Working Paper 74-5

# COMMERCIAL BANKING PERFORMANCE AND STRUCTURE: A FACTOR ANALYSIS APPROACH

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## INTRODUCTION[1]

The Hunt Commission's recommendations and other proposed banking law changes have made commercial bank performance under regulation a matter of some public concern. Such changes in bank regulation should depend on empirical evidence, rather than on emotional value judgments, if they are to be soundly based.

Indeed, many empirical studies have been made of the relations between the structure of the banking industry, banking regulation, bank conduct, and the performance of the industry. They have found that numerous forces affect banking activity. These influences generally include differences in regulatory policies, bank structural conditions (deposit concentration, new bank entry), and managerial categories (bank operating and financial traits) of various kinds. Additional influences on banking performance that have been identified include locational variations in the demand for financial services and the erratic swings of monetary and business cycles in recent years.

The trouble is, however, that such studies have partly contradicted each other.[2] This literature does not generate a concensus of the

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[1]This paper draws upon parts of William Jackson, "Commercial Bank Regulation, Structure, and Performance" (unpublished doctoral dissertation, University of North Carolina, 1974). The analysis below, however, factors all banking variables considered and is thus more extensive than the factor analysis in the cited dissertation. Moreover, it utilizes factor analysis as an explanatory rather than as a purely statistical technique. A Conference of State Bank Supervisors Dissertation Fellowship and National Defense Education Act funds partly supported this research. Ray Gobble programmed the analysis at the Federal Reserve Bank of Richmond.

[2]Alfred Broaddus, "The Banking Structure: What It Means and Why It Matters," Federal Reserve Bank of Richmond, Monthly Review (November, 1971), pp. 7-10. Jackson, Chapter IV.

most important influences on bank activity that can guide bankers, legislators, and regulators in forming decisions to improve the performance of this industry.

Accordingly, this study briefly presents Phillips' theoretical model of the banking environment that integrates the concepts that underlie many of the previous studies in this area. It then empirically isolates the clusters of related traits that occur in banking, as a guide to future research concerning the banking industry. Finally, it tentatively explains some sources of observed banking performance as suggested by its empirical analysis.

## A MODEL OF FINANCIAL INTERACTIONS

The reasons for numerous conflicting results of banking studies may lie not only in their methodological differences, but also in the nature of the banking industry and its environment. That is, important traits, such as bank entry and demand, or bank size and branching laws, which are nominally different, seem to be highly correlated.[3] It would appear that empirically isolated determinants of banking performance may capture the effects of other variables and thus be partial proxies for complex

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[3]Franklin R. Edwards, "The Banking Competition Controversy," Studies in Banking Competition and the Banking Structure (Washington: Comptroller of the Currency, 1966), pp. 334-35. Donald P. Jacobs, "The Interaction Effects of Restrictions on Branching and Other Bank Regulations," Journal of Finance, XX (May, 1965), 332-39.

underlying strands of common, highly related influences.[4]

Indeed, there is a theoretical basis for believing that such banking trait interactions exist. Almarin Phillips' model of the market process shows an environment in which real-world firms operate.[5] Although this model is applicable to any type of corporate activity, it lucidly shows the channels of banking activity, as slightly modified below.

Banking performance has much more than a single cause, as Figure 1 shows. Starting in the left-hand side of this Figure, the goals of the firm (various combinations of profits, growth, and safety) and the goals of inter-firm groups (such as the high prices and restricted competition advocated by trade associations) enter into the behavior of firms. These goals, together with public-interest and bureaucratic considerations, determine various forms of Government regulation by Federal agencies and State banking commissions, which in turn limit

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[4] Robert J. Saunders, "On the Interpretation of Models Explaining Cross Sectional Differences Among Commercial Banks," Journal of Financial and Quantitative Analysis, IV (March, 1969), 25-37. For example, "... a relationship between concentration and price may appear in the statistics, when none in fact exists, due to a correlation between concentration and other price-determining variables ...." Jack M. Guttentag and Edward S. Herman, Banking Structure and Performance (New York: New York University Institute of Finance, Bulletin Nos. 41-43, 1967), p. 82.

[5] Almarin Phillips, "Structural and Regulatory Reform for Commercial Banking," Issues in Banking and Monetary Analysis, eds. G. Pontecorvo et. al. (New York: Holt, 1967), pp. 7-30; Phillips, Market Structure, Organization and Performance (Cambridge: Harvard University Press, 1962); Phillips, "A Conceptual Optimal Banking Structure for the United States: Discussant," Proceedings of a Conference on Bank Structure and Competition (Chicago: Federal Reserve Bank of Chicago, 1969), pp. 35-40. Compare Broaddus, pp. 2-10; Guttentag and Herman, pp. 66-67, 80.

