Loan Portfolio Composition and Management Control of Bank Risk: An Empirical Investigation

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Abstract

The extent of managerial control over loan default risk is a significant policy issue for commercial banks and the public agencies which regulate them. The responsibility of bank management and the rationale for government regulation and deposit insurance rest in large measure on the fundamental issue of whether loan loss variances (over time and across banks) ensue from managerial decisions or macroeconomic conditions. Our time series models of large banks show systematic, bank dependent loss rates over time, the signs of the coefficients confirm a risk reinforcing rather than a risk adjusting management culture. Our cross sectional regressions reveal significant relationships between individual and group (all sample bank) loan losses for commercial and consumer types of loans, indicating that significant unpredictable macroeconomic forces exist. Thus, we identify risks arising from macroeconomic conditions appropriate for government insurance and risks ensuing from managerial decisions appropriate free market discipline.

I. Introduction

Management control over banking risks is an essential assumption underlying the moral hazard problems of bank deposit insurance and examination (Buser, Chen and Kane, 1981). Furthermore, the moral hazard risk becomes an operational problem only if bank management fails to adjust loan risk policy properly in response to adverse results. Research testing the validity of moral hazard with respect to loan losses has been sparse. Research by Sinkey (1979), Aharony and Swary (1983), Murphy (1979), and Swary (1986) linked individual commercial bank failures to loan losses at those institutions. Only Keeton and Morris (KM, 1987) dealt directly with the issue of managerial risk preference and market conditions as underlying causes of loan loss variance. The KM model of loan losses in the Tenth Federal Reserve District banks clearly related loan losses in one period to past losses and other indications of risk taking. The intertemporal approach set forth in KM initiated direct testing of the management control assumption with respect to the moral hazard hypothesis of deposit insurance.

We propose overcoming the geographic, single period, and econometric limitations of the KM study. Further, we examine the sensitivity of loan portfolio performance induced by changes in the loan portfolio composition. We estimate a system of equations using data for all large banks in the United States. The system of equations permits efficient parameter estimates for loan loss variables, including interactions with loan yield and bank profit functions. Moreover, the time series approach taken in this research estimates autoregressive coefficients which are interpretable as risk adjustment preferences. The results confirm the risk habitat hypothesis which is an important condition for the existence of a moral hazard. However, the results also reveal significant macroeconomic conditions as causes of loan losses, such as those found in Jaffee (1975) for bond defaults.

The next section (II) describes a model for the loan loss process in the context of a bank loan portfolio model. Expected loan losses generated by the model are used to derive unexpected loan losses. Then, unexpected losses are incorporated in a Flannery (1981) type of bank profitability model. Empirical estimates of model parameters are discussed in section III. In section IV we discuss results showing that both, macroeconomic and managerial control coefficients, are significant in the loan loss function. Further, we find that management risk taking behavior is conditioned by

past loan losses in a manner consistent with preferred risk habitat hypothesis rather than a risk adjustment hypothesis.

II. Loan Loss Model

Our loan loss model posits that individual bank loan risk is a function of management control, and macroeconomic loan performance. Management control would be evident if actual loan losses influence subsequent risk taking; alternatively, the hypothesis that management does not control loan risk would be confirmed by observing that losses do not follow a time dependent pattern. We expect to find evidence of managerial control over risk taking, based on significant relationships observed by KM and consistent with the Kereken (1986, p. 34) intuition, "... *by appeal to experience it is possible to rank at least some loan policies.*" Thus, current loan losses are expected to be significantly related to lagged loan losses.

The magnitude of the lagged dependent variable coefficient provides a basis for testing hypotheses:

Hypothesis I: management loan risk taking and macroeconomic conditions remain the same over time.

Hypothesis II: management loan risk taking and macroeconomic conditions vary over time.

If the value of the lagged loan loss coefficient is unitary, then future loan losses are explained entirely by past conditions.(1) For example, a bank pursuing an aggressive lending policy will continue to be aggressive. Such a bank would have reported above average loan losses in the past and is likely to suffer above average losses in the future. On the other hand, a bank pursuing a conservative lending policy would have had lower loan losses in the past and is likely to suffer lower loan losses in the future. Thus, hypothesis I may be termed a "*risk habitat*" policy in contrast to hypothesis II which is a "*risk adjusting*" policy.

