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The Relation Between Bank Portfolios and Earnings: An Econometric Analysis

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THE RELATION BETWEEN BANK PORTFOLIOS AND EARNINGS: AN ECONOMETRIC ANALYSIS[1]

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Numerous theories of commercial bank behavior have been proposed. In all of them, some form of profit maximization has been posited, either explicitly or implicitly, as the motivating force. Therefore, the rates of return, positive and negative, which a bank realizes from its assets and liabilities are important determinants of a bank's portfolio composition. Conversely, the composition of a bank's portfolio is an important determinant of its profits.[2]

The relevant rates of return on earning assets, of course, are not easily observed nominal rates; servicing and processing costs must be deducted. Similarly, the relevant rates for liabilities are not observable interest payments per dollar; servicing costs net of service charges to depositors must be added. The relevant rates of return are net rates, and to apply a theory of bank behavior it is necessary to have estimates of these net rates.

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[1]We are indebted to Jane Kelly, William Mann, and Brian Moore for research assistance and to Stephen Goldfeld, Stuart Greenbaum, James Pierce and James Tobin for helpful comments. This research was financed in part by a grant from the National Science Foundation. The analysis and conclusions are solely the responsibility of the authors and do not necessarily reflect views of the Board of Governors of the Federal Reserve System or the Federal Reserve Bank of Kansas City.

[2]A bank's portfolio is considered to include both its assets and its liabilities, rather than just its assets. The elements of a portfolio are nonnegative in amount. Correspondingly, the rates of return on elements of a portfolio may be positive or negative. The rates of return on earning asset elements should be positive and those (rates of cost) on deposit liability elements should be negative.

The purpose of this paper is to provide empirical estimates of the net rates of return which banks realize on various elements of their portfolios.

Regression methods are utilized to allocate revenue and cost among the elements of bank portfolios. Thus, given observations of a cross-section of banks least-squares regressions of net current operating income (and other variants of profit) on various assets and liabilities are computed. The coefficients are estimates of net rates of return. They are compared with estimates derived by ordinary cost accounting techniques; this comparison provides some basis for evaluating the statistical cost accounting approach.[3]

The first section of the paper explains the analytical framework underlying the study and describes the data. The second and third sections report applications of the model to different samples of banks. By far the richest set of data concerns member banks in the Tenth Federal Reserve District, which are analyzed in Section 2. In Section 3, data for Connecticut commercial banks are studied and the estimates of net rates of return derived are compared with estimates from functional cost analyses by the Federal Reserve Bank of Boston. The final section of the paper briefly relates our empirical results to some problems of banking structure.

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[3] A detailed discussion of statistical cost accounting techniques and a comparison with ordinary cost accounting methods may be found in John R. Meyer and Gerald Kraft, "The Evaluation of Statistical Cost Accounting Techniques as Applied in the Transportation Industry," American Economic Review: Supplement, Vol. 51, No. 2 (May 1961), pp. 313-334.

1. Analytical Framework and Data

The analytical framework of the paper is quite simple. It evolved from a study of scale economies in banking by Lyle Gramley and from a study of commercial banking in India by one of the authors.[4]

By way of introduction, we review the work of Gramley. He wished to show how bank growth and size affect bank costs, revenue, and earnings. Other explanatory variables, reflecting the composition of assets and liabilities, were included in the regressions to improve the fit. He did not formulate his model to derive estimates of net rates of return. Thus, the regressions explaining costs, revenue, and earnings did not include all earning assets and deposit liabilities as explanatory variables. This omission will bias estimates of rates of return if omitted variables are correlated with the included variables. One reason for the omission of some categories of assets and liabilities was serious collinearity resulting from the particular form in which variables were introduced. For example, sub-categories of loans were introduced as ratios to total loans. This built a linear relation among the loan variables into the regression equation and made interpretation of the coefficients difficult. Finally, the regressions were estimated from data averaged over the 4 years 1956-59. Since interest rates were not stationary during the 4 years the structure of the model may have been changing. In sum, it is not possible to interpret Gramley's

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[4] Lyle E. Gramley, A Study of Scale Economies in Banking, Kansas City, Mo.: Federal Reserve Bank of Kansas City, 1962. Donald D. Hester, Indian Banks: Their Portfolios, Profits, and Policy, Bombay: Bombay University Press, 1964.

regression coefficients unambiguously as estimates of net rates of return. Reformulation of Gramley's model in order to estimate rates of return is the aim of this paper.

a. Framework.

The analytical framework can be thought of as statistical cost accounting. Rates of return are imputed to earning assets and deposit liabilities by regression methods.

Variation in revenue over a sample of banks can be described by:

$$(1) \qquad R_t = r_0 + r_1 X_{1t} + r_2 X_{2t} + \ldots + r_n X_{nt} + er_t , \qquad t = 1, 2, \ldots$$

where, for the t^{th} bank,

R_t = its current operating revenue,

X_{it} = the book value of the i^{th} asset or liability in its portfolio, and

er_t = a stochastic term associated with the bank.

The coefficients r_i , $i = 1 \ldots n$, represent gross rates of return on elements of a bank's portfolio, while r_0 represents "fixed" revenue. Certain minor aspects of a bank's total revenue, such as trust department revenue, safety deposit box income, etc., are not accounted for in the equation; good measures of these outputs are not readily available. Similarly, variation in costs can be described by:

$$(2) \qquad C_t = c_0 + c_1 X_{1t} + c_2 X_{2t} + \ldots + c_n X_{nt} + ec_t , \qquad t = 1, 2, \ldots$$

where, for the t^{th} bank,

C_t = its current operating cost, and

ec_t = a stochastic term.

The X's are the same as in the revenue equation. The coefficients c_i , $i = 1 \ldots n$, represent rates of cost on elements of a bank's portfolio, while c_0 represents fixed cost. As before, some minor aspects of a bank's total cost are not accounted for in the equation.

These two equations can be fitted to data for a sample of banks, yielding estimates of the revenue and cost coefficients for the elements of a bank's portfolio. Then, subtracting the cost coefficients from the corresponding revenue coefficients will give estimates of net rates of return.

Alternatively, variation in earnings or net income over a sample of banks can be described by:

$$(3) \qquad Y_t = y_0 + y_1X_{1t} + y_2X_{2t} + \ldots + y_nX_{nt} + ey_t \ ,$$

where, for the t^{th} bank,

$Y_t = R_t - C_t$ = its net current operating income,

X_{it} = the book value of the i^{th} asset or liability in its portfolio, and

ey_t = a stochastic term.

The coefficients y_i , $i = 1 \ldots n$, represent net rates of return on elements of a bank's portfolio. The intercept y_0 represents net fixed revenue. Again, not all aspects of a bank's total net income are accounted for. This equation can be fitted to data for a sample of banks, yielding estimates

of net rates of return. As is well known, these estimates will be the same as those derived by differencing estimated revenue and cost functions, if the same X's are used. This is the approach we follow, primarily for reasons of simplicity.

One possible disadvantage of this "aggregative" approach, however, should be mentioned. The fitting of separate equations for revenue and cost permits a more precise a priori specification of the equations. Thus, some explanatory variables used in one equation can be omitted from the other. This is helpful if there are problems of collinearity. The use of net income as a single dependent variable is equivalent to including all of the explanatory variables in each of the separate equations.

In equation (3), net current operating income is assumed to be a linear function of the elements of a bank's portfolio. A nonlinear relationship is a distinct possibility, but we do not formally test for nonlinearity or try nonlinear forms. Plots of residuals from linear regressions against different portfolio elements do not reveal any obvious nonlinearities. As a first approximation we assume that banks earn constant marginal rates of return from elements of their portfolios.

This assumption may seem unrealistic for certain elements of a bank's portfolio. It is generally agreed, for example, that interest rates on business loans are lower at larger banks. It is also likely, however, that the costs of acquiring and servicing business loans are smaller at larger banks. Thus, the net rate of return on these loans may be approximately the same at all sizes of banks. Some indirectly related, supporting evidence on this

particular point has recently been presented by George Benston.[5]

To avoid inefficiency in the estimation of coefficients associated with heteroskedasticity of residuals, all variables in equation (3) have been deflated by total assets.[6] Thus, the general form of the equation to be estimated is:

$$(4) \qquad Y_t/A_t = y_0\, 1/A_t + y_1 X_{1t}/A_t + y_2 X_{2t}/A_t + \ldots + y_n\, X_{nt}/A_t + u_t\ ,$$

where, for the t^{th} bank,

A_t = its total assets, and

$u_t = ey_t/A_t$ = a stochastic term.

Note that in the above equation y_0 is the coefficient of the reciprocal of assets. It still can be interpreted as a measure of net fixed revenue.

Since total assets is not specified as an explanatory variable in equation (3), there is no intercept in equation (4). Total assets might be included in equation (3) as a proxy for some nonmeasurable sources of net income. But it also would "pick up" some of the net income attributable

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[5] George J. Benston, "Commercial Bank Price Discrimination Against Small Loans: An Empirical Study," Journal of Finance, Vol. 19, No. 4 (December 1964), pp. 631-643.