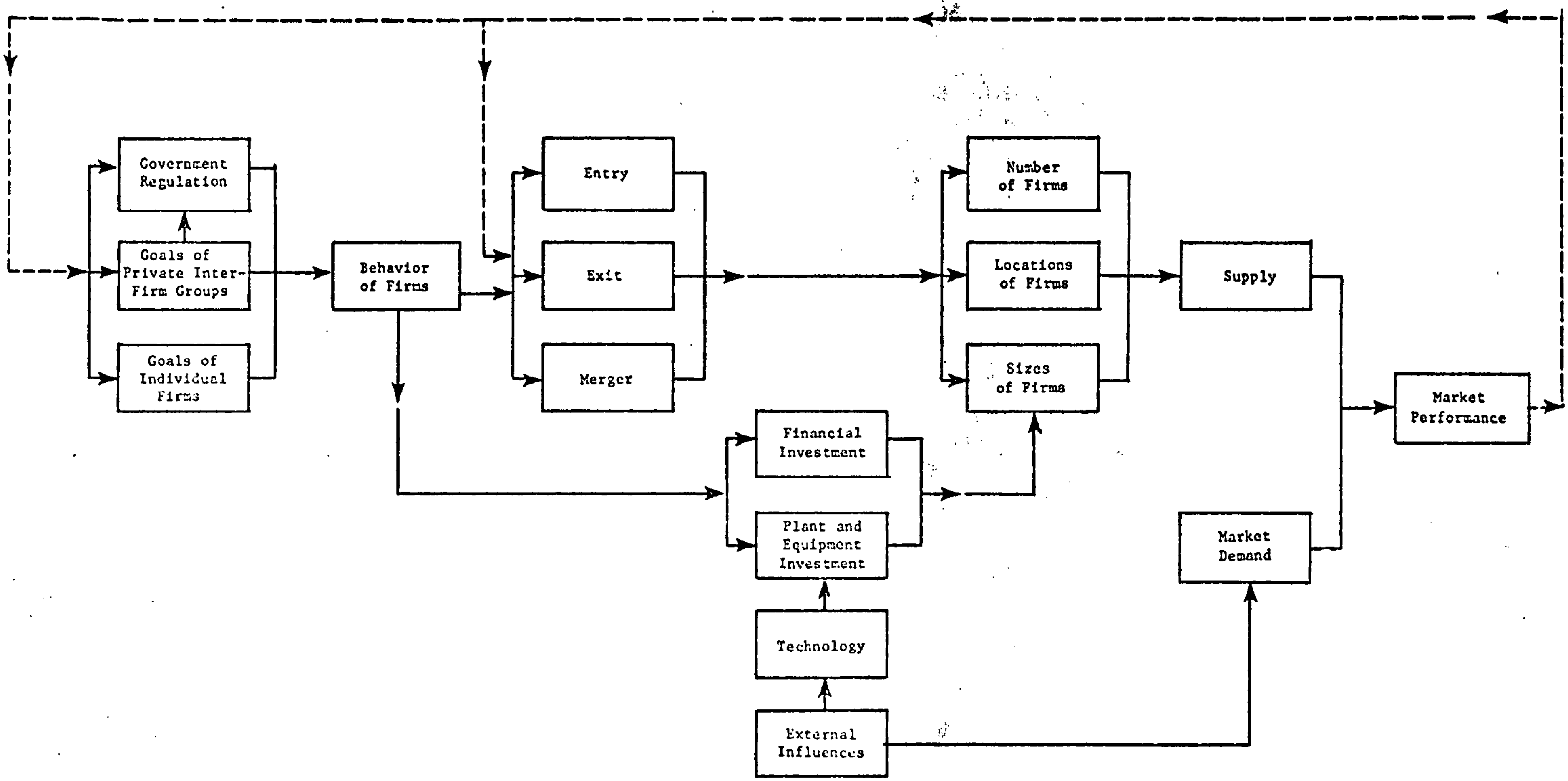


Figure 1. Flow Chart of "The Market Process"

Source: Adapted from Almarin Phillips, "Structural and Regulatory Reform for Commercial Banking," Issues in Banking and Monetary Analysis, eds. G. Pontecorvo et al., (New York: Holt, 1967), p. 10. Reproduced by permission of Almarin Phillips.

the range of firm behavior. Moreover, Government regulatory policies clearly dampen both new bank entry and bank "exit" as independent decision-making entities by merger. (Allowing the exit of badly managed banks through total cessation of operations when unprofitable seems to be contrary to public policy.)