Macroeconomic conditions affecting loan losses include a wide range of business and social attributes such as gross national product, profit, personal income, inflation, and interest rates. The effects of macroeconomic conditions can be observed in the industry loss experience. Thus, we can specify individual bank losses as a function of system-wide loan losses to capture macroeconomic conditions, as in equation (1).

$$LL_{it} = \alpha_0 LL_{i,t-k} + \sum_{j=1}^{4} \alpha_j W_{j,it} + \epsilon_{it} \qquad [1]$$

where LL_{it} is the ratio of loan losses to loans for bank i in period t, $W_{j,it}$ is the proportions of j type loans for bank i in period t and $LL_{i,t-k}$ is the ratio of loan losses to loans for bank i in period t-k.

Coefficient α_0 determines the extent to which current loan losses influence future loan losses and can be viewed as a measure of management's risk-taking behavior.(2) A bank pursuing an aggressive lending policy will continue to be aggressive. Such a bank will have had above-average loan losses in the past and is likely to have above-average losses in the future. On the other hand, a bank pursuing a conservative lending policy will have had lower loan losses in the past and is likely to have lower loan losses in the future. The decision to increase the loan loss reserve is an acknowledgement by the bank that loans outstanding have become riskier than the risk assessed at the time of lending. It is not an indication of any change in the risk preference concerning future loans. There is no assurance that future loans will be less risky. Benefits from the deposit-insurance scheme provide adequate underpinning for management's preference for a "*risk habitat*" rather than a "*risk-adjusting*" behavior.(3) A significantly positive correlation between current and past loan losses validates the risk-habitat behavior. Four loan types (j = 1..4) will be defined: real estate, commercial (industrial), consumer, and other. The coefficients α_j(j=1..4) estimate individual bank loan loss response to a bank's loan portfolio composition. Non-zero values for the coefficients α_j would indicate the types of loans which have caused changes in the loan loss rate.(4) Non-equal values of α_j (i.e. $\alpha_2 \neq \alpha_3$) will imply that managements can influence bank loan losses by simply adjusting the composition of loan portfolio.

Changes in loan loss rates may be offset by changes in loan yields, as greater (lesser) risk should result in larger (smaller) rewards. Loan yields are modeled as the second function specifying independent variables as asset proportions, as in the loan loss function, and a lagged dependent variable. In equation (2), II_{it} is the loan yield (interest income to loans) for bank i in period t, $W_{j,it}$ is the proportions of j type loans in period t, and $II_{i,t-k}$ is the loan yield in period t-k.

$$II_{it} = \beta_0 II_{i,t-k} + \sum_{j=1}^{4} \beta_j W_{j,it} + \zeta_{it} \qquad [2]$$

Further, operating expenses may vary with loan losses and yields. The net result, operating earnings, represents a complex function of risk, return, portfolio balancing and expense control in a changing financial market. The operating earnings function introduces management control over the asset portfolio, changes in liability funding costs to the system, and trends in operating expenses. Thus, the form of operating return function is as follows:

$$OR_{it} = \gamma_0 OR_{i,t-k} + \sum_{j=1}^{3} \gamma_j A_{j,it} + \gamma_4 D_{it} + \xi_{it} \quad [3]$$

where OR_{it} is the ratio of operating earnings to bank i assets, $A_{j,it}$ is the proportion of assets invested in category k by bank i, $D_{i,t}$ is the proportion of liabilities to assets by bank i, and $OR_{i,t-k}$ is the operating return in period t-k.

Loan loss ratios, loan yields, and operating returns will be estimated assuming that all are endogenous in a system of equations.

Coefficients γ_j (j=1,2,3) are functions of current economic conditions and the return characteristics of each asset type. They can be interpreted as the contribution to operating return asset of category j. These coefficients are expected to be positive. Coefficient γ_4 is the average cost of liabilities and is expected to be negative (relative to profits). Operating cost economies of scale are assumed constant across banks.

For a rationally priced loan portfolio, loan yield and operating return should reflect the true risk of the loan portfolio. That is, a bank investing in a portfolio of above average risk loans should exhibit above average loan yield and operating return. Further, under hypothesis I, we expect that the loan yields will be serially correlated. The same argument can be made about the operating earnings. Banks with above average operating returns in the past are likely to have above average operating returns in the future and is unlikely to change its loan portfolio composition or loan pricing policy, or its asset composition unless there is a drastic change in the lending environment or regulations. This conjecture of management's risk habitat behavior is consistent with the Flannery (1981) finding that the coefficient of the lagged dependent variables is positive. Therefore, coefficients β_0 and γ_0 are expected to be positive.(5) Coefficients γ_j (j=1,2,3) measure the industry-wide average operating return derived from investments, loans and other tangible assets. Coefficient γ_4 represents industry-wide liability funding costs and is expected to be negative.