[6] Deflation is not the most desirable method of correcting for heteroskedasticity, but in practice is the simplest. Dissatisfaction with the deflation method has led one of us to develop an iterative procedure for reducing heteroskedasticity: Donald D. Hester, "An Iterative Procedure for Reducing Heteroskedasticity in Regression Analysis," unpublished, 1964. Only experimental applications have been made to the data of this study.

to portfolio variables, since total assets is highly correlated with many portfolio elements. It appears to us more useful to force the net income of a bank -- other than the fixed component y_0 -- to be assigned to observable portfolio assets and liabilities. If all sources of net earnings could be measured, the coefficient of total assets should be zero.

In practice, however, intercepts are estimated for equation (4) to test the assumption that they are zero. The intercepts usually are positive and are significant in about one third of the regressions. If the intercept is significant, this is noted, but the intercept is suppressed in the reported regression. Inclusion of the intercept aggravates collinearity; standard errors of all coefficients typically rise when an intercept is included.

A number of questions arise about the appropriateness of regression analysis in the present context. The Markoff theorem states that least-squares estimators of the y's in equation (4) are best linear unbiased estimators if the following four conditions are satisfied:

$\underline{a}$ $E(u_t) = 0$, for all t

$\underline{b}$ $E(u_t \cdot u_t) = \sigma^2$, for all t

$\underline{c}$ $E(u_t \cdot u_{t'}) = 0$, for all t and t', $t \neq t'$, and

$\underline{d}$ $E(u_t \cdot X_{it}/A_t) = 0$, for all X_i.

Condition $\underline{a}$ customarily is assumed to be satisfied. In this case some sources of a bank's net income are not accounted for and it is unlikely that they cancel out. This will tend to bias the coefficient of $1/A$, probably towards zero.

Gross heteroskedasticity has been eliminated from the residuals of equation (3) by deflation. Condition b is roughly satisfied in equation (4).

Condition c is usually assumed to be satisfied in cross-section studies. Variations in the degree of competition in individual banking markets may occasionally cause this assumption to be violated; we think such violations are not important in our study.

Condition d requires a more extended discussion. Portfolio selection theory suggests that investors place higher percentages of their funds in those assets which bear higher rates of return, all other things being equal. Suppose that the net rate of return on a certain category of loans differed at two banks. The theory suggests that the bank facing the higher rate will hold a larger relative amount of the loan. That bank also will tend to have high earnings, i.e., a positive residual. For this category of loans, $E(u_t \cdot X_{it}/A_t) > 0$. If this argument is correct, then the estimated rates of returns for some loan types will be positively biased.

We reject this argument. Most of the market areas in which banks operate are sufficiently competitive that rates of return on identical assets should not vary greatly among banks. These market areas overlap geographically and are further interrelated by the existence of other financial institutions, such as savings and loan associations, insurance companies, finance companies, etc. There are many explanations for variation in the composition of bank portfolios other than rates of return. Important explanations include differences in the aggressiveness of lending officers, differences in aversion to risk among lending officers, differences in the degree of deposit

predictability, and differences in loan demand which are not reflected in interest rates. In fact, the estimated net rates of return on loans are modest; often they do not significantly exceed rates of return imputed to securities.

Another possible source of correlation between residuals and explanatory variables cannot be dismissed, errors-in-variables. Errors-in-variables will cause least-squares estimators to be biased; the seriousness and direction of the bias cannot be evaluated a priori. There are here several possible sources of errors-in-variables:

(1) As is well known, book values of assets differ from market values. Ideally, market values should be used in the analysis. To the extent that the two measures differ, an errors-in-variables problem exists.

(2) The measures of the explanatory variables are simple averages of either two or three balance sheets on different dates during a year. For certain variables these averages are not entirely accurate measures of the "true" average values. These errors-in-variables are not too serious for the Tenth District sample. The Connecticut sample is more contaminated, particularly if "window dressing" of end-of-year balance sheets is pronounced.[7]

(3) Another type of measurement error arises from variations of composition within the balance sheet categories used as explanatory variables. For example, the maturity composition of Government securities holdings differs among banks. The available data do not allow us to use various maturity classes of Government securities as separate variables. If there

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[7] "Window Dressing" in Bank Reports, Sixteenth Report by the Committee on Government Operations, Washington: U.S. Government Printing Office, 1963.

is a relation between the size of Government holdings and composition, this will introduce a bias. Unfortunately, we know little about such possible relations.

We conclude from this discussion that application of the regression model is reasonably justified; conditions necessary for applying the Markoff theorem are approximately satisfied. The estimates reported are believed to be fairly good estimates of net rates of return earned on different assets and liabilities, subject to certain qualifications specified below. Of course, collinearity among the independent variables necessarily affects our ability to identify rates of return; it does not affect the applicability of the Markoff theorem.

b. Data.

Data used in the analysis are from two sources. Tenth District bank data are from call reports and year-end income and dividend reports in the possession of the Federal Reserve Bank of Kansas City. Individual asset or liability variables are measured for a year by averaging the prior year-end and the current mid-year and fall call report values of the asset or liability. The 300 banks analyzed are a size stratified random sample drawn from the 750 Tenth District member banks.

Data about Connecticut commercial banks are from the Annual Report of the Bank Commissioner of the State of Connecticut for various years.[8] For Connecticut banks, only year-end balance sheets were available; an arithmetic

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[8] Annual Report of the Bank Commissioner of the State of Connecticut, Hartford: 1956-63.

average of two successive balance sheets is used to measure variables. The sample sizes vary from year to year and are reported with the regressions.

Banks in the Kansas City District are predominantly unit banks; in Connecticut branch banking exists. Consequently, in Connecticut regressions the number of branches is introduced as a separate variable in an attempt to make the two samples comparable.

The size distributions of commercial banks in the two samples are quite similar. The median bank has total assets of about $9 million in the former and about $13 million in the latter. In both samples the smallest bank has less than $1 million and the largest bank has about $500 million in assets.

In the empirical work, three different dependent variables are considered: net current operating income, net profit before income taxes, and net profit after taxes. Primary emphasis is placed on the analysis of net current operating income. This is the variable which is likely to have the most stable relationship to portfolio variables.

Net profit before taxes differs from net operating income in that it reflects the results of a number of nonrecurring or "nonoperating" transactions and other arbitrary accounting decisions. Thus losses and writeoffs (or recoveries) on loans, realized capital losses (or gains) on securities, and other losses (or profits) are deducted from (included in) net profit. For those banks on an accrual accounting basis, transfers to reserves for bad debts and transfers to security valuation reserves are included in net profit. Many banks have set up reserves for bad debts, but very few have valuation reserves for securities. Differences in accounting systems among

banks create problems in using the variable net profits before taxes.[9]

Net profit after taxes is simply net profit before taxes less income taxes. This variable suffers from the difficulties noted above and in addition from the sharp jump in the marginal tax rate at $25,000 in profits. Therefore we pay little attention to net profit after taxes.

Certain asset and liability items are not used as independent variables. Indeed, it would not be possible to use them all, since they are connected by the balance sheet identity. Also, measures of some items are not readily available. Capital accounts, value of buildings and equipment, and cash are not used as independent variables in regressions involving Connecticut banks. For Tenth District banks, capital accounts, value of buildings and equipment, and cash other than correspondent balances are not used.

In Table 1-1, a list of variables with their symbol equivalents is presented.

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[9] See P. Horvitz and S. Shapiro, "Loan Loss Reserves," National Banking Review, Vol. 2, No. 1 (September 1964), pp. 27-49.

TABLE 1-1*

Variables Used in the Present Study

Variable	Symbol
Net current operating income	Y
Net profit before income taxes	P
Income taxes	T
Total assets	A
U.S. Government securities	X_1
Tax-exempt securities	X_2
All securities except U.S. Governments	X_3
Net loans	$\bar{X}_4$
Gross loans	X_4
Real-estate loans	X_{41}
Real-estate loans -- secured by farm land	X_{411}
Real-estate loans -- FHA	X_{412}
Real-estate loans -- VA	X_{413}
Real-estate loans -- secured by other assets	X_{414}
Farm loans	X_{42}
Farm loans -- CCC	X_{421}
Farm loans -- other	X_{422}
Loans to individuals	X_{43}
Loans to individuals -- single payment	X_{431}
Loans to individuals -- installment	X_{432}

(Continued)

TABLE 1-1*
(Continued)

Variable	Symbol
Loans to individuals -- installment auto	X_{4321}
Loans to individuals -- installment repair	X_{4322}
Loans to individuals -- installment other	X_{4323}
Commercial and industrial loans	X_{44}
Other loans	X_{45}
Demand balances with commercial banks	X_5
Demand deposits of individuals, partnerships, and corporations	$\bar{X}_6$
Demand deposits (all)	X_6
Demand deposits of banks	X_{61}
Other demand deposits	X_{62}
Time and savings deposits of individuals, partnerships, and corporations	$\bar{X}_7$
Time and savings deposits (all)	X_7
Number of branches	X_8
All deposit liabilities except $\bar{X}_6$ and $\bar{X}_7$	$\bar{X}_9$
Other bonds, notes, debentures, corporate stocks and minor miscellaneous assets	X_o

*All amounts are in thousands of dollars. The following identities connect variables in Table 1-1.

a) $X_4 \equiv X_{41} + X_{42} + X_{43} + X_{44} + X_{45}$

b) $X_{41} \equiv X_{411} + X_{412} + X_{413} + X_{414}$

c) $X_{42} \equiv X_{421} + X_{422}$

d) $X_{43} \equiv X_{431} + X_{432}$

e) $X_{432} \equiv X_{4321} + X_{4322} + X_{4323}$

f) $X_6 \equiv X_{61} + X_{62}$

2. Analysis of Tenth District Banks

The analysis of data for Tenth District banks can best be introduced by stating some hypotheses which will be tested (or strictly speaking their negative will be tested). They are:

a Variations in the X_i/A account for differences in individual bank values of Y/A and P/A .

b More disaggregated measures of the X_i/A significantly improve the explanation of differences in individual bank values of Y/A .

c Differences in the relationships between the X_i/A and Y/A exist among the individual years, 1956-59.

d Differences in the relationships between X_i/A and P/A exist among the individual years, 1956-59.

a. Net current operating income.