The central section of Figure 1 shows that the number, sizes, and locations of firms are influenced by structural changes, which in turn are a direct function of Government regulations such as branching laws as well as of firm behavior. The behavior of firms also directly influences the sizes of existing companies through plant and equipment investment, which is a direct growth mechanism. In banking, however, investment in "capital accounts" will necessarily augment the size of the firm through the acquisition of financial assets as well as through the purchase of plant and equipment, given regulatory supervision of the capital structure of the bank by guideline ratios that generally relate risk assets and deposit liabilities to bank equity. A bank can thus only acquire new deposits to purchase financial assets if it invests its "own funds" over time.

As banks grow, they may come to dominate their smaller competitors, allowing them to restrict the effective supply of bank services through a quasi-monopolistic relationship. Alternatively, as banks grow in absolute size, they may enjoy real (data processing, labor) or financial (portfolio-related) economies of scale in their operations that should allow them to lower the cost and, hence, increase the supply of their intermediation services. Technology, a function largely of external influences (business-machine company research) in this industry, may generate such economies of scale, although the progress of the minicomputer industry may allow smaller banks to increase their operational efficiency to match that of larger banks.

These diverse determinants of banking supply functions thus combine to form the well-known branching-numbers-size conundrum in banking. That is, the achievement of maximum operating efficiency in the financial services rendered by banks may require the formation by merger of gigantic branch systems of a size capable of absorbing the deposits of an entire state.[6]

In the lower right-hand section of Figure 1, the ultimate market demand for financial services is largely external to a bank, being based upon real-sector and monetary-sector variations such as population growth, business activity, and economy-wide financial trends. (Some forms of imperfect competition may allow a firm to alter the slope or position of the demand curve it chooses to operate along, however.) The intersection of supply and demand vectors determines various dimensions of banking performance, which are directly observable in the market place. Markedly imperfect competition, some forms of regulation such as high reserve requirements, and contractionary exogenous forces should reduce observed performance; while aggressive

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[6] A bank with $800 million in deposits appears to be more operationally efficient than any smaller combination of firms, according to six studies compared by "Bank Costs and Output--A Commentary on the Evidence," Midwest Banking in the Sixties, ed. Dorothy Nichols (Chicago: Federal Reserve Bank of Chicago, 1970), p. 190. If so, then Alaska, New Hampshire, Vermont, and the Virgin Islands should have been monopoly-bank areas, while eleven other states should have been banking duopolies, if not monopolies reflecting later technological advances, based on 12/31/68 deposit levels. U. S. Department of Commerce, Statistical Abstract of the United States (Washington: Government Printing Office, 1969), p. 445.

firm behavior, some other forms of regulation designed to increase competition, and expansionary external forces should stimulate observed performance. In turn, bankers, customers, and regulators will change their decisions over time corresponding to their desires to improve industry performance to increase their own utility functions. The dashed lines in Figure 1 show that such feedback effects occur over time, altering the conduct of all participants in this market process. (Customer reactions will appear as changes in external influences on demand; new entrants will be attracted by high potential profits in an area, etc.) In competitive industries the feedback from performance to structure is assumed to very strong. Imperfect competition will make this feedback subject to behavioral and regulatory intervention, as shown in the left-hand side of Figure 1.

Clearly, various causes of banking performance work with, through, or in opposition to each other over time in this model. This model shows that bank behavior (competition), structure, and regulation are separate concepts that interact with external influences to form bank performance. In theory, any relationship between, say, technology and performance is a one-to-one association. Yet, in practice the observed correlation may not be of the predicted direction or magnitude. This effect may occur when strong influences, such as Government regulation, swamp the effects of some of the other influences illustrated in Figure 1. (How did technology--a direct determinant of supply in Phillips' original model--limit bank passbook deposit savings interest rates to 4.50% in the 1970-71 period?)

## BANKING DATA

One standard way of approximating these types of interactive effects is to compute simple correlation coefficients for variables representing the influences illustrated in Figure 1. Fortunately, numerical proxies for most of these influences can be created in forms that allow the relative comparison of banks in various locations over time.

In order to explore inductively this approach to banking performance, fifty-three variables are computed for a sample of 1,644 banks in 44 states. These variables are selected to represent important theoretical or institutional banking traits, based in part upon the influences found important by previous researchers.

The data consist of averaged yearly ratios at essentially the bank level or the appropriate external-environment (state) level and cover the sample period of 1969 through 1971.[7] Table 1, below, lists these variables. They are divided into regulatory (R), structural (S), managerial (M), demand (D), and performance (P) categories for ease of exposition.