In summary, three expected performance equations combine system-wide loan losses, loan yields and operating returns. The dependent variables in the system of equations (loan loss ratio (LL), loan yield (II), and operating return (OR)) are assumed to be interdependent. For example, changes in loan yield would be related to changes in loan loss ratio; and changes in returns on assets are specified as related to changes in loan yields. Each equation contains a set of industry variables and a lagged dependent variable. The industry variables represent macroeconomic conditions and the lagged dependent variable explains unspecified microeconomic effects. Further, we assume loan losses at the estimation bank converge to zero loan losses at all banks and prior loan losses at the estimation bank equal zero.(6)

III. Estimation Method

The proposed pooled cross-sectional analysis captures the competitive nature of the loan market and existing economic conditions. Information contained in the past data is incorporated by adding a suitable number of lagged dependent variables as independent variables.(7)

Since some unobserved variables are omitted from equations (1), (2) and (3), the error terms are likely to be correlated. Separate ordinary least square (O.L.S.) runs on each equation lead to unbiased but inefficient estimates of coefficients and standard errors (Theil, 1971). The efficiency can be increased and the standard error considerably reduced by taking into account the correlations across equations. Hence, coefficients are jointly estimated for a pooled cross-section of banks using Zellner's seemingly unrelated regression technique (Zellner, 1962).

The pooled cross-sectional regression provides the estimates of average loan losses rates and loan yields for each type of loan, average operating returns for each category of asset, average cost of liabilities. The methodology is similar to that used by Hester and Zoellner (1966), Hester and Pierce (1975), and Maisel and Jacobson (1978) to study the costs and revenues of commercial banks.

IV. Data

Banks account for loan losses with three measures: (1) loan losses reserve (reserve ratio), (2) provision for loan losses (provision ratio) and (3) net write-off (write-off ratio). The provision for loan losses reflects bank management's estimate of future write-offs. The basis for such estimates varies but generally depends on loan specific default risk assessments of large loans and historical experience of portfolios of small loans. Default risk assessment of large loans is subjectively determined in light of borrower specific current economic conditions and collateral.(8) Provisions for loan losses are accounted for as expenses charged against current revenue in the income statement and transferred to loan loss reserves on the balance sheet (Godfrey, 1975).

Net write-off, the third alternative for the dependent variable, is the charge to loan loss reserves in recognition of a specific loan loss less recoveries. This value is normally negative. Bank management subjectively determines part or all of a specific debt that will be

written off, then continues collection procedures until further action is uneconomic. Thus, net write-off data provide a measure of loan default losses more closely synchronized with loan market value changes than the loan loss provision measure.

Loan yield, the dependent variable (II) in equation (2), is interest income (including fees) divided by total loans. Operating return, the dependent variables (RR) in equation (3), was measured with current operating earnings after taxes divided by total earning assets. The scaling equation (1) by total loans and equations (2) and (3) by earning assets solved the problem of heteroskedasticity introduced by the varying size of banks. Intangible assets were subtracted from the total assets to find tangible assets. Also, extraordinary income, realized security gains and losses, and their tax implications are excluded from the operating earnings.

The proposed model was estimated with Compustat bank annual reports from 1966 through 1985.(9) From 1965 to 1972 very few banks were included because most banks did not report portfolio amounts by loan classification.(10) For sub-period analysis, data were divided into four groups (1966-75, 1976-79, 1980-82 and 1983-85), reflecting changing interest rate and regulatory conditions.

The classification of loans into four types, real estate loans, industrial and commercial loans, consumer loans, and other loans, is the most detailed level available from Compustat. Real estate loans are adjusted for loans insured and guaranteed by the U.S. government. Investment represents the total of all investment securities held in the bank's investment account, the income from which is subject to federal income tax.

The mean and standard deviations of independent and dependent variables for four periods (1966-75, 1976-79, 1980-82 and 1983-85) are reported in Table 1. The loan portfolio mix and the asset mix are nearly constant in the four periods, but the loan loss ratios change substantially, as indicated by the relatively high standard deviations with respect to averages.

V. Empirical Results

The jointly estimated coefficients for the reserve ratio, loan yield, and operating return are presented in Table 2. Lagged reserve ratios are very significantly (significance level = 0.01), and positively correlated with current reserve ratios during all periods. Provision ratios and write-off ratios exhibit a very similar and equally significant time series behavior, as shown by the significantly (significance level = 0.01) positive correlation between the current and the lagged ratios (Tables 3 and 4). The positive sign indicates that loan losses result in part from bank specific factors which remain stable over time. The implications of a positive sign contrast sharply with the credit policy correcting implication of a negative sign.