Hypothesis a is tested by using data from the individual years and from 4-year averages. Hypothesis a is tested in every regression reported in this section and in every case is accepted at the .01 level of significance. That is, a null hypothesis that no relationship exists between the X_i/A and Y/A or P/A is rejected.

Hypothesis b is tested only by using the 4-year averages of banks' earnings and assets and liabilities. A number of regressions were fitted in which the sets of independent variables differed according to the degree of disaggregation. By applying analysis of covariance we determine whether

finer breakdowns of assets and liabilities significantly improve the description of net current operating income. Data are from 288 individual banks during the years 1956-59. These data were used in the earlier study by Gramley.[10]

Tables 2-1, 2-2, and 2-3 report the results of regressing Y/A on the X_i/A when the latter are disaggregated to different degrees. The coefficients reported in the three tables are plausible in that their signs conform to a priori expectations, i.e., the coefficients of assets are positive and those of liabilities are negative. In Tables 2-1 and 2-2 all coefficients except the intercept are significantly different from zero at the .01 level. Coefficients of asset and liability variables and intercepts are measured in per cent per annum; all other coefficients are in dollars. An asterisk indicates significance at the .05 level in a two-tailed test. Standard errors are indicated in parentheses below the corresponding regression coefficients.

Analysis of covariance reveals that the variance of residuals is markedly reduced by partially disaggregating loans. The hypothesis that each of the five classes of loans earns the same net rate of return is rejected at the .01 level; R^2 rises from .2634 to .3758 in the regressions without

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[10] Use of data which has been averaged over a number of years has the disadvantages mentioned in the previous section. On the other hand, averaged data may be preferable to annual data, the variance of the transitory component of the variables is smaller. We believe that the averaged data permit us to make correct judgments in testing hypothesis b. The convenient availability of the averaged data early in our study was the major consideration in our decision to use them.

intercepts.[11] However, a further disaggregation of loans and a disaggregation of demand deposits does not significantly improve the explanations of net current operating income. In addition, there are indications that collinearity is becoming a problem impairing the reliability of the individual estimates. Consequently, we view the coefficients in Table 2-2 as final estimates of net rates of return for the averaged data.

The intercept in Table 2-2 is significant at the .05 level, suggesting that net income exists which is unrelated to the observed assets and liabilities but is related to bank size. As noted in the previous section, we are uncertain about the interpretation of this coefficient. Its size may simply be a reflection of the correlation between total assets and the portfolio variables. Suppressing positive intercepts has the effect of reducing the apparent cost of deposit liabilities and increasing the apparent rate of return from assets.

No further interpretation of coefficients reported in Table 2-2 will be made in this paper. Table 2-4 reports coefficients of the same assets and liabilities estimated from data for each of the 4 years and for the 4 years pooled. We remark that we have computed but not reported regressions in the forms reported in Table 2-1 from annual data. For each year the decision to adopt the form reported in Table 2-4 was supported by analysis of covariance.

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[11] In Table 2-1, total net loans is the loan variable; in Table 2-2 the sum of X_{4i}, i=1, ...,5,is total gross loans. The correlation between total gross loans and total net loans is sufficiently high to insure that the conclusion from the analysis of covariance is not a consequence of the change in definition of aggregate loans. Net loans constituted 98.5 percent of gross loans in 1963.

TABLE 2-1

Imputed Net Rates of Return When Asset Disaggregation is Low

Variable	Y/A	Y/A
Intercept	2.20* (.95)	----
1/A	-3,320* (686)	-3,575* (683)
X_1/A (U.S. governments)	2.91* (.66)	3.70* (.57)
X_3/A (Other securities)	2.65* (.66)	3.51* (.55)
$\overline{X}_4/A$ (Net loans)	4.28* (.70)	5.29* (.55)
X_5/A (Deposits with banks)	1.71* (.66)	2.27* (.62)
X_6/A (Demand deposits)	-3.78* (.86)	-2.13* (.50)
X_7/A (Time deposits)	-4.89* (.82)	-3.47* (.55)
R^2	.2773	.2634
S_u	.00318	.00321
N	288	288
F	16.73*	15.64*

TABLE 2-2

Imputed Net Rates of Return When Asset Disaggregation is Medium

Variable	Y/A	Y/A
Intercept	1.90* (.88)	----
1/A	-2,849* (722)	-2,870* (728)
X_1/A (U.S. governments)	4.09* (.68)	4.85* (.58)
X_3/A (Other securities)	3.78* (.66)	4.59* (.55)
X_{41}/A (Real estate loans)	4.70* (.81)	5.55* (.71)
X_{42}/A (Farm loans)	4.74* (.65)	5.61* (.51)
X_{43}/A (Loans to individuals)	7.00* (.74)	7.87* (.62)
X_{44}/A (Commercial and industrial loans)	4.92* (.86)	5.99* (.71)
X_{45}/A (Other loans)	7.22* (1.46)	8.18* (1.40)
X_5/A (Deposits with banks)	2.48* (.68)	3.04* (.63)
X_6/A (Demand deposits)	-4.46* (.80)	-3.12* (.51)
X_7/A (Time deposits)	-5.82* (.78)	-4.65* (.57)
R^2	.3864	.3758
S_u	.00293	.00296
N	288	288
F	17.43*	16.71*

TABLE 2-3

Imputed Net Rates of Return When Asset Disaggregation is High

Variable	Y/A	Y/A
Intercept	1.57 (.94)	----
1/A	-2,947* (753)	-2,935* (756)
X_1/A (U.S. governments)	3.77* (.83)	4.58* (.68)
X_3/A (Other securities)	3.67* (.80)	4.50* (.62)
X_{411}/A (Farm land secured real estate loans)	2.49 (1.43)	2.96* (1.41)
X_{412}/A (FHA real estate loans)	4.70* (1.45)	5.68* (1.33)
X_{413}/A (VA real estate loans)	3.79* (1.76)	4.39* (1.73)
X_{414}/A (Other real estate loans)	5.57* (1.25)	6.62* (1.08)
X_{421}/A (CCC Farm loans)	3.48* (1.05)	4.29* (.94)
X_{422}/A (Other farm loans)	4.76* (.81)	5.67* (.61)
X_{431}/A (Single payment loans to individuals)	4.39* (1.32)	5.05* (1.27)
X_{4321}/A (Automobile installment loans to individuals)	7.46* (1.01)	8.34* (.86)
X_{4322}/A (Repair installment loans to individuals)	5.16 (2.79)	6.09* (2.75)
X_{4323}/A (Other installment loans to individuals)	6.30* (1.43)	7.24* (1.32)

(Continued)

TABLE 2-3
(Continued)

Variable	Y/A	Y/A
X_{44}/A (Commercial and industrial loans)	4.71* (.94)	5.66* (.74)
X_{45}/A (Other loans)	7.12* (1.50)	8.01* (1.41)
X_5/A (Balances with banks)	2.12* (.79)	2.75* (.70)
X_{61}/A (Demand deposits of banks)	-4.12* (.88)	-2.97* (.54)
X_{62}/A (Other demand deposits)	-3.79* (.83)	-2.84* (.61)
X_7/A (Time deposits)	-5.28* (.81)	-4.47* (.65)
R^2	.4003	.3941
S_u	.00290	.00291
N	288	288
F	11.08*	10.83*

TABLE 2-4

Imputed Net Rates of Return for the Years 1956-59 and for 4 Years Pooled -- Y/A**

