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Deregulation of interest rates, inflation and disinflation, agricultural recession, and deterioration of loan quality have combined to destabilize the earnings of commercial banks - agricultural banks in particular. In response to this financial environment bankers have employed various portfolio adjustments and asset and liability management strategies to reduce risk exposure and stabilize profits (Barry and Lee; Mitchell). Those portfolio adjustment strategies have taken various forms (e.g., increased variable-rate lending, reduction of loan maturities, matching of maturities on assets and liabilities, matching of rate patterns, etc.). The tentative hypothesis is that banks which have effectively implemented these strategies will also exhibit greater earnings stability (Barnard and Barry).

The net interest margin (gross interest income less gross interest expense) conveys information on how effective bank management has been in allocating funds and controlling expenses. Additionally, shifts in the interest margin provide the basis for analyzing the contributions of market (rate) instabilities and portfolio adjustments to individual bank performance as well as aggregate bank profitability.

Given that growth and stabilization of the net interest margin are the primary objectives of asset and liability management, it is interesting to note that few studies have focused on the net interest margin and its determinants. Studies which have measured the aggregate net interest margin suggest that it has been quite stable over time. However, other studies have looked at the net interest margin variance and found that changes in portfolio composition and asset yields have resulted from interest rate fluctuations.

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While previous analyses have documented the trends in aggregate bank interest margins and profits, they have not considered the systematic variance of individual banks from the reported trends, and reasons for those differences. As a result, we still do not have a clear picture of the extent to which bank profits have varied or empirically supported reasons why some banks are more profitable than others. The objective of this paper is to develop a clearer understanding of the variability of bank interest income and how that relates to bank management and portfolio characteristics. This information would be useful, in understanding how interest rate volatility affects bank performance, and in developing banking policies for dealing with these instabilities and the effects of farm financial stress.

Initially, this paper provides a brief review of aggregate bank statistics to identify recent trends in commercial bank income, expenses and profits. Second, selected approaches to the measurement and analysis of bank income are summarized and compared. Third, the paper contains a report of preliminary results from an analysis of individual bank interest margins and profits during 1976-85. Measures of bank earnings and an index of individual bank asset/liability management performance are computed and analyzed for agricultural and nonagricultural banks in Minnesota to illustrate the approach. Finally, hypotheses and implications for further work are explored.

Bank Earnings in Retrospect

Income and expense statistics for all commercial banks in the U.S. indicate that the long-term decline in profitability was temporarily reversed in 1985 (Table 1). A primary reason for the improvement in bank profitability during 1985 was the realization of capital gains on securities. Interestingly, aggregate net interest margin remained relatively stable during 1981-85 despite volatile market interest rates. Lower market interest rates actually contributed to larger interest margins in 1985. The decline in interest expense from 1984 to 1985 was due both to generally lower market rates and less reliance on money market liabilities to fund bank assets. The corresponding decline in interest income was partially reduced by a reported shift away from low-yield assets (such as government-issued securities) toward loans and tax-exempt securities. These portfolio shift effects on interest income and expenses were primarily reflected in the portfolios of large banks. Wider interest margins in 1982-85 were offset by generally reduced asset quality, as indicated by successive annual increases in the provision for loan losses.

Small bank earnings have been under continuing pressure during the 1980s (Table 2). Interest expenses at small banks have fluctuated with other banks during 1981-85, but overall have not declined as much as the remainder of the banking industry

Table 1. Income, Expenses, and Profits as a Percentage of Assets for All U.S. Commercial Banks, 1981-85.