The lagged write-off variable coefficient changed significantly (significance level = 0.01) from 1966-75 (1.01) to later periods (.58, .46, and .60). Similar results were observed for the reserve lagged variable coefficient and provision lagged variables coefficient (Tables 2 and 3). Further analysis of the write-off ratio determinants (Table 4) shows that commercial lending risks became particularly important beginning in the 1976-79 period and continuing through the 1980's. Similar problems developed in the consumer loan portfolios in the 1976-82 period but were controlled by the 1983-85 period.

We turn next to the issue of portfolio composition factors affecting loan losses. Real estate loan portfolio weights and loan loss reserves were uncorrelated in all four periods (Table 2). Whereas, commercial loan weights and loan loss reserves are positively correlated in all four periods (Table 2). Commercial loans weights and provision for loan losses are positively correlated from 1976 to 1985 but not from 1966 to 1975. Consumer loans weights are positively correlated to provision for loan losses in all four periods (Table 3). The significant correlations between loan portfolio weights and loan loss indicate that portfolio allocation decisions explain some of the difference in individual bank loan losses. Moreover, the changes in significant coefficients provide a basis for concluding that diversification across major loan types reduces loan loss variance over time. However, we note that commercial loans are the most strongly and real estate loans the least strongly influenced by industry effects over time. Therefore, commercial loans might dominate real estate loans so strictly as to eliminate risk reduction by diversification.

The relative importance of a loan loss determinant is measured by the change in the loan loss rate caused by one standard deviation shift in the predictor (Table 5, a variable ranked 1 is the most important factor). The lagged dependent variable, which measures factors specific to the bank and its loan portfolio, is the most important determinant for all three loss measures. The proportion of assets in real estate loans is the least important determinant of loan losses. The ranks of other determinants vary from period to period and with the choice of the loss ratio. From 1983 to 1985, other loans ranked second and commer-cial loans ranked third in importance as determinants of the provision ratio. During 1983-85, the increase in importance of other loans as determinants of loan losses was attributed to problem foreign loans.

The relative importance of portfolio composition variables as determinants of loan yield and operating return is reported in Table 5. From 1980 to 1985 other

Table 1

Mean and Standard Deviation of Independent and Dependent Variables in Equations (1), (2), and (3)

	1966-75	1976-79	1980-82	1983-85
Real Estate Loans ‡	24.28	27.37	28.55	27.54 *
	(10.78)	(11.28)	(11.21)	(10.87)**
Commercial Loans ‡	38.90	34.82	42.57	43.80
	(10.67)	(10.22)	(12.87)	(11.93)
Consumer Loans ‡	21.44	23.95	21.26	21.79
	(10.03)	(10.59)	(10.55)	(10.95)
Other Loans ‡	15.38	13.86	7.63	6.84
	(14.32)	(17.48)	(16.17)	(15.13)
Investment §	19.23	19.06	17.05	16.71
	(6.30)	(7.25)	(7.15)	(7.96)
Total Loans §	54.64	53.50	53.02	56.90
	(6.63)	(7.39)	(7.93)	(9.24)
Other Assets §	26.13	37.44	29.93	26.39
	(7.58)	(8.40)	(7.77)	(8.09)
Liabilities §	92.96	93.93	94.13	94.13
	(1.54)	(1.39)	(1.26)	(1.09)
Reserve Ratio ‡	1.61	1.16	1.23	1.39
	(0.41)	(0.31)	(0.35)	(0.42)
Provision Ratio ‡	0.41	0.54	0.59	0.83
	(0.48)	(0.32)	(0.37)	(0.67)
Write-off Ratio ‡	-0.36	-0.44	-0.47	-0.64
	(0.38)	(0.35)	(0.32)	(0.61)
Loan Yield §	8.27	9.52	13.67	11.65
	(1.60)	(1.47)	(1.46)	(1.14)
Operating Return §	0.91	0.90	0.92	0.77
	(0.40)	(0.37)	(0.41)	(0.60)

* mean ** standard deviation
‡ percentage of total loans § percentage of total asset

loan weight ranked as the most important while past loan yield ranked as the least important determinant of loan yield. Real estate loan weights ranked fourth in importance as determinants of loan yield, indicating low-risk (default) and low-return (accounting). Commercial loan weights as a determinant of interest income, ranked second during 1980-82 (a period characterized by high interest rates) but ranked third during 1983-85 (a period characterized by low interest rates). The higher loan loss risk of commercial loans received an interest income premium.

We tested the null hypothesis that investment yields remained constant (Table 5). The analysis of variance F-statistic was significant (significance level = 0.05) for the Loan Yield dependent variable but insignificant for the Operating Return dependent variable. Thus, the changes occurring over this period of time impacted returns within but not outside of the asset portfolio.