Variable	1956	1957	1958	1959	Pooled
1/A	-2,467* (819)	-3,337* (825)	-2,875* (811)	-2,927* (955)	-2,885* (421)
X_1/A	4.72* (.61)	4.62* (.64)	4.48* (.60)	4.04* (.60)	4.48* (.30)
X_3/A	3.98* (.58)	4.20* (.61)	4.60* (.57)	4.27* (.58)	4.24* (.29)
X_{41}/A	5.24* (.78)	5.25* (.82)	6.01* (.74)	4.96* (.77)	5.38* (.38)
X_{42}/A	5.33* (.55)	6.05* (.59)	5.25* (.53)	4.68* (.54)	5.28* (.27)
X_{43}/A	7.50* (.65)	8.07* (.69)	7.19* (.65)	6.94* (.67)	7.41* (.33)
X_{44}/A	6.52* (.78)	6.00* (.79)	5.72* (.74)	5.15* (.73)	5.80* (.37)
X_{45}/A	6.93* (2.01)	7.85* (.99)	6.26* (1.83)	5.24* (1.02)	6.69* (.56)
X_5/A	2.81* (.64)	2.72* (.68)	2.91* (.64)	2.24* (.72)	2.67* (.33)
X_6/A	-2.96* (.53)	-2.92* (.56)	-2.90* (.53)	-2.29* (.53)	-2.77* (.26)
X_7/A	-4.28* (.60)	-4.81* (.64)	-4.54* (.59)	-3.92* (.60)	-4.36* (.30)
R^2	.3324	.3587	.3109	.2819	.3334
S_u	.00345	.00347	.00332	.00360	.00347
N	296	294	293	291	1174
F	14.35*	15.90*	12.98*	11.35*	54.35*

** Intercepts were positive and significant at the .05 level in the 1956, 1957, and pooled regressions. In 1958 and 1959, intercepts were positive but not significant at .05. Intercepts have been suppressed in all regressions.

An analysis of covariance was performed on the regressions reported in Table 2-4 to test hypothesis c. The null hypothesis of no year-to-year differences in coefficients cannot be rejected at the .05 level; no significant differences in the set of estimated net rates of return exist over the 4-year period. The F ratio is 1.06 for regressions reported in Table 2-4.[12]

The imputed rate of return on U. S. Government securities in the pooled regression is 4.48 per cent, which appears unreasonably high if judged by observable yields on federal debt during this 4-year period. One possible explanation is that banks with large holdings of Governments relative to total assets have a different maturity distribution of securities in their portfolios. Thus, banks with high values of X_1/A may have a large proportion of high yielding long-term bonds. This will tend to cause imputed rates of return to be positively biased.

Similarly, the estimated return on other securities, largely state and local bonds, appears high assuming that banks hold high quality bonds. Interest rates on Moody's Aaa and Baa municipals in 1957, for example, were 3.10 and 4.20 per cent, respectively.[13] The lower quality bond yields correspond quite closely to the estimated net rate of return.

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[12] An analysis of covariance also was applied to annual regressions of the form reported in Table 2-1 to test hypothesis c. For this set of regressions, hypothesis c is accepted. Apparently the imputed rate of return on total loans differed over the 4 years. In view of the result in the text, it appears that this result is more attributable to variations in loan composition than to variations in interest rates.

[13] Federal Reserve Bulletin, Vol. 44, No. 6 (June 1958), p. 675.

Estimated net rates of return on real-estate and farm loans appear plausible; these loans net about 5.3 per cent per annum. The estimated net return on commercial and industrial loans is 5.8 per cent. Far more lucrative are loans to individuals, which include a considerable amount of consumer installment business. The estimated net rate of return for these loans is 7.4 per cent. Finally, other loans, X_{45}, are estimated to have a net return of 6.7 per cent. This seems unreasonably high, for other loans are largely money market loans. We have no ready explanation for this result.

The coefficient of X_5/A is the estimated net rate of return earned by sample banks from correspondent balances carried with other banks. We interpret the estimated rate of return of 2.67 per cent to measure the value of services obtained from correspondent banks expressed as a percentage of a bank's correspondent balances. These services include check clearing, bond portfolio management, loan participation, and advice and information about clients. It is interesting to note that this rate is approximately equal to the estimated net cost of servicing demand deposits, 2.77 per cent.

The estimated net cost of time and savings deposits of 4.36 per cent exceeds the 2.77 per cent net cost of demand deposits by a considerable margin. It is instructive to examine the difference between these two costs in the annual regressions. At the end of 1956, Regulation Q was relaxed to permit banks to pay higher rates of interest on time and savings deposits. In 1956, the difference between the net cost of these two classes of deposits was 1.3 per cent; in 1957, it was 1.9 per cent; in both 1958 and 1959, it was 1.6 per cent. It appears that the effect of the 1956 change in Regulation Q was to drive up the cost of time relative to demand deposits by about .3 per cent per annum,

although this figure is very tentative in view of the size of the standard errors of coefficients of X_6/A and X_7/A.

Using the coefficient of $1/A$ as an estimate of net fixed cost, we can estimate roughly the "break-even" size of banks in the Tenth Federal Reserve District. Estimated net fixed cost is $2,885. The average ratio of net current operating income to assets for these banks was approximately 1.3 per cent during the 1956-59 period. Assuming that this average ratio can be applied for banks of all sizes, we find that $2,885/.013 \cong $225,000 is the break-even size. Since such a bank would earn no return for its stockholders, we expect the smallest viable bank to be somewhat larger. The smallest member bank in the Tenth District during the period had approximately $500,000 in total assets.

The pooled regression accounts for 33 per cent of the variance in net current operating income. Clearly, a number of factors accounting for variation in bank net operating income exist which are unrelated to the portfolio variables studied here. These may include market power, executives who are not paid their marginal product, luck, variations in loan demand and deposit supply, etc. Market power is examined in the next section, but other factors cannot be studied in this paper.

b. Net profits before taxes.

To what extent do individual bank variations in assets and liabilities explain bank variations in net profit before income taxes? Table 2-5 reports net rates of return estimated for the same set of variables reported in Table 2-4. [14] Again, the coefficients have been estimated for each of the

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[14] An analysis of covariance revealed that the disaggregation of total loans to the five major categories significantly improved the explanation of the variance of P/A.

4 years and for the 4 years pooled. A hypothesis of no year-to-year variation in coefficients is rejected at the .05 level, largely because of the weak relationship in the 1956 regression. The explanation for the variability is unclear; the hypothesis is not rejected at the .01 level.

The dependent variables in Tables 2-4 and 2-5 differ, as explained above, in that net profit before taxes is affected by losses and writeoffs on loans or transfers to bad debt reserves, realized losses or gains on securities, and other nonrecurring losses or gains. Therefore, the coefficients in Table 2-5 are rough estimates of net rates of return after allowance for losses on loans and realized capital losses or gains on securities. Comparison of the coefficients in the two tables may suggest the magnitudes of Tenth District banks' net losses or gains on different assets in their portfolios. For example, subtracting coefficients of X_1/A in Table 2-4 from the corresponding coefficients in 2-5 suggests that banks on average realized substantial capital losses on their U. S. Government securities in 1956 and 1959, a small loss in 1957, and a small gain in 1958. A similar pattern applies to banks' transactions in other securities, X_3/A. Over the 4-year period, the average realized loss on U. S. Government securities was about .5 per cent per annum; the average realized loss on other securities was about .75 per cent per annum.

Estimated losses and writeoffs on loans, or transfers to reserves for bad debts, vary considerably depending upon the year and the type of loans. In general, they were higher in 1956 and 1959, years of active lending. Referring to the pooled figures, the estimated losses and writeoffs for different classes of loans, expressed as per cent per annum of loans in that class, are .7 per cent

TABLE 2-5

Imputed Net Rates of Return for the Years 1956-59 and for 4 Years Pooled -- P/A**

Variable	1956	1957	1958	1959	Pooled
1/A	-950 (1,402)	-1,782 (1,017)	-3,419* (1,098)	-1,936 (1,135)	-1,877* (586)
X_1/A	3.73* (1.04)	4.56* (.79)	4.82* (.81)	2.92* (.71)	4.01* (.42)
X_3/A	2.70* (1.00)	4.03* (.75)	4.13* (.78)	2.92* (.69)	3.49* (.40)
X_{41}/A	4.62* (1.33)	5.27* (1.01)	5.43* (.99)	3.49* (.91)	4.64* (.53)
X_{42}/A	3.96* (.94)	5.09* (.73)	4.44* (.71)	3.12* (.64)	4.12* (.37)
X_{43}/A	4.72* (1.12)	6.75* (.85)	6.68* (.89)	4.40* (.80)	5.61* (.46)
X_{44}/A	4.46* (1.33)	5.23* (.97)	5.97* (1.00)	3.24* (.87)	4.70* (.51)
X_{45}/A	3.82 (3.45)	6.34* (1.22)	4.38 (2.48)	4.49* (1.21)	5.13* (.78)
X_5/A	2.26* (1.10)	3.45* (.84)	2.57* (.87)	1.55 (.85)	2.54* (.46)
X_6/A	-2.00* (.91)	-3.01* (.69)	-2.78* (.71)	-1.38* (.64)	-2.32* (.37)
X_7/A	-3.91* (1.03)	-4.79* (.79)	-4.50* (.80)	-2.84* (.72)	-3.93* (.42)
R^2	.0671	.1644	.2002	.1099	.1249
S_u	.00591	.00429	.00450	.00428	.00483
N	296	294	293	291	1174
F	2.93*	6.24*	7.23*	4.26*	16.22*

** Intercepts were positive and significant at the .05 level in the 1957, 1958, and pooled regressions, but have been suppressed.

in the case of mortgages, 1.2 per cent for farm loans, 1.8 per cent for loans to individuals (including installment credit), 1.1 per cent for commercial and industrial loans, and 1.6 per cent for other loans. With the exception of farm loans, coefficients of loan variables in Table 2-5 tend to be positively related to the estimated losses and writeoffs associated with each loan variable. There appears to be some reward for risk taking.