Year	Gross Interest Income	Gross Interest Expense	Net Interest Margin	Non-Interest Income[a/]	Non-Interest Expense	Income Before Losses	Provision for Loan Losses	Income Before Taxes	Return on Assets[b/]	Return on Equity[c/]
	percent of net earning assets[d/]									
1981	11.93	8.77	3.17	.82	2.77	1.22	.26	.96	.76	13.09
1982	11.36	8.07	3.28	.90	2.93	1.25	.40	.85	.71	12.10
1983	9.63	6.38	3.25	1.03	2.96	1.32	.47	.85	.67	11.24
1984	10.23	6.97	3.26	1.18	3.05	1.39	.57	.83	.64	10.60
1985	9.39	6.03	3.36	1.37	3.17	1.56	.66	.90	.70	11.33

a/ Noninterest income was adjusted for net securities gains (losses).

b/ Net income (after taxes and extraordinary items) as a percent of average net assets.

c/ Net income (after taxes and extraordinary items) as a percent of average equity capital.

d/ Assets used in the computation of percentages are fully consolidated and net of loan loss reserves.

SOURCE: Danker and McLaughlin (1986), p. 618.

Table 2. Income, Expenses, and Profits as a Percentage of Assets for Small U.S. Banks, 1981-85.[a/]

Year	Gross Interest Income	Gross Interest Expense	Net Interest Margin	Non-Interest Income[b/]	Non-Interest Expense	Income Before Losses	Provision for Loan Losses	Income Before Taxes	Return on Assets[c/]	Return on Equity[d/]
	percent of net earning assets[e/]									
1981	11.55	7.15	4.39	.58	3.24	1.73	.29	1.45	1.14	13.39
1982	11.75	7.35	4.40	.65	3.31	1.74	.42	1.31	1.07	12.45
1983	10.60	6.32	4.28	.70	3.29	1.69	.51	1.18	.96	11.12
1984	10.89	6.72	4.17	.73	3.28	1.62	.63	.99	.81	9.49
1985	10.31	6.04	4.27	.85	3.37	1.75	.86	.88	.70	8.20

a/ Small banks are those reporting less than $100 million in assets.

b/ Noninterest income was adjusted for net securities gains (losses).

c/ Net income (after taxes and extraordinary items) as a percent of average net assets.

d/ Net income (after taxes and extraordinary items) as a percent of average equity capital.

e/ Assets used in the computation of percentages are fully consolidated and net of loan loss reserves.

SOURCE: Danker and McLaughlin (1986), p. 629.

during this period. Assets funded by money market instruments actually increased in 1985 as large time deposits and checkable deposit accounts were expanded to offset a sharp decline in demand deposits. Interest income at small banks generally remained more stable than at other banks during 1981-85, which contributed to the overall stability of the net interest margin. Lower small bank earnings reduced the incentive to shift the asset portfolio to tax-exempt securities (given the typically heavier investment of small banks in securities). Eroding loan quality and escalating loan loss provisions reduced income throughout 1981-85. Return on assets and return on equity measures reflect the continuing decline in small bank profitability.

Agricultural bank income patterns have generally been similar to those of small banks (Table 3). Melichar's derivation of agricultural bank earnings for 1975-85 indicates that agricultural banks have been quite profitable in aggregate with the exception of the most recent years. The most profitable years for agricultural and other small banks were those of rising, and high, market interest rates. Higher bank profits during the early 1980s were attributable to both asset and liability factors. On the asset side, short term investments generated higher yields and rates earned on loans increased without a significantly higher percentage of loan losses. During the initial years of this period agricultural banks also had access to low cost deposits to fund loans and investments. Phased deregulation of rates on bank deposits during 1981-84 resulted in higher interest expense. The net result was only a gradual decline in the aggregate net interest margin at agricultural banks. Comparatively rapid decline in loan quality, and the corresponding rise in the provision for loan losses, severely reduced average income before tax as a percentage of assets inthe post-1981 period.

The pattern of relatively stable net interest margin and sharply lower net income at agricultural banks was repeated at the regional level (Keeton and Hecht; Belongia and Gilbert). However, regional declines in aggregate bank income have been more severe than at the national level in recent years apparently due to the relative importance of agricultural lending and the extent of agricultural recession.