As a determinant of operating returns, liabilities and past operating returns were the two least important variables. Investments ranked third in importance as a determinant of operating returns. Total loans (55% of total assets) and other assets (19% of total assets) were the two most important determinants of operating returns. The significance of other assets--which include non-consolidated subsidiaries, lease financing, customers' liability for bankers' acceptances and real estate properties owned by the bank--is not surprising because banks listed by Compustat are large, well established, and diversified. The insignificance of liability costs as a

Table 2

Estimated Coefficients of Equations (1), (2), and (3) for Reserve Ratio, Loan Yield and Operating Return; Seemingly Unrelated Regression

	1966-75	1976-79	1980-82	1983-85
Dependent Variable: Reserve Ratio				
Real Estate Loans ‡	.00074	.00089	-.00020	.00199
	(0.66)	(1.28)	(-0.34)	(1.85) *
Commercial Loans ‡	.00312	.00439	.00230	.00903
	(3.17)	(7.17)	(4.47)	(9.65)
Consumer Loans ‡	.00145	.00393	.00073	.00267
	(1.12)	(4.53)	(0.94)	(2.29)
Other Loans ‡	-.00060	.00234	-.00007	.00634
	(-0.64)	(4.54)	(-0.15)	(6.53)
Lagged Reserve Ratio	.85702	.70442	.94950	.63377
	(27.23)	(31.99)	(39.54)	(18.34)
Dependent Variable: Loan Yield				
Real Estate Loans ‡	.02896	.02840	.06424	.08718
	(5.71)	(4.68)	(11.83)	(14.45)
Commercial Loans ‡	.01947	.03796	.09064	.08470
	(5.72)	(6.43)	(16.52)	(15.93)
Consumer Loans ‡	.02917	.02238	.08845	.09597
	(4.98)	(2.86)	(13.25)	(15.24)
Other Loans ‡	.03281	.01724	.09094	.09240
	(7.81)	(3.41)	(16.56)	(15.32)
Lagged Loan Yield	.73077	.73913	.41992	.22358
	(24.31)	(13.55)	(12.99)	(6.11)
Dependent Variable: Operating Return				
Investment §	.04865	.04835	.02995	.11457
	(5.45)	(7.03)	(2.36)	(5.57)
Total Loans §	.05602	.05093	.02791	.10889
	(5.79)	(6.88)	(2.06)	(5.17)
Other Assets §	.05359	.04836	.03320	.11512
	(5.47)	(6.30)	(2.38)	(5.46)
Liabilities §	-.05666	-.04940	-.02904	-.11424
	(-5.67)	(-6.42)	(-2.06)	(-5.15)
Lagged Operating Return	.79546	.68424	.68904	.47159
	(20.10)	(30.10)	(39.54)	(10.61)

‡ percentage of total loans § percentage of total assets
* t-statistics in the parenthesis

Table 3

Estimated Coefficients of Equations (1), (2), and (3) for Provision Ratio, Loan Yield and Operating Return; Seemingly Unrelated Regression

	1966-75	1976-79	1980-82	1983-85
Dependent Variable: Provision Ratio				
Real Estate Loans ‡	.00084	-.00009	-.00110	.00258
	(0.79)	(-0.13)	(-1.03)	(2.05) *
Commercial Loans ‡	.00068	.00287	.00592	.00632
	(0.94)	(5.06)	(8.41)	(6.81)
Consumer Loans ‡	.00256	.00292	.00372	.00464
	(2.04)	(3.34)	(2.74)	(3.39)
Other Loans ‡	.00348	.00040	.00148	.00596
	(3.94)	(0.79)	(1.66)	(4.91)
Lagged Reserve Ratio	.95449	.59179	.53791	.44252
	(23.22)	(29.65)	(11.29)	(13.07)
Dependent Variable: Loan Yield				
Real Estate Loans ‡	.03677	.02944	.06421	.08504
	(7.24)	(4.83)	(11.80)	(14.29)
Commercial Loans ‡	.02484	.03940	.09039	.08274
	(7.28)	(6.66)	(16.37)	(15.84)
Consumer Loans ‡	.03797	.02360	.08819	.09430
	(6.47)	(3.00)	(13.18)	(15.16)
Other Loans ‡	.04032	.01826	.09778	.09012
	(9.56)	(3.61)	(16.45)	(15.19)
Lagged Loan Yield	.64055	.72557	.42133	.23934
	(21.29)	(13.31)	(12.93)	(6.70)
Dependent Variable: Operating Return				
Investment §	.03456	.03639	.02549	.06564
	(5.19)	(5.91)	(2.41)	(5.24)
Total Loans §	.03790	.03999	.02520	.06970
	(5.27)	(6.06)	(2.25)	(5.48)
Other Assets §	.03767	.03670	.02780	.06734
	(5.15)	(5.43)	(2.42)	(5.32)
Liabilities §	-.03855	-.03764	-.02507	-.06922
	(-5.19)	(-5.49)	(-2.15)	(-5.19)
Lagged Operating Return	.78985	.71864	.69685	.55647
	(25.64)	(33.95)	(21.34)	(16.37)

