a pooled cross-section and time-series model.

The major empirical findings of this study can be summarized as follows. First, test results support the hypothesis that risk-reducing diversification

effects of OBS banking items dominate risk increasing effects of OBS banking items, thus reducing overall riskiness of banks. Second, the results also validate the hypothesis that OBS banking items do not affect systematic risk. Only Standby Letters of Credit reduce systematic risk. Third, all seven off-balance measures of risk in this study are risk-reducing depending on proxy used for total risk. Two off-balance sheet items (AOS, ACLC, and ASLC) are always risk-reducing regardless of the proxy used for total risk.

Fourth, the explanatory powers of the models are improved significantly when implied asset variances, instead of equity variances, are used to proxy for total risk. This is evidenced by significant increase in R^2. These results provide credence to the argument that implied asset variances are better measures of total market risk for regulated banking industry. Fifth, several on-balance measures of accounting risk also show statistically significant correlations with market measures of risk. Finally, 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, but do not affect systematic risk, implying that off-balance sheet risk is not a concern of well-diversified stockholders. 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.

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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
Systematic Risk	BETA	.85337	.40162
Equity Risk	SIGMAE	.01828	.01124
Asset Risk (RV)	SIGMA 1	.00155	.00179
Asset Risk (RV)	SIGMA 2	.00065	.00208
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 Cross-Section and Time-Series Results
(Dependent Variable: BETA)

Equations No.	Constant	AOB	ACOMM	APART	ASLC	ACLC	ASWAP	AOBS	LEV	DIV	AGAP	ALOSS	POR	ASIZE	$\bar{R}^2$	F(8,152)
1	10.58 (4.78)***	-.008 (-.19)	---	---	---	---	---	---	10.64 (4.75)***	-.09*** (-2.55)***	-.00003 (-.05)	9.32 (3.29)***	-.0048 (-.70)	.024 (-.67)	.14	3.58***
2	10.29 (4.67)***	---	-.067 (-.56)	---	---	---	---	---	10.37 (4.61)***	-0.082 (-2.47)***	-.000002 (-.003)	9.36 (3.50)***	-.0046 (-.68)	.025 (.86)	.13	3.28 ***
3.	10.54 (4.76)***	---	---	-.02 (-.16)	---	---	---	---	10.53 (4.75)***	-.087 (-2.55)***	-.00002 (-.045)	9.18 (3.48)***	-.0047 (-.68)	-.021 (-.78)	.14	3.54 ***
4	9.14 (4.12)***	---	---	---	-1.10 (-1.68)**	---	---	---	9.60 (4.26)***	-.09 (-2.60)***	-.00005 (-.08)	9.88 (3.64)***	-.004 (-.58)	.057 (1.53)*	.12	2.95 ***
5	10.57 (4.80)***	---	---	---	---	.82 (.44)	---	---	10.52 (4.74)***	-.09 (-2.73)***	-.00002 (-.02)	9.06 (3.46)***	-.004 (-.68)	.017 (.72)	.15	3.88***
6	10.42 (4.68)***	---	---	---	---	---	.06 (1.08)	---	10.12 (4.44)***	-.08 (-2.37)***	-.00006 (-.08)	7.84 (2.72)***	-.004 (.08)	.005 (.16)	.15	3.94***
7	10.60 (4.79)***	---	---	---	---	---	---	-.002 (-.07)	10.51 (4.65)***	-.088 (-2.50)***	-.00005 (-.07)	8.95 (3.13)***	-.004 (-.69)	.015 (.44)	.15	3.54 ***

NOTES:
1) BETA is the systematic risk;
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 Cross-Section and Time-Series Results
(Dependent Variable: SIGMAE)

Equations No.	Constant	AOB	ACOMM	APART	ASLC	ACLC	ASWAP	AOBS	LEV	DIV	AGAP	ALOSS	POR	ASIZE	$\bar{R}^2$	F(8,152)
1	.11 (2.31)**	-.0015 (-2.06)**	---	---	---	---	---	---	.13 (2.74)***	-.0017 (-1.78)**	-.00001 (-1.42)*	.34 (5.40)***	-.00007 (-1.47)*	.0018 (2.49)***	.27	8.12 ***
2	.13 (2.90)***	---	-.005 (-1.97)**	---	---	---	---	---	.14 (3.15)***	-.0015 (-1.61)*	-.00001 (-1.80)*	.31 (5.17)***	-.00008 (-2.48)***	.0014 (2.10)**	.30	9.28 ***
3	.12 (2.53)***	---	---	-.0022 (-1.11)	---	---	---	---	.13 (2.67)***	-.0015 (-1.53)*	-.00001* (-1.55)*	.28 (4.85)***	-.00009 (-2.01)**	.0011 (2.53)***	.23	6.47 ***
4	.052 (.95)	---	---	---	-0.07 (-4.15)***	---	---	---	.086 (1.67)**	-.0022 (-2.32)***	-.00001 (-2.07)**	.31 (5.34)***	-.00004 (-1.57)*	.0033 (3.97)***	.35	11.74 ***
5	.10 (2.30)**	---	---	---	---	-.067 (-1.65)**	---	---	.11 (2.48)***	-.0009 (-.95)	-.00001 (-1.66)**	.26 (4.66)***	-.00001 (-2.76)**	.001 (1.79)**	.27	7.97 ***
6	.14 (2.96)***	---	---	---	---	---	-.0026 (-1.56)*	---	.15 (3.10)***	-.0018 (-1.90)**	-.00001 (-1.60)*	.33 (4.78)***	-.00009 (-2.00)**	.0013 (2.00)**	.26	7.44 ***
7	.13 (2.73)***	---	---	---	---	---	---	-.001 (-2.16)**	.15 (3.17)***	-.0018 (-1.86)**	-.00001 (1.51)*	.36 (5.56)***	-.00007 (-1.47)*	.0019 (2.57)***	.27	7.98 ***