Interest Margin Analysis

Olson and Sollenberger first discussed interest margin variance analysis as a tool for measuring the effects of shifts in bank asset and liability composition, changes in asset yields and cost of funds, and increases (decreases) in bank resources. The rationale for undertaking interest margin variance analysis is quite easily explained. If bank assets and liabilities are not equally sensitive to market interest rate fluctuations,

Table 3. Average Income, Expenses and Profit as a Percentage of Assets for U.S. Agricultural Banks, 1975-85[a/]

Year	Gross Interest Income	Gross Interest Expense	Net Interest Margin	Non-Interest Income	Non-Interest Expense	Income Before Losses	Provision For Loan Losses	Income Before Taxes
	percent of total assets							
1975	6.3	3.1	3.2	.3	2.2	1.4	.1	1.3
1976	6.6	3.3	3.3	.3	2.2	1.4	.1	1.3
1977	6.7	3.4	3.3	.3	2.2	1.4	.1	1.3
1978	7.0	3.6	3.5	.4	2.3	1.6	.2	1.4
1979	7.8	4.1	3.7	.4	2.3	1.8	.2	1.5
1980	9.3	5.3	4.0	.4	2.4	2.0	.2	1.7
1981	11.0	7.1	4.0	.5	2.5	1.9	.3	1.6
1982	11.4	7.5	3.9	.5	2.6	1.8	.4	1.4
1983	10.3	6.5	3.8	.5	2.6	1.7	.6	1.1
1984	10.6	6.9	3.7	.5	2.6	1.6	.8	.8
1985	10.0	6.2	3.8	.5	2.7	1.7	1.2	.6

a/ Assets used in computation of percentages are total assets.

SOURCE: Melichar (1986).

changes in rates will have differential effects on interest income and interest expense, and will result in changes in the net interest margin. However, if the composition of bank assets and liabilities shifts significantly between categories with low yields and those with high yields, interest income, interest expense and net interest margins will be affected even without a significant change in market interest rates.

Keeton and Matsunaga later used the interest margin variance method to analyze net interest margins for three size classes of banks located in the Tenth Federal Reserve District (Kansas City) using individual bank data from 1977-84 Reports of Condition and Income. Interest income, interest expense, and net interest margin were decomposed into separate "portfolio shift" and "rate" effects. The portfolio shift effects between two points in time (t and T) were calculated for assets and for liabilities as,

$$\sum_i (s_{iT} - s_{it}) [(r_{it} + r_{iT})/2]$$

where, s_{it} is the fraction of total assets (or total funds) in category i in year t and r_{it} is the average rate of return earned (or paid) on category i in year t. The rate effects were analogously calculated as,

$$\sum_i (r_{iT} - r_{it}) [(s_{it} + s_{iT})/2]$$

These two effects were summed to estimate the total change in the interest income ratio and the interest expense ratio. The net interest margin effects were subsequently derived by subtracting the interest expense ratio effects from the interest income ratio effects.

Keeton and Matsunaga found that asset-sensitivity (where rate-sensitive assets exceed rate-sensitive liabilities) only partially explained changes in net interest margins. During 1977-81 all three size classes of banks were asset-sensitive and rising market interest rates raised interest income more than interest expense. However, once the effects of portfolio shifts (out of demand deposits and passbook savings accounts into deregulated retail deposits and managed liabilities) were netted-out, rate fluctuations during 1981-84 were not a major determinant of changes in net interest margins at small- and medium-sized banks. During 1984-85, rate fluctuations generally raised the net interest margin at small banks in the Tenth District, but the rate effect was largely offset by shifts in portfolio composition (Keeton and Hecht).

One criticism of the interest margin variance methodology, as it has been applied, is that portfolio shift and interest rate effects are not clearly separable in their influence on income

and expense items. That is, a bank may have responded to a changing liability mix and rising cost of funds by rasing the interest rates on loans. In that way bank interest income and interest expense measures are both influenced by rising rates. This would be increasingly common among banks which converted to variable-rate pricing of loans. A second major criticism of the application by Keeton and Matsunaga is that it confines the analysis of interest margin variability to portfolio shift and rate effects only. All of the observed variability in net interest margin is attributed to either of these two factors. Other qualitative and quantitative adjustments to the bank's portfolio are not considered.