‡ percentage of total loans § percentage of total assets
* t-statistics in the parenthesis

Table 4

Estimated Coefficients of Equations (1), (2), and (3) for Write-off Ratio, Loan Yield and Operating Return; Seemingly Unrelated Regression

	1966-75	1976-79	1980-82	1983-85
Dependent Variable: Write-off Ratio				
Real Estate Loans ‡	-.00062	.00065	.00092	-.00172
	(-0.61)	(0.74)	(1.01)	(-1.49) *
Commercial Loans ‡	-.00067	-.00177	-.00455	-.00437
	(-0.97)	(-2.57)	(-7.94)	(-5.24)
Consumer Loans ‡	-.00180	-.00341	-.00509	-.00125
	(-1.49)	(-3.19)	(-4.40)	(-1.00)
Other Loans ‡	-.00153	-.00083	-.00167	-.00265
	(-1.88)	(-1.36)	(-2.21)	(-2.41)
Lagged Reserve Ratio	1.01423	.57985	.45656	.59818
	(20.21)	(22.47)	(10.59)	(16.31)
Dependent Variable: Loan Yield				
Real Estate Loans ‡	.03720	.02858	.06409	.08277
	(7.33)	(4.66)	(11.78)	(14.40)
Commercial Loans ‡	.02504	.03818	.09015	.08397
	(7.35)	(6.39)	(16.33)	(15.92)
Consumer Loans ‡	.03853	.02267	.08800	.09565
	(6.57)	(2.86)	(13.15)	(15.28)
Other Loans ‡	.04077	.01758	.09537	.09149
	(9.69)	(3.44)	(16.41)	(15.29)
Lagged Loan Yield	.63561	.73642	.42284	.22920
	(21.17)	(13.25)	(12.98)	(6.34)
Dependent Variable: Operating Return				
Investment §	.04282	.04650	.03246	.06872
	(5.20)	(7.11)	(3.05)	(4.89)
Total Loans §	.04763	.04939	.03097	.07148
	(5.35)	(7.03)	(2.76)	(5.01)
Other Assets §	.04652	.04655	.03422	.06935
	(5.15)	(6.48)	(2.96)	(4.87)
Liabilities §	-.04803	-.04749	-.03128	-.07105
	(-5.23)	(-6.50)	(-2.66)	(-4.74)
Lagged Operating Return	.74833	.66918	.66408	.51765
	(20.27)	(30.44)	(19.86)	(14.11)

‡ percentage of total loans § percentage of total assets
* t-statistics in the parenthesis

Table 5

Importance of Independent Variables as a Determinant of the Loan Loss Ratio, the Loan Yield and the Operating Return

	1966-75	1976-79	1980-82	1983-85
Dependent Variable: Reserve Ratio				
Independent Variable				
Real Estate Loans	4	5	4	5
Commercial Loans	2 *	2 *	2 *	2 *
Consumer Loans	3	3 *	3	4 *
Other Loans	4	4 *	5	3 *
Lagged Reserve Ratio	1 *	1 *	1 *	1 *
Dependent Variable: Provision Ratio				
Independent Variable				
Real Estate Loans	4	5	5	5 *
Commercial Loans	5	3 *	2 *	3 *
Consumer Loans	3 *	2 *	3 *	4 *
Other Loans	2 *	4	4	2 *
Lagged Provision Ratio	1 *	1 *	1 *	1 *
Dependent Variable: Write-off Ratio				
Independent Variable				
Real Estate Loans	5	5	5	4
Commercial Loans	4	3 *	2 *	2 *
Consumer Loans	3	2 *	3 *	5
Other Loans	2	4	4	3 *
Lagged Write-off Ratio	1 *	1 *	1 *	1 *
Dependent Variable: Loan Yield				
Independent Variable				
Real Estate Loans	3	3	4	4
Commercial Loans	5	2	2	3
Consumer Loans	4	5	3	2
Other Loans	2	4	1	1
Lagged Loan Yield	1	1	5	5
Dependent Variable: Operating Return				
Independent Variable				
Investment	3	3	3	3
Total Loans	2	2	2	1
Other Assets	1	1	1	2
Liabilities	5	5	4	5
Lagged Operating Return	4	4	5	4

* regression coefficients are significant at 95 percent confidence interval.
1 being the most important coefficient

determinant of operating return supports the hypothesis that the bank funding market is highly interest elastic.