Differences in estimated coefficients of correspondent balances, X_5/A ; demand deposits, X_6/A ; and time deposits, X_7/A , are not much larger than a standard error between Tables 2-4 and 2-5. This corresponds well to the interpretation of differences between the two sets of regressions; no sizable losses are experienced on these assets and liabilities. In the next section, however, evidence is reported that deposit structure may impair a bank's ability to realize capital gains.

Standard errors of estimate are considerably larger in Table 2-5 than in Table 2-4; this reflects the fact that writeoffs of loans, transfers to bad debt reserves, and realization of capital gains or losses are largely arbitrary and to some extent random.

c. Net profit after taxes

We have also studied the relationship between profits after taxes and the explanatory variables reported in Table 2-5. An analysis of covariance revealed that no year-to-year variation in the relationship existed over the 4 years being studied. The estimated pooled regression is:

$$(P-T)/A = \underset{(443)}{105.}\ 1/A + \underset{(.31)}{2.74^*}\ X_1/A + \underset{(.30)}{3.25^*}\ X_3/A + \underset{(.40)}{3.24^*}\ X_{41}/A + \underset{(.28)}{2.85^*}\ X_{42}/A$$

$$+ \underset{(.34)}{3.64^*}\ X_{43}/A + \underset{(.39)}{2.86^*}\ X_{44}/A + \underset{(.59)}{3.29^*}\ X_{45}/A + \underset{(.35)}{1.94^*}\ X_5/A - \underset{(.28)}{1.78^*}\ X_6/A$$

$$- \underset{(.31)}{2.70^*}\ X_7/A \qquad R^2 = .1129\ , \qquad S_u = .00364\ , \qquad N = 1{,}174\ , \qquad F = 14.57^*$$

The intercept is significant, but has been suppressed.

These coefficients appear very plausible. All coefficients except that for X_3/A, which consists largely of tax-exempt securities, are considerably smaller than in the other regressions, reflecting the effect of taxation. The size ranking of other asset and liability coefficients reported in the pooled regression in Table 2-5 is preserved in the after-tax regression. The coefficient of the reciprocal drops to an insignificant level, probably because large banks pay a higher marginal rate of tax than small banks. The most remarkable feature of the after-tax regression is the strategic importance of deposit composition on after-tax bank profits. Deposit composition is much more important than asset composition; banks with large values of X_7/A are likely to have low profits.

d. Comparison with market rates of interest.

Finally, it is interesting to compare the estimated net rates of return reported in Table 2-4 with average operating ratios published by the Federal Reserve Bank of Kansas City.

The average rates of return for U. S. Government and other securities, unadjusted for associated expenses, are substantially below those reported in Table 2-4. Some possible explanations for these differences have been

suggested above. Loan rates of interest, however, appear consistent with estimates reported in Table 2-4. If the rates are comparable, the cost of servicing loan portfolios appears to be about .75 per cent. The interest cost of time deposits rises steadily in Table 2-6 from 1.55 per cent to 2.13 per cent. In part this reflects the relaxation of Regulation Q at the end of 1956, which primarily concerned savings deposits and time deposits left with a bank for long periods of time. Thus, the rise in interest costs also reflects a shift towards longer maturity time deposits. Again, if the estimates are comparable, the noninterest costs of servicing time and savings deposits appear to be about .5 per cent less than costs of servicing demand deposits.

TABLE 2-6

Operating Ratios of Tenth District Member Banks, 1956-59*

	Variable	1956	1957	1958	1959
a)	Interest on Government securities/Government securities	.0249	.0261	.0269	.0299
b)	Interest and dividends on other securities/other securities	.0243	.0256	.0278	.0283
c)	Revenue on loans/net loans	.0638	.0678	.0650	.0666
d)	Interest on time deposits/ time deposits	.0155	.0183	.0200	.0213

*Source: Federal Reserve Bank of Kansas City, Operating Ratios of Member Banks.

In summary, variations in individual bank assets and liabilities account for about 33 per cent of the variance in net current operating income. Significant differences exist in the net rates of return earned by banks from different types of loans. The estimated relationship between net current operating income and portfolio elements is stable over the 4 years. Variations in individual bank assets and liabilities account for about 12 per cent of the variance in profits before taxes and about 11 per cent of the variance in profits after taxes. Bad debt losses on loans and realized capital gains or losses on securities can be plausibly estimated.

3. Analysis of Connecticut Commercial Banks

In this section, data concerning the earnings and balance sheets of Connecticut state commercial banks during the years 1957 through 1963 are analyzed. These data are inferior to those used in the previous section because assets and liabilities are less accurately measured. Assets and liabilities are arithmetic averages of year-end balance sheets and are available in less detail.

The number of observations varies from year to year owing to the emergence of new banks and the disappearance of old banks through mergers. Banks which absorb other banks during a year were eliminated from the sample for that year to avoid measurement errors. Finally, one bank having no time or demand deposits was omitted due to its atypical balance sheet.

The following hypotheses are considered:

a Variations in X_i/A account for differences in individual bank values of Y/A and P/A for the 7-year period.

b Differences in the relationships between X_i/A and Y/A, and between X_i/A and P/A, exist among individual years.

c Individual banks tend to have either all positive or all negative residuals for each of the 7 years.

d Residuals of a Y/A regression for 1960 are related to the number of competitors which a bank faced.

a. Net current operating income and profits before taxes.

Table 3-1 reports evidence concerning hypothesis a. As in the previous section, coefficients of all assets and liabilities are expressed in per cent per annum. Coefficients of 1/A and X_8/A are measured in dollars. Standard errors of coefficients are in parentheses. An asterisk indicates significance at .05.

Signs of all significant coefficients conform to a priori expectations; intercepts are not significantly different from zero. Further, estimated rates of return appear plausible despite the pooling of observations drawn from 7 years. Perhaps most striking is the seeming similarity of net rates of return on Governments, tax-exempt securities, and loans. Evidently loans are the highest yielding of the three assets, but their net rate does not differ from that of either of the securities variables by as much as a standard error. On the other hand, demand deposits are significantly cheaper than time and savings deposits. Government and other banks' deposits, $\overline{X}_9$, also tend to be cheaper than time and savings deposits.

The mean value of P/A is 1.1 per cent for the Connecticut banks. Dividing this value into the coefficient of 1/A indicates that the break-even size of a bank is about $1,100,000. The mean value of Y/A is 1.3 per cent; not allowing

TABLE 3-1

Imputed Net Rates of Return for 7 Years Pooled -- Y/A and P/A

Variable		Y/A	P/A
1/A		-10,325* (4,763)	-11,944* (5,009)
X_1/A	(U. S. Governments)	3.601* (.645)	3.861* (.679)
X_2/A	(Tax exempts)	3.373* (.588)	3.895* (.618)
X_4/A	(Gross loans)	3.806* (.646)	4.166* (.679)
$\bar{X}_6/A$	(Demand deposits of individuals)	-1.149* (.525)	-2.023* (.552)
$\bar{X}_7/A$	(Time deposits of individuals)	-2.958* (.611)	-3.311* (.643)
X_8/A	(Branches)	1,963 (1,866)	3,238 (1,962)
X_o/A	(Other income earning assets)	1.845* (.801)	2.932* (.843)
$\bar{X}_9/A$	(Other deposit liabilities)	-2.220* (.928)	-1.660 (.976)
R^2		.310	.302
S_u		.00382	.00402
N		258	258
F		12.89*	12.39*

for gains or losses on assets reduces the estimated break-even size to about $800,000. The smallest bank in the sample had approximately $1,000,000 in assets.

Coefficients in the Y/A and P/A regressions differ only slightly. All assets have slightly higher net rates of return in the P/A regressions, perhaps reflecting realized capital gains in security transactions and excessive previous writeoffs of loans. Similarly, deposits appear to be more costly in the P/A regressions. It is noteworthy that the estimated cost of demand deposits is higher in the P/A regression by a much larger percentage than the estimated costs of time and savings and other deposits. An interpretation is that the high demand deposits impair a bank's ability to realize capital gains on its portfolio. Banks with high proportions of demand deposits may tend to hold short-term securities which are unlikely to yield large capital gains.