A more complete approach to interest margin analysis has been suggested by Hanweck and Kilcollin. Following that approach, a representation of the bank's net interest margin (NIM) at time t is,

$$NIM_t = \frac{1}{\sum_{n=1}^{N} x_n} \sum_{n=1}^{N} (r_n x_n - k_n y_n) \qquad (1)$$

where, r_n is the periodic interest return on assets with volume x_n, repriced in period n and held in period t; k_n is the periodic rate of interest paid on liabilities with volume y_n, repriced in period n and held in period t; and bank assets equal bank liabilities ($\Sigma x_n = \Sigma y_n$).

If a general market interest rate (i_t) is defined, the effect of a change in i_t on the bank's net interest margin can be derived as,

$$\frac{\delta NIM_t}{\delta i_t} = \frac{1}{\sum_n X_n} \left(x_t \frac{\delta r_t}{\delta i_t} - y_t \frac{\delta k_t}{\delta i_t}\right) + \left(\sum_n r_n \frac{\delta x_t}{\delta i_t} - \sum_n k_n \frac{\delta y_t}{\delta i_t}\right)$$

$$- NIM_t \sum_n \frac{\delta x_t}{\delta i_t} \qquad (2)$$

Equation 2 suggests four factors as determinants of the bank's net interest margin, given a change in the general level of interest rates. First, the proportions of assets ($x_t/\Sigma x_n$) and liabilities ($y_t/\Sigma y_n$) repriced in period t are inverse

indicators of the maturity structures of assets and liabilities. For example, if interest rates increased (decreased) and the proportion of assets repriced within the period exceeded (were less than) the proportion of liabilities, the NIM would increase (decrease). This would be the conventional argument for managing the balance sheet gap.

A second relationship is the change in new asset yields and liability rates in response to movement in the general level of interest rates, $\delta r_t/\delta i_t$ and $\delta k_t/\delta i_t$, respectively. That is, the interest rate spreads between assets and liabilities will fluctuate incrementally as interest rates change.

A third effect is that portfolio shifts may occur in response to changing (or the expectation of changing) interest rates (i.e., Σr_n $(\delta x_n/\delta i_t)$ and Σk_n $(\delta y_n/\delta i_t)$ may be nonzero). It is worth noting that these second and third effects coincide with the rate and portfolio shift effects quantified by Keeton and Matsunaga.

The fourth component in Equation 2, Σ $(\delta x_n/\delta i_t)$, indicates that the change in the size of the bank's portfolio may occur in response to (or in anticipation of) a change in the level of interest rates. For example, a bank may temporarily reduce loan volume (ration credit) in the nth period, a period of monetary restraint and rising interest rates, to prevent a negative spread. Since $\Sigma x_n/\delta i_t$ appears twice in Equation 2, however, the sign of this response to a change in the level of interest rates could be negative and still result in an increase in the net interest margin.

If all four effects in Equation 2 are significant, the implications are threefold. First, determining through balance sheet gap analysis that a mismatch between maturities of assets and liabilities exists is not sufficient to determine the impact of a change in interest rates on bank net interest margin. Second, estimations of portfolio-shift and rate effects alone do not fully describe changes in the net interest margin. Rather, these effects on the net-interest margin derive from changes in the general level of interest rates, as do other effects. As a result, estimates of these effects from individual-bank, time-series data confound the impacts of underlying interest rate movements by not separating trend adjustments in net interest margins from deviations about that trend. Potentially important aspects of interest margin variance are ignored.

Third, the presence of "maturity" and "intermediation" factors (the first and fourth effects in Equation 2) suggests that portfolio adjustments may to a significant degree reflect bank management and related bank-specific factors. It is hypothesized that these "bank effects" include; 1) variations in management ability, 2) differences in local loan market

condition, 3) differences in information flows within banks, and 4) differences in the aggressiveness and risk preferences of loan and security officers. Additionally, it is hypothesized that these effects are most operative on the asset side of a bank's portfolio.