Next, we studied the distribution of unexpected loan losses to determine whether loan loss rates were normally distributed or positively skewed. Finding normally distributed variances would confirm the macroeconomic hypothesis, as the macroeconomic effects would shift the loss ratio average but not cause asymmetries. On the other hand, managers of a relatively few number of banks taking extraordinary risks would cause the distribution to be positively skewed. Both causes might exist simultaneously, as macroeconomic effects might shift the mean of a non-symmetric distribution.

Tests of the variance of loss ratios across banks required several computational steps. First, the expected loss ratios from 1966 to 1985 for 150 banks were calculated using equation (1). Second, variances of the unexpected reserve ratio, the unexpected provision ratio and the unexpected write-off ratio were calculated for each bank, and banks ranked in ascending order by variance. The percentile distribution of variance of the unexpected loss ratios is presented in Table 6. The frequency distributions of the variance of the unexpected reserve ratio, the unexpected provision ratio and the unexpected write-off ratio are presented in Figure 1. The frequency distributions appeared to indicate that the fluctuations in unexpected loan losses were small for most banks but extraordinarily large for a few banks. Third, significance tests were conducted with Pearson's coefficient of skewness and the moment ratio coefficient of skewness.(11) Both test statistics were significant (significance level = 0.01) for the three loan loss measures, confirming our observation that variances of unexpected loan losses across banks are positively skewed.

VI. Summary

Loan loss rate and loan yield were modeled as a function of individual bank loan portfolio composition, banking industry experience, and past individual bank loan loss rate and past loan yield. The three equation

Table 6

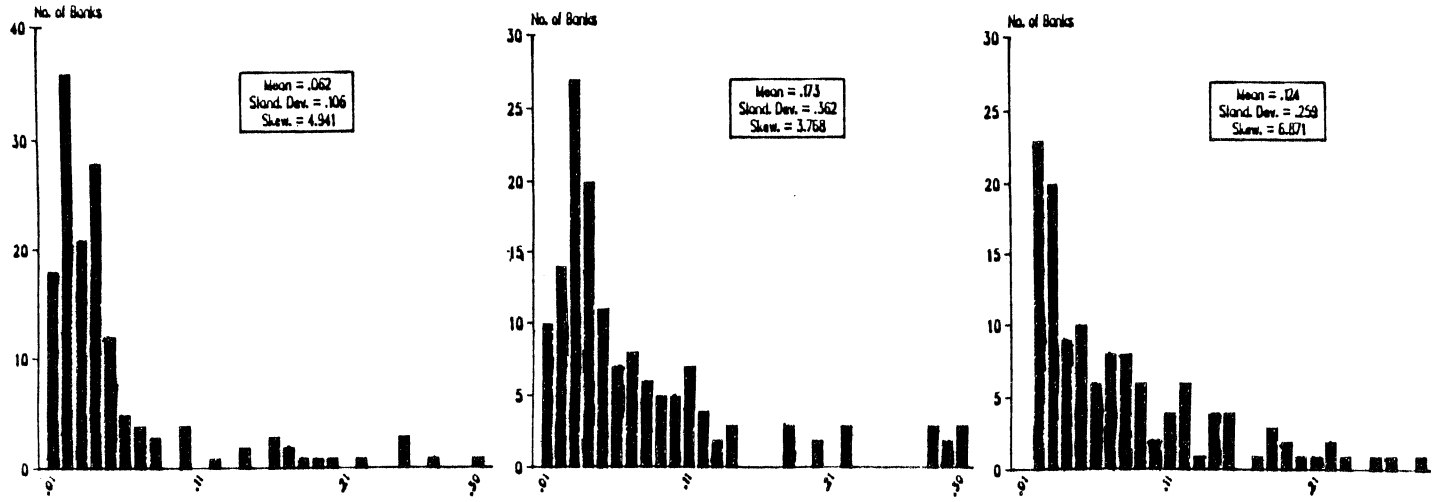
Decile Range of the Variance of Unexpected Loss Ratios