Hypothesis b states the belief that net rates of return earned by banks from assets and liabilities varied considerably over the 7-year period. These variations should be revealed when the model is estimated from data referring to individual years. Tables 3-2 and 3-3 report estimated net rates of return for assets and liabilities in each of the years 1957-63. An analysis of covariance indicates that the null hypothesis of no year-to-year variation in net rates of return is rejected at the .01 level for both P/A and Y/A regressions. Inspection of the coefficients in Tables 3-2 and 3-3 reveals that the estimated net rates of return differ considerably from year to year. Further, the standard error of estimate and R^2 vary considerably from year to year. Intercepts are significant in the 1957, 1958, and 1963 regressions,

but have not been reported because of their limited interest. Inspection of F ratios indicates that with the exception of 1963, all regressions are significant at the .01 level; the 1963 regression is significant at the .05 level.

The lower level of significance of the 1963 regression is probably due to the peculiar operating experiences of two newly organized banks in the sample. No doubt the earnings and expenses of new enterprises differ considerably from those of established banks; these two banks should not have been included in the sample. In no other year were there new banks in the sample.

There appear to be two explanations for year-to-year variation in estimated net rates of return. First, interest rates did vary over the period. If the costs of servicing assets or liabilities did not vary greatly, then these variations should be reflected in Tables 3-2 and 3-3. Estimated net rates of return on loans, U. S. Government securities, and other assets exhibit an upward trend over the 7-year period. Similarly, estimated net rates of return on both demand and time and savings deposits become more negative. The net revenue imputed to a branch declined quite steadily over the period. Imputed rates of return on other deposits and tax-exempt securities and the coefficient of the reciprocal, $1/A$, appear to have been roughly steady over the period. These statements apply to both tables.

A simple interpretation of the decline in net revenue from a branch is that both rising bank salaries and increasing competition have caused nonportfolio branch expenditures to rise faster than nonportfolio branch revenues -- e.g., locational "rents" and safe deposit fees. Of course, this

TABLE 3-2

Imputed Net Rates of Return for the Years 1957-63 -- Y/A

Variable	1957	1958	1959	1960	1961	1962	1963
1/A	-14,924 (17,299)	-13,591 (16,950)	-15,589 (11,480)	-26,090* (6,773)	-10,593 (8,618)	-6,143 (6,750)	510 (20,388)
X_1/A	3.228 (1.839)	5.182* (2.013)	2.351 (1.502)	2.782* (.822)	4.362* (1.364)	3.732* (1.271)	6.578* (2.448)
X_2/A	3.662* (1.389)	5.010* (1.618)	3.088* (1.318)	1.665* (.815)	2.982* (1.375)	3.510* (1.174)	3.802 (2.702)
X_4/A	3.113 (1.717)	4.532* (1.983)	2.111 (1.509)	3.405* (.951)	5.459* (1.466)	5.365* (1.301)	5.037 (2.548)
$\bar{X}_6/A$	-1.295 (1.330)	-2.209 (1.579)	.653 (1.230)	-.114 (.809)	-2.726* (1.330)	-2.478* (1.064)	-2.651 (2.005)
$\bar{X}_7/A$	-2.254 (1.623)	-3.929* (1.868)	-1.759 (1.408)	-2.383* (.829)	-3.898* (1.351)	-3.915* (1.251)	-4.743 (2.521)
X_8/A	12,269* (4,724)	8,827 (5,117)	5,770 (4,256)	-62 (2,656)	-3,270 (4,182)	166 (3,918)	-17,962* (7,202)
X_0/A	.932 (1.893)	2.803 (2.200)	1.592 (1.700)	1.034 (1.113)	2.728 (1.816)	2.352 (1.358)	3.412 (3.608)
$\bar{X}_9/A$	-.828 (2.040)	-4.706 (2.961)	-5.011* (2.104)	-1.536 (1.285)	.487 (1.779)	-.340 (1.605)	-1.434 (5.242)
R^2	.597	.528	.541	.743	.468	.618	.424
S_u	.00354	.00398	.00319	.00205	.00296	.00217	.00550
N	41	38	37	38	38	33	33
F	6.763*	5.074*	4.852*	12.24*	3.709*	5.928*	2.695*

TABLE 3-3

Imputed Net Rates of Return for the Years 1957-63 -- P/A

Variable	1957	1958	1959	1960	1961	1962	1963
1/A	-5,774 (17,687)	-2,679 (17,641)	-5,151 (13,256)	-31,053* (8,275)	19,046* (9,065)	-12,226 (8,118)	-5,817 (19,340)
X_1/A	3.383 (1.881)	5.707* (2.095)	1.774 (1.734)	2.500* (1.004)	5.087* (1.434)	5.372* (1.528)	7.177* (2.322)
X_2/A	3.820* (1.421)	5.272* (1.684)	3.246* (1.522)	3.091* (.996)	4.417* (1.446)	4.655* (1.412)	4.173 (2.563)
X_4/A	3.099 (1.755)	5.371* (2.063)	2.233 (1.742)	4.037* (1.162)	6.561* (1.542)	6.666* (1.565)	5.250* (2.417)
$\bar{X}_6/A$	-2.153 (1.360)	-3.479* (1.643)	-.078 (1.420)	-1.253 (.989)	-4.062* (1.399)	-4.040* (1.280)	-3.216 (1.902)
$\bar{X}_7/A$	-2.318 (1.660)	-4.558* (1.944)	-1.697 (1.626)	-2.959* (1.013)	-5.005* (1.421)	-5.228* (1.504)	-5.054* (2.391)
X_8/A	15,682* (4,830)	9,306 (5,325)	9,984* (4,914)	3,888 (3,245)	-3,453 (4,399)	-4,895 (4,712)	-18,305* (6,832)
X_0/A	1.737 (1.936)	3.642 (2.290)	2.675 (1.963)	2.705 (1.359)	4.309* (1.910)	3.822* (1.634)	4.899 (3.422)
$\bar{X}_9/A$	.034 (2.086)	-3.180 (3.082)	-3.791 (2.429)	-.908 (1.570)	.809 (1.871)	-.549 (1.930)	-1.902 (4.973)
R^2	.650	.555	.444	.699	.512	.514	.415
S_u	.00362	.00415	.00368	.00251	.00312	.00261	.00521
N	41	38	37	38	38	33	33
F	8.459*	5.267*	3.281*	9.790*	4.429*	3.882*	2.605*

result should not be interpreted to imply that branches have become unprofitable; branches generate deposits and loans. Income from branch deposits and loans is measured elsewhere in the regression equations.

Inspection of the coefficients of demand deposits and time and savings deposits suggests that the 1956 relaxation of Regulation Q may have caused time and savings deposits to be more expensive in years after 1957. Similarly, the 1962 relaxation of Regulation Q may have caused the two rates to diverge more in 1963. No formal test of these suggestions has been performed; a glance at relevant standard errors indicates that they are highly tentative. The competition of time deposits has forced banks to improve services associated with checking accounts and to reduce compensating balance requirements. B Both actions drive up the costs of servicing demand deposits. On the other hand, costs of servicing government deposits and deposits of other banks apparently have not risen to the same extent. Today, government and correspondent deposits are relatively more attractive to these banks than in past years.

Rates of return on loans and securities fluctuate considerably in Tables 3-2 and 3-3. Table 3-4 reports various market interest rates corresponding to these rates. Differences between rates in Table 3-4 and Table 3-2 are not excessive if judged in terms of standard errors of the latter.

TABLE 3-4

Market Rates of Interest: 1957-63*

	1957	1958	1959	1960	1961	1962	1963
Bank rates on short-term business loans -- all loans	4.6	4.3	5.0	5.2	5.0	5.0	5.0
Government securities, 3-5 year	3.62	2.90	4.33	3.99	3.60	3.57	3.72
Government securities, long-term	3.47	3.43	4.07	4.01	3.90	3.95	4.00
Corporate bonds	4.21	4.16	4.65	4.73	4.66	4.61	4.50
State and local bonds	3.56	3.36	3.74	3.69	3.60	3.30	3.28

* Source: Federal Reserve Bulletin, various issues.