NOTES:
1) SIGMAE is the annualized standard deviation of equity returns;
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 Cross-Section and Time-Series 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	.043 (6.49)***	.00008 (.81)	---	---	---	---	---	---	.033 (4.89)***	-.00023 (-2.17)***	-.000003 (-2.13)**	.023 (2.74)***	-.000004 (-.72)	-.0006 (-6.83)***	.43	16.32***
2	.044 (6.98)***	---	.0002 (.48)	---	---	---	---	---	.035 (5.23)***	-.0003 (-2.68)***	-.000002 (-1.64)*	.033 (4.62)***	-.0000005 (-.09)	-.0005 (-6.40)***	.41	15.02 ***
3	.043 (6.63)***	---	---	..0001 (.80)	---	---	---	---	.034 (5.10)***	-.0002 (-2.34)***	-.000003 (-2.04)**	.025 (3.64)***	-.000004 (-.68)	-.0005 (-9.07)***	.44	17.26 ***
4	.043 (5.90)***	---	---	---	-.003 (-1.53)*	---	---	---	.036 (5.01)***	-.0003 (-3.17)***	-.000003 (-1.92)**	.027 (3.63)***	-.000002 (-.28)	-.0004 (-3.52)***	.43	16.21 ***
5	.040 (5.91)***	---	---	---	---	-.023 (-3.61)***	---	---	.033 (4.64)***	-.0002 (-1.76)**	-.000002 (-1.50)*	.032 (5.00)***	-.0000004 (-.08)	-.0004 (-5.36)***	.41	15.06 ***
6	.042 (6.32)***	---	---	---	---	---	.0002 (1.22)	---	.033 (4.70)***	-.0002 (-2.21)**	-.000003 (-2.06)**	.021 (2.28)**	-.000003 (-.64)	-.0005 (-7.78)***	.42	15.07 ***
7	(.042)* (6.55)***	---	---	---	---	---	---	.00006 (1.37)*	.032 (4.79)***	-.0002 (-2.11)**	-.000003 (-2.15)**	.020 (2.34)***	-.000004 (-.82)	-.00062 (-7.39)***	.43	16.33 ***

NOTES:
1) SIGMA1 is the annualized standard deviation of asset returns calculated from Ronn-Verma (1986) 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 7

Pooled Cross-Section and Time-Series 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	.027 (4.70)***	-.00004 (-.36)	---	---	---	---	---	---	.018 (3.29)***	-.00013 (-1.05)	-.000001 (-1.22)	-.0019 (-.29)	-.000004 (-.41)	-.0004 (-3.39)***	.30	9.50 ***
2	.023 (4.26)***	---	-.00003 (-.08)	---	---	---	---	---	.015 (2.91)***	-.00009 (-.75)	-.000001 (-1.11)	-.0054 (-.76)	-.000006 (-.86)	-.0004 (-4.09)***	.29	8.68 ***
3	.025 (5.41)***	---	---	-.00008 (-.43)	---	---	---	---	.017 (3.95)***	-.00008 (-.74)	-.000001 (-1.08)	-.0033 (-.64)	-.000004 (-.48)	-.00047 (-4.81)***	.34	10.87 ***
4	.024 (3.80)***	---	---	---	-.0013 (-.53)	---	---	---	.016 (2.63)***	-.00012 (-.99)	-.000001 (-1.13)	-.0034 (-.62)	-.000002 (-.26)	-.00048 (-3.57)***	.30	9.12 ***
5	.026 (5.05)***	---	---	---	---	-.013 (-2.22)**	---	---	.018 (3.70)***	-.00007 (-.67)	-.000002 (-1.96)***	-.004 (-.80)	-.000003 (-.43)	-.00043 (-4.03)***	.32	10.24 ***
6	.024 (4.50)***	---	---	---	---	---	-.00002 (-.13)	---	.016 (3.04)***	-.00011 (-.93)	-.000001 (-1.11)	-.005 (-.62)	-.000004 (-.52)	-.00043 (-3.96)***	.31	9.70 ***
7	.025 (4.56)***	---	---	---	---	---	---	-.00003 (-.48)	.018 (3.09)***	-.00013 (-1.03)	-.000001 (-1.09)	-.0015 (-.19)	-.000003 (-.34)	-.00043 (-3.27)***	.31	9.81 ***

NOTES:
1) SIGMA2 is the annualized standard deviation of asset returns calculated from Ron-Verma (1986) 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%.

ENDNOTE

[1] On March 1, 1988, the Federal Reserve, in conjunction with other bank regulatory agencies and foreign central banks, issued a risk-based capital proposal. This proposal, which would be phased in by 1992, would replace current standards that require U.S. banks and bank holding companies to hold a flat percentage of capital against all balance sheet assets. The principal changes embodied in the risk-based capital proposal are that (1) different types of assets would receive different risk weights according to their perceived riskiness, (2) some off-balance sheet items would also be weighted and added to risk-weighted assets, and (3) banks from 12 participating countries would, for the first time, be subject to a common minimum capital standard.

In these proposed guidelines, supplemental capital ratios are to be calculated that explicitly include standby and commercial letters of credit, and loan commitments. Loan commitments are in the money market risk category (weight = 30%), commercial letters of credit are in the moderate risk category (weight = 60%), and standby letters of credit are in either the moderate risk category or the standard risk category (weight = 100%) depending on their reasons for issuance. The weights determine the quantity of each item that is included in risk assets and then compared to primary capital.