		Unexpected Variance		
Decile*	Range	Reserve Ratio	Provision Ratio	Write-of Ratio
First	Minimum	.00073	.00053	.00194
	Maximum	.01257	.01835	.01591
Second	Minimum	.01444	.01836	.01610
	Maximum	.01777	.02621	.02109
Third	Minimum	.01800	.02636	.02116
	Maximum	.02201	.03100	.02768
Fourth	Minimum	.02203	.03125	.02771
	Maximum	.02715	.03838	.03975
Fifth	Minimum	.02757	.03840	.03987
	Maximum	.03383	.04681	.05393
Sixth	Minimum	.03456	.04709	.05770
	Maximum	.03964	.06591	.07506
Seventh	Minimum	.03971	.06716	.07767
	Maximum	.04659	.09288	.10354
Eighth	Minimum	.04674	.09373	.10448
	Maximum	.06061	.13035	.14115
Ninth	Minimum	.06199	.13778	.14391
	Maximum	.12044	.42320	.22122
Tenth	Minimum	.13529	.48379	.22920
	Maximum	.83996	2.3571	2.6357

* ascending order of risk

Figure 1

Distribution of Variance of Unexpected Reserve, Provision and Write-off Ratios



model estimates, based on 150 banks from 1966 through 1985 indicated that past loan loss rate and past loan yields were the most important determinants of loan loss rates and loan yields, respectively. During the earlier period, 1966-75, stable risk preference and macroeconomic conditions prevailed. Then, a significant change occurred after 1980 in loan risks. The major source of the change in risk was observed to be in commercial and consumer loans.

Operating returns were modeled on the basis of the asset composition, industry average return for each category of asset, the cost of liabilities, and past operating returns. As determinants of operating returns, liabilities and past operating returns were the two least important variables. The total loans and other assets (investments in non-consolidated subsidiaries, leases financing, and customers' liability for banker's acceptance) variables were the two most important determinants of operating returns.

We define the risk of the loan portfolio as unexpected loan losses and measure risk by the variance of unexpected loan losses across time. The results indicate that the variance of unexpected loan losses is skewed to the right, i.e., for most banks the fluctuations in unexpected loan losses are small. Thus, that most banks pursue lending policies which generate relatively stable loan loss rates but some exhibit extraordinarily high risk lending policies.

Overall, we conclude that loan losses are due to both managerial preference with respect to risk taking and to macroeconomic conditions. Macroeconomic factors include the type of loan (commercial, consumer, real estate, and other) comprising the bank portfolio. Managerial control appears to be substantially but not solely responsible for bank loan risks. Thus, regulatory policy is justified in holding bank management responsible for credit default risk but simultaneously providing an insurance umbrella for catastrophic events impacting the entire industry. Further, diversification by loan type was confirmed as a risk reduction strategy because loss experience varied unpredictably over time across all loan types except real estate. The risks from real estate loans were found to be insignificant, and consequently, banks are unlikely to reduce credit risk by diversifying away from real estate into other loan types.

VII. Suggestions For Future Research

Having found differences over time suggests that additional attention be paid to the cyclical behavior of loan losses. Long-period cycles, generations in length, may exist in response to supervisory cycles and investor behavior. The hypothesis that exceptional loan loss periods follow managerial and supervisory neglect, not infrequently mentioned in explaining institutional failures in the 1980's, could be tested as a long-period, cyclical event. If proven true, then lending institution structure would need to be revised to provide more consistent controls over very long time periods.

Footnotes

1. Alternatively, the same result might be obtained if management risk taking and macroeconomic conditions operated inversely with offsetting effects. This alternative was rejected *a priori* as extremely unlikely.
2. A unitary value of α_0 implies that current loan losses are determined entirely by past loan losses and manager's risk preference is unaffected by changes in the lending environment.
3. Penati and Protopapadakis (1988) provides an analytical framework for dealing with deposit-insurance and risk-taking behavior.
4. Pooled cross-sectional estimation filters out dependence of α_j and β_j on microeconomic conditions.
5. Flannery (1981) has found positive correlations between current and past revenues, and current and past costs.
6. Equations (1), (2) and (3) is specified without a constant term. This assumption was tested by estimating the equations with constant terms; estimated coefficients were found to be insignificant.
7. Our time series investigation test extended lags but showed significance for only a single period lagged dependent variable.
8. There are other methods, such as the numerical credit scoring, to rate the risk of a loan (Edmister and Schlarbaum, 1974). However, the emphasis is once again on individual loans but not on a portfolio of loans.
9. Compustat data present accounting rather than market values. However, they are the most consistent and comprehensive data available for the estimation of equations (1), (2), and (3).
10. As in all studies employing the Compustat data, survivorship bias resulted from the Compustat policy of including only banks in existence at the time the tape is compiled. Banks deleted, primarily as a result of merger, acquisition, or liquidation, were not represented.
11. Pearson's Coefficient of Skewness (Figure 1) is as follows:
    Skewness = 3(Mean - Median)/Standard Deviation.
    The distribution is considered to be skewed when the value is outside the range -3 to +3.

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