Due to the lack of sufficient micro-level data, it is not possible to estimate the separate effects indicated by Equation 2 using historical bank data. An alternative to decomposing the interest margin variance into separate effects (as done by Keeton and Matsunaga), or to estimating a linear relationship between the average net interest margin and lagged market interest rates (as done by Hanweck and Kilcollin), is to develop an index of net interest margin stability. This index has been suggested as an indicator of interest margin variance and asset/liability management performance at the individual-bank level of analysis (Binder and Lindquist).

Net Interest Margin Beta

Conceptually, the empirical beta approach derives from the capital asset pricing model (CAPM) developed by Sharpe (1964) and Lintner (1965). Under market equilibrium the CAPM defines a linear relationship between an asset's expected return and the systematic risk of that return. The equilibrium expected return (R_j) is equal to the sum of the risk-free rate of return (R_f) and a risk premium (which reflects the covariance of the asset's return with that of the market portfolio).[1] Computationally, beta is estimated by linear regression of the time series of excess return on the asset ($r_{jt} = R_{jt} - R_{ft}$) on the excess return on the market portfolio ($r_{mt} = R_{mt} - R_{ft}$),

$$r_{jt} = \alpha_j + \beta_j r_{mt} + e_{jt} \qquad (3)$$

where α_j and β_j are the estimated parameters, e is the error term, and t is the time index.

Analogously, the net interest margin beta (NIM-beta) is an indicator of the systematic component of net interest margin

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[1] The expected return of the j^{th} asset is defined by the CAPM as,

$$R_j = R_f + \frac{(E(R_m) - R_f)}{\sigma_m^2} \sigma_{jm},$$

where R_f is the risk free rate of return, $E(R_m)$ is the expected return on the market portfolio, σ_m^2, is the variance of the portfolio return, and σ_{jm} is the covariance of the returns.

according to the December 1985 report.[6] The number of ag banks analyzed was 433 and the number of nonag banks was 269.

Two measures of bank earnings were analyzed; the net interest margin percentage (net interest margin divided by net earning assets) and the percentage earnings before tax (net interest margin plus net noninterest income less provision for loan losses, all divided by net earning assets). Average annual values for these two measures at all small banks in Minnesota are reported in Table 4. Aggregate net interest margin increased from 1976 to 1981, then declined through 1984, and rose again in 1985. This pattern was similar to the national trend. Standard deviation of the net interest margin series increased through 1981/82 (a period of generally rising interest rates), and declined during 1983-85. The income before tax series for Minnesota banks also followed the national trend, but declined more rapidly than the national average in 1984 and 1985. The standard deviation of income before tax increased steadily from 1978-85. The largest increases occurred in 1982 and again in 1985.

Corresponding annual series of net interest margin and income before tax for agricultural banks in Minnesota are reported in Table 5. Interestingly, net interest margins for agricultural banks increased to higher levels by 1981, and fell more rapidly in the post-1981 period than did all small banks in the state. Also, mean income before tax fell more rapidly and its standard deviation increased faster among ag banks in the post-1981 period, than among comparably-sized nonag banks.

Following the methodology described in the previous section, a reference portfolio of commercial banks was used to derive estimates of alpha and beta for all banks in Minnesota. The small U.S. commercial bank net interest margin and income before tax series reported by Danker and McLaughlin, and in previous issues of the Federal Reserve Bulletin, was used as the reference portfolio for the Minnesota small bank model. An alternative reference portfolio which could have been used for ag banks is the agricultural bank series reported by Melichar. Results derived using the small bank portfolio is the only one reported here.

Results of the estimation of α and β for the net interest margin and income before tax of Minnesota agricultural banks are reported in Table 6. Average estimated coefficients are reported for 4 average total asset classes and 8 average ag loan ratio

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[6] Melichar has used the average agricultural loans/total loans ratio of all commercial banks as the basis for defining agricultural banks. The .1615 ratio is the average for 1985.