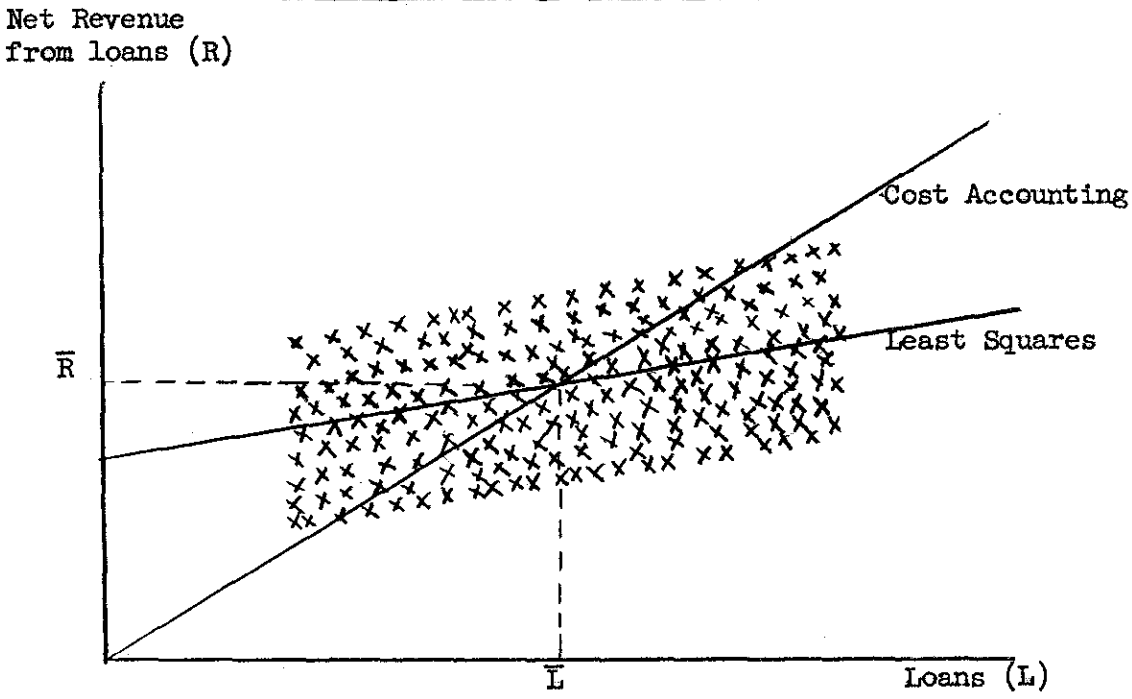
A second explanation for variation in net rates of return also has validity. By using an average of year-end balance sheets to measure the portfolio position of a bank during a year, large measurement errors may have been introduced. Estimated rates of return may vary as these errors vary among years. The 1958 recession with its associated bond market turbulence and the boisterous 1959 recovery were years in which "straight line" movements in various variables were quite unlikely. Therefore, rates of return estimated for those years are quite likely to be biased. In other years, these measurement errors are likely to be of limited consequence. The fact that net rates of return are more stable in the Tenth District sample, which used an average of three call reports, lends support to this explanation. Unfortunately, the analysis of covariance reported earlier in this section cannot discriminate between these two sources of year-to-year variation.

b. Comparison of Results with Functional Cost Analysis

Since 1960, the Federal Reserve Bank of Boston has conducted cost analyses for member banks in the First District with total assets of less than $50 million.[15] From these studies, a different set of imputed rates of return can be obtained. The Bank's estimates will not correspond exactly to those in Table 3-2 for at least two reasons: (1) the population of banks is different and (2) the Bank's method of imputing rates is markedly different -- it follows standard cost accounting conventions which do not correspond closely to the least squares method. Figure 3-1 suggests one of the reasons that the

FIGURE 3-1

A Comparison of Two Methods of Estimating Net Rates of Return from Loans*



*This diagram is an adaptation of a diagram reported in Meyer and Kraft's article, op. cit., p. 321.

[15] Federal Reserve Bank of Boston, Functional Cost Analysis Average Participating Bank, 1960-62.

two methods may yield quite different estimates of the net rates of return. The least squares estimates are marginal net rates of return, whereas the cost accounting estimates are average net rates of return for a sample of banks. The former should be of more interest to bankers.

Table 3-6 compares the two sets of estimates for 1960, 1961, and 1962. Because of the relatively large standard errors for the rates of return reported in Table 3-2, it is impossible to reject a hypothesis that both sets are identical. It is clear that rates reported in Table 3-2 are more unstable than those of the Boston Fed.

TABLE 3-6

A Comparison of Boston and Least Squares Imputed Net Rates of Return

	1960		1961		1962	
	Boston	3-2	Boston	3-2	Boston	3-2
Demand deposits	-1.45	-.11	-1.42	-2.73	-1.46	-2.48
Time and savings deposits	-2.77	-2.38	-3.09	-3.90	-3.53	-3.92
Loans	4.78	3.41	4.42	5.46	4.60	5.37
Investments	2.97	2.53	2.79	4.04	3.00	3.68

c. Bank effects.

Inspection of the residuals of the pooled regressions reported in Table 3-1 suggests that a given bank tends to have throughout the period either all positive or all negative residuals. No formal test for individual "bank effects" was attempted because of the comparatively small number of observations on each

bank. In part, such bank effects are due to the particular environment and executive skills which different banks have. Other explanations include economies of scale and market power.

Finally, hypothesis d was tested with different measures of bank market power in an attempt to account for bank effects. Four measures of market power were considered. Each concerns the structure of the market in the town where a bank's head office is located. The weaknesses of all measures are conspicuous. The measures are:

1. Number of rival commercial banks serving the town.
2. Number of offices of rival commercial banks serving the town.
3. Number of rival commercial banks, mutual savings banks, and savings and loan associations serving the town.
4. Number of offices of rival commercial banks, mutual savings banks, and savings and loan associations serving the town.

Residuals of the 1960 regressions reported in Tables 3-2 and 3-3 were related to each of the four measures of market power. The results were negative. Either market power has no effect on bank net earnings or the measures of market power are too crude to register the relationship.

To summarize this section, in any one year roughly 50 per cent of the variance in Y/A and P/A can be explained by variations in bank portolios. The imputed rates of return vary significantly from year to year during the period 1957-63 and are much more irregular than cost accounting rates reported by the Federal Reserve Bank of Boston. In part this variability is attributable to errors-in-variables in the present sample, which are, in principle, avoidable. In attempting to explain the remaining 50 per cent of the variance, we find that bank effects appear to exist, but they are unrelated to crude measures of bank market power.

4. Some Concluding Remarks

In this final section, three further aspects of our study of bank earnings are considered. To what extent do Connecticut state banks and Tenth District member banks differ in the net rates of return from assets and liabilities in their portfolios? What does the analysis suggest about the organization of banking? Finally, how may the desired estimates of net rates of return be improved and applied in research on banks?

a. Comparison of Tenth District and Connecticut Banks.

Net rates of return cannot be precisely compared for we do not observe the same asset and liability variables for the two sets of banks. However, the most comparable regressions are reported in Table 4-1; the Connecticut regressions have been previously reported in Table 3-1.

Given that the size distribution of banks is very similar, it appears that net fixed costs are about three times larger at Connecticut banks than at Tenth District banks. One possible explanation for this difference is that Tenth District member banks have smaller buildings and permanent staff (overhead) relative to total assets than Connecticut banks. Another explanation is that Tenth District banks have more market power than Connecticut banks. We are unable to discriminate between these explanations with available data; other explanations are possible as well.

The estimated net rate of return from U. S. Government securities in Y/A regressions appears to be the same for both sets of banks. This makes good sense. The coefficients of X_1/A, however, are considerably larger in those

TABLE 4-1

A Comparison of Net Rates of Return -- Pooled Estimates**

Variable	Connecticut 1957-63		Tenth District 1956-59	
	Y/A	P/A	Y/A	P/A
1/A	-10,325* (4,763)	-11,944* (5,009)	-3,660* (386)	-2,698* (515)
X_1/A	3.60* (.65)	3.86* (.68)	3.63* (.29)	3.31* (.38)
X_2/A	3.37* (.59)	3.90* (.62)	--	--
X_0/A	1.85* (.80)	2.93* (.84)	--	--
X_3/A	--	--	3.48* (.28)	2.90* (.38)
X_4/A	3.81* (.65)	4.17* (.68)	--	--
$\bar{X}_4/A$	--	--	5.22* (.28)	4.11* (.38)
X_5/A	--	--	2.07* (.32)	1.98* (.43)
$\bar{X}_6/A$	-1.15* (.53)	-2.02* (.55)	--	--
$\bar{X}_7/A$	-2.96* (.61)	-3.31* (.64)	--	--
$\bar{X}_9/A$	-2.20* (.93)	-1.66 (.98)	--	--
X_6/A	--	--	-2.04* (.25)	-1.71* (.33)

TABLE 4-1
(Continued)

Variable	Connecticut 1957-63 Y/A	Connecticut 1957-63 P/A	Tenth District 1956-59 Y/A	Tenth District 1956-59 P/A
X_7/A	--	--	-3.43* (.28)	-3.14* (.38)
X_8/A	1,963 (1,866)	3,238 (1,962)	--	--
R^2	.310	.302	.255	.100
S_u	.00382	.00402	.00366	.00489
N	258	258	1,174	1,174
F	12.89*	12.39*	58.46*	19.71*

** Intercepts were significant for both of the Tenth District regressions, but for neither of the Connecticut regressions. Intercepts have been suppressed in all regressions.

regressions with total loans dissegregated, as reported in Table 2-4. In P/A regressions, Connecticut banks appear to have realized capital gains on securities, on balance, while Tenth District banks have realized capital losses. The large losses absorbed by Tenth District banks primarily reflect the fact that during 1956-59 capital losses were common; in 1961-63 capital gains were prevalent. The Connecticut regression was estimated from both periods.

The sum of the variables X_2/A and X_0/A is approximately equivalent to X_3/A. In Y/A regressions, Tenth District banks appear to have earned a little more than Connecticut banks from other securities; the difference is not great. However, in P/A regressions the reverse is true. As reported in Section 2, Tenth District banks absorbed sizable capital losses on their other securities.[16]

Variables $\overline{X}_4/A$ and X_4/A differ only slightly ($\overline{X}_4/A = 98.5\% \; X_4/A$); the amount of reserves for bad debts is excluded from $\overline{X}_4/A$, but not from X_4/A. The rates of return estimated by regressing Y/A differ considerably between the two groups of banks. Tenth District banks have a larger estimated net rate on loans; they also have a larger fraction of loan losses, writeoffs, and additions to reserves. In P/A regressions it appears that both sets of banks earned the same net rate of return on their loans.[17]

Variables $\overline{X}_6/A$ and X_6/A differ by the amount of demand balances of governments and banks, which are included in $\overline{X}_9/A$. Because $\overline{X}_9$ is small

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[16] Roughly 87 per cent of X_3 is in the form of tax-exempt securities, 12 per cent consists of other bonds and notes, and 2 per cent is Federal Reserve stock.

[17] Losses and writeoffs on loans are higher in Tenth District states relative to Connecticut. See P. Horvitz and S. Shapiro, op. cit.

relative to $\bar{X}_6$, in Y/A regressions it appears that the cost of servicing demand deposits is higher at Tenth District banks. The coefficient of X_6/A is approximately twice as large as that of $\bar{X}_6/A$. Similarly, variables $\bar{X}_7/A$ and X_7/A differ by the amount of time and savings balances which are in $\bar{X}_9/A$. Because $\bar{X}_9/A$ is small relative to $\bar{X}_7/A$, in Y/A regressions the cost of time and savings deposits appears to be about the same in both samples. In P/A regressions, the estimated costs of both demand and time deposits are about the same for the two samples of banks. An explanation for the difference between coefficients of $\bar{X}_6/A$ in Y/A and P/A regressions has been proposed in Section 3.

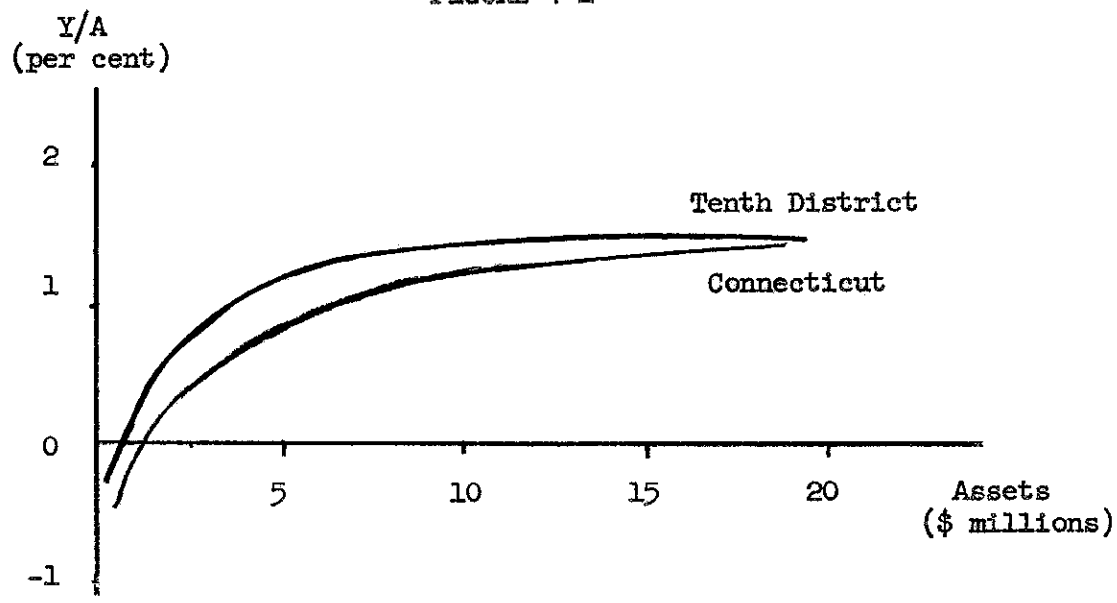
Another important difference between the sets of banks concerns the difference in "fit" of the annual regressions reported in Sections 2 and 3. For Tenth District banks, R^2 never exceeded .41; typically R^2 was about .33 in regressions of Y/A and about .13 in regressions of P/A. For Connecticut state banks, on the other hand, R^2 was on the order of .55 for the yearly regressions of both Y/A and P/A. Similarly, S_u was smaller for Connecticut bank regressions of P/A. This difference existed despite the better quality of data about Tenth District banks. Apparently nonportfolio factors are more important determinants of bank income of Tenth District banks. Examples of such nonportfolio factors include differences in the quality of bank management, market power, and loss experiences.

b. The organization of banks and other issues.

Gramley's earlier study of Tenth District banks found that the ratios of both current operating revenue and current expenses to total assets decline

with bank size and that the ratio of net current operating income to assets rises with bank size.[18] Results similar to the latter are reported above, after holding constant the composition of bank portfolios, for both Tenth District and Connecticut state banks. What do these findings suggest for desirable bank organizations? Figure 4-1 shows the relationship between bank size and Y/A which exists in Table 4-1 when all other variables are set at their means. The effect of size on Y/A declines steadily as bank size increases, so that the advantages of big banks in terms of greater earning power are slight when compared to banks of about $10 million in total assets.[19]

FIGURE 4-1



The two sets of banks differ fundamentally in another dimension of organization. Connecticut banks have branch systems; almost no branches exist

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[18] See, in particular, "Relationship of Bank Size and Bank Earnings," Monthly Review, Federal Reserve Bank of Kansas City, December 1961, pp. 3-9.

[19] Regressions have been computed for Connecticut banks in which both the natural log of assets and 1/A appear; the natural log of assets never had significant coefficients in these regressions.

in the Tenth District. In Table 4-1 it appears that the net contribution of the number of branches to earnings was zero over the 7-year period, although coefficients of X_8/A were declining over the period. Apparently branches generated enough nonportfolio income, on average, to offset establishment and other costs unrelated to assets and liabilities. Thus, branches undoubtedly generate income by acquiring deposits and making loans, but do not, on balance, cost a bank anything in the way of overhead.

It is interesting to speculate about the following two situations. Assume that two neighboring towns exist. In the first situation, one unit bank is located in each town; in the second siutation, a single bank has two offices, one in each town. Which arrangement is more profitable? Our results indicate the second, for a branch on average costs nothing, but a second unit bank will have to cover the costs indicated by coefficients of $1/A$. To be sure, bank net earnings are not the only or even the most important consideration in the debate over unit versus branch banking. Nevertheless, we believe that, in the case of small banking units, this result argues in favor of small branch systems rather than unit banks.

The estimated net return on correspondent balances carried with other banks has an interesting message for students of bank portfolio management. Banks earn a respectable rate of return on these balances. Theories which argue that banks should manage their portfolios to minimize excess cash, in the belief that banks earn no income from balances, are likely to reach conclusions which have little relevance to contemporary banking practice.

Finally, the regression analysis of Y/A for Tenth District banks suggests that large differences exist in net rates of return for different classes of loans. However, these differences are greatly reduced when net rates are

estimated by regressing P/A on the same variables. These estimated net rates of return on loans still exceed the return on Governments; the reward for lending rather than investing in Governments is about .75 per cent for noninstallment bank loans and about 1.50 per cent for installment loans. For Connecticut banks, the difference between rates of return on total loans and U. S. Government securities is less, about .30 per cent. A comparable estimate for Tenth District banks is about .80 per cent. The explanation for the smaller margin for Connecticut banks is that they suffered considerably smaller losses on their investments than their Tenth District counterparts. The net return on loans in the two samples appears to have been identical.

c. Summary of the analysis and research plans.

In conclusion, the present paper has reported empirical estimates of net rates of return earned by two samples of commercial banks from various assets and liabilities in their portfolios. On the whole, the statistical cost accounting method seems to have worked satisfactorily and should prove useful in future studies of banks. Most estimated coefficients are roughly consistent with other available information about the banks studied. When different dependent variables were studied, sizable changes in the coefficients of a particular asset were detected; these variations usually had plausible explanations. Evidently the method is quite sensitive. This sensitivity makes the method promising, but it also emphasizes the fact that other sets of dependent and independent variables than those considered here might produce quite different estimates of an asset's net rate of return.

Some suggestions for developing further the techniques of this paper have arisen from our work. First, more detailed information about assets, liabilities,

costs, and revenues should be analyzed. Second, analysis of disaggregated dependent variables should prove useful in overcoming collinearity. Finally, it would be useful to test the method on other groups of banks in different time periods.

To a more than the usual degree, the research results reported are intermediate products. We plan to explore the relation between the average bank portfolio and imputed rates of return on different dates for the two samples of commercial banks. Further, net rates of return estimated for different groups of banks in different years should considerably improve knowledge of our monetary mechanism. In any event, it is reassuring to know that portfolio composition does affect bank profits, though the relation is far from perfect and perhaps changing over time.