Table 4. Annual Net Interest Margin and Net Income Before Tax for Small Banks in Minnesota, 1976-85[a/]

Year	Net Interest Margin		Income Before Tax	
	Mean	Standard Deviation	Mean	Standard Deviation
	------ percent of net earning assets -------			
1976	3.19	0.59	0.66	0.74
1977	3.29	0.56	0.78	0.69
1978	3.49	0.59	1.18	0.61
1979	3.85	0.66	1.43	0.67
1980	4.08	0.78	1.51	0.90
1981	4.21	0.98	1.57	0.87
1982	4.13	0.98	1.29	1.14
1983	4.03	0.85	1.17	1.20
1984	4.02	0.74	1.01	1.27
1985	4.16	0.72	0.78	1.58
1976-85 (Average)	3.84	0.84	1.14	1.06

a/ Small banks were defined as those reporting less than $100 million in net earning assets on December 1985.

Table 5. Annual Net Interest Margin and Net Income Before Tax for Agricultural Banks in Minnesota, 1976-85.[a/]

Year	Net Interest Margin		Income Before Tax	
	Mean	Standard Deviation	Mean	Standard Deviation
	------ percent of net earning assets -------			
1976	3.07	0.52	0.82	0.54
1977	3.14	0.50	0.90	0.56
1978	3.32	0.44	1.25	0.43
1979	3.72	0.55	1.54	0.52
1980	4.07	0.67	1.74	0.61
1981	4.24	0.88	1.83	0.78
1982	4.13	0.87	1.57	0.85
1983	4.03	0.82	1.36	0.95
1984	3.99	0.67	1.03	1.21
1985	4.07	0.65	0.50	1.75
1976-85 (Average)	3.78	0.79	1.25	0.99

a/ Agricultural banks were defined as those with an ag loan ratio exceeding .1615 in 1985.

Table 6. Estimated α and β Coefficients For Net Interest Margin and Income Before Tax of Minnesota Agricultural Banks by Asset and Ag Loan Ratio Classes

Item	Net Interest Margin		Income Before Tax	
	α	β	α	β
Average Total Assets (1976-85):				
less than $25 mil.	-.260	1.311	.012	1.990
$25-50 mil.	-.708	.768	-.039	2.001
$50-75 mil.	-.849	1.003	-.241	2.356
$75-100 mil.	--	--	--	--
Average Ag Loan Ratio (1976-85):				
less than .10	-.754	.558	-.489	.387
.10 - .20	-.537	.498	-.274	1.149
.20 - .30	-.506	.799	-.130	1.652
.30 - .40	-.388	1.005	-.074	2.014
.40 - .50	-.355	1.205	-.008	1.915
.50 - .60	-.243	1.492	.046	2.128
.60 - .70	-.262	1.510	.155	2.354
greater than .70	-.323	1.550	.127	2.327
All Ag Banks:	-.350	1.215	-.004	2.003

classes. Average NIM-α coefficients are negative and small in nearly all classes shown. Although the overall NIM-α coefficient is negative (-.350), it is small and quite likely is not significantly different from zero. This would indicate that Minnesota ag banks were not significantly less profitable than other small commercial banks in the nation during 1976-85. As average total bank assets increased, the NIM-α coefficient became more negative indicating a tendency for larger banks to generate lower expected net interest margins than smaller banks in the state.

The NIM-β coefficients varied from 1.311 (for the under $25 million class) to .768 (for the $25-50 million class) indicating that systematic variations in net interest margin exist when compared to the national bank portfolio, and vary between agricultural banks by size. Small ag banks (under $25 million) generate net interest margins which vary more than the portfolio of all small banks in the nation. Inspection of the NIM-β estimates by ag loan ratio indicates that the level of systematic income risk tends to increase with the degree of specialization in agricultural lending. Ag banks with average ag loan ratios above .40 exhibited greater instability in net interest margin than ag banks which were more diversified. This suggests that banks which were heavily into ag lending during 1976-85 were quite asset-sensitive and bank management generally either allowed that sensitivity to continue in order to earn a higher return on assets, or was not actively managing assets and liabilities to reduce sensitivity of the net interest margin to market rate instabilities. Although the particular rationale for a larger NIM-β is not clear, the result has been that small banks which were heavily ag-oriented exhibited greater interest income risk than the portfolio of all small banks.

A useful way of summarizing the identified net interest margin relationships is to regress the estimated NIM-β data set for all small banks in Minnesota on the corresponding average values for each bank. The independent variables are; average total assets (TA), average ag loan ratio (ALR), and average net interest margin (NIM).

$$\begin{array}{lccccc} \text{NIM-}\beta = & -4.54 & + 1.19\ \text{ALR} & + 137.3\ \text{NIM} & + (.95 \times 10^{-5})\ \text{TA} \\ & (.54) & (.29) & (11.4) & (.46 \times 10^{-5}) \end{array}$$

$R^2 = .18$
$F = 52.6$

All coefficients are significant at the 5-percent level or higher, as indicated by the standard errors of the estimated coefficients in parentheses. In addition to confirming the positive ag lending ratio relationship, the regression indicates that banks with higher expected net interest margins also

exhibited greater systematic net interest income variability. One interpretation is that banks with greater NIM variability were rewarded with higher expected returns during this 10-year period. The regression also indicates that larger banks were characterized by greater NIM instability, contrary to the β-coefficient which was found on the small ag bank asset group.

While the NIM-β provides an indicator of systematic interest margin variability and bank management, it does not incorporate information on noninterest items and provision for loan losses. For that reason, the above estimation was repeated for ag banks in Minnesota looking, this time, at the income before tax (IBT) measure of bank earnings. The β-coefficients reported in Table 6 suggest that the range of systematic income risk in IBT among ag banks is somewhat greater than that observed for NIM. That is, the magnitude of the average IBT-β increases more rapidly as the ag loan ratio is raised. The sharp initial increase in IBT-β at the .10-.20 ag loan ratio level indicates that ag banks throughout the range above .10 have experienced greater systematic risk due to the combined effects of noninterest revenues and noninterest expenses, and provisions for loan losses. It is not clear at this stage of analysis which factor has been the most influential, although recent bank trend statistics suggest that the provision for loan losses is a major determinant of instability in income before taxes.

The regression equation which was estimated for IBT-β is as follows:

$$\underset{}{\text{IBT-}\beta} = \underset{(.19)}{.96} + \underset{(.28)}{2.87}\ \text{ALR} - \underset{(11.50)}{40.55}\ \text{IBT} + \underset{(.41 \times 10^{-5})}{(.10 \times 10^{-4})}\ \text{TA}$$

$$R^2 = .13$$
$$F = 36.0$$

All regression coefficients are significant at the 5-percent level or higher. Interestingly, the negative coefficient on average income before tax indicates that banks which maintained higher income before tax (and provision for loan losses correspondingly low) also reported the lowest systematic variability with the portfolio of all small banks.

Additional Work and Implications

While the preceding analysis is preliminary in nature, it does represent an alternative means for analyzing bank management, and bank performance differences. Instead of measuring total variability in the net interest margin and income before tax, the systematic component of income risk in these two measures was measured. One of the questions which remains is, how can the analysis be improved in terms of its usefulness? The

following are some directions for further work.

First, the net interest margin beta could be decomposed into gross interest income and gross interest expense betas to analyze the relative stability of these components of the net interest margin. These betas could be regressed on alternative classes of assets and liabilities to develop a better measure of how adjustments in each contributes to systematic interest margin variability. Second, alternative reference portfolios could be used to measure the α- and β-coefficients. The agricultural bank portfolio could be used to re-estimate the ag bank betas. An interest rate series could be used as a proxy for a market portfolio, and would facilitate the direct analysis of how interest rate instabilities have influenced the stability of bank interest margins and related measures of profit. Third, the period 1976-85, could be split into subsets of years (1976-80 and 1981-85) to analyze the extent to which rising rates and interest rate deregulation contributed to greater bank earnings instability. Fourth, some general research questions become: 1) do large-beta banks tend to grow faster than other banks, 2) do large-beta banks tend to fail more frequently than banks with lower levels of systematic risk, 3) do methods of risk management such as gap management, interest rate futures and options, etc. serve as effective means for reducing beta risk on the liability side, and 4) do variable rate lending practices reduce beta risk on the asset side?

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