Their correlation matrix, containing 1,378 items of information, is not shown because of space limitations. Over 67% of its correlation coefficients are significant at the 0.01 level, while another 10% of its correlation coefficients are significant at the

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[7] Unpublished data were provided by the Board of Governors of the Federal Reserve System and by the Federal Deposit Insurance Corporation. See Jackson, Chapter V. The period studied was one in which bank accounting methods were roughly comparable to those of industrial firms. Moreover, the distortions of wage and price controls did not significantly affect banking during this period.

Table 1. Banking Variable List

REGULATORY TRAITS (0-1 dummy variables)

$R_1$ : national bank

$R_2$ : state member bank

$R_3$ : insured nonmember bank

$R_4$ : unlimited branching state

$R_5$ : limited branching state

$R_6$ : unit only state

$R_7$ : unlimited multibank holding company state[1]

$R_8$ : limited multibank holding company state

$R_9$ : multibank holding companies prohibited state

STRUCTURAL VARIABLES (by state)

$S_1$ : yearly entry rate, relative to firm numbers

$S_2$ : yearly merger rate, relative to firm numbers

$S_3$ : 5-banking organization deposit concentration ratio, 1969

$S_4$ : $S_3$'s long-term change, 1961-69

$S_5$ : mean bank size, 1969 deposits

$S_6$ : coefficient of variation of bank deposits, 1969 ($S_5$/its standard deviation; bank size variation)

$S_7$ : Herfindahl index, 1969 deposits (the sum of all banks' squared market shares; an oligopoly proxy)

$S_8$ : Gini coefficient, 1969 deposits (inequality of size)

$S_9$ : mutual savings bank and savings and loan association time and savings deposit market shares, 1970 (nonbank competition)

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[1]Changes in bank holding company regulation have made $R_7$, $R_8$, and $R_9$ less important than they were during this period.

Table 1--continued

MANAGERIAL VARIABLES (bank figures)

$M_1$ : branching dummy variable, 0 or 1 branches operated[2]

$M_2$ : branching dummy variable, 2 to 5 branches operated

$M_3$ : branching dummy variable, 6 or more branches operated

$M_4$ : multibank holding company affiliation dummy variable

$M_5$ : time and savings deposits/total deposits

$M_6$ : "investments"/assets

$M_7$ : cash/assets (liquidity)

$M_8$ : agricultural loans/loans

$M_9$ : commercial and industrial loans/loans

$M_{10}$: consumer and individual loans/loans

$M_{11}$: trust revenue/total revenue

$M_{12}$: equity/assets (leverage measured inversely)

$M_{13}$: labor expense/revenue

$M_{14}$: occupancy expense/revenue

$M_{15}$: dividends/net income (a proxy for the goal of the firm acting through "investment")

$M_{16}$: bank asset size (economies of scale)

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[2]Data deficiencies prevented the treatment of bank branching as a cardinal variable.

Table 1--continued

DEMAND VARIABLES (by state or year)

$D_1$ : percentage of labor force in agriculture

$D_2$ : percentage of labor force in manufacturing

$D_3$ : percentage of labor force in finance, insurance, and real estate

$D_4$ : unemployment rate

$D_5$ : population density

$D_6$ : urban population percentage

$D_7$ : per capita income

$D_8$ : population growth rates, 1960-70

$D_9$ : gross state product growth rates, 1960-70

$D_{10}$: households per banking office

$D_{69}$: 1969 time dummy variable

$D_{70}$: 1970 time dummy variable

$D_{71}$: 1971 time dummy variable

PERFORMANCE VARIABLES (bank figures)

$P_1$ : operating revenue less demand deposit service charges/assets (a proxy for output relative to bank assets in flow terms)

$P_2$ : net income/equity (profitability)

$P_3$ : loan interest minus loan loss provisions/loans

$P_4$ : time and savings deposit interest/time and savings deposits

$P_5$ : $Y_3$ minus $Y_4$, price spread (the "price of bank intermediation services")[3]

$P_6$ : loans/total deposits (a stock-type output proxy)

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[3]This linear combination of variables can be analyzed since the factor analysis model (unlike the usual regression model) contains no intercept term. It may approximate the overall "monopoly power" of a bank, to a better extent than Lerner's index. Tibor Scitovsky, "Economic Theory and the Measurement of Concentration," NBER, Business Concentration and Price Policy, (Princeton: Princeton University Press, 1955), p. 105.

0.10 level. Numerous interactions between nominally independent traits thus seem to exist in the environment of this industry.[8]

FACTOR ANALYSIS TECHNIQUE

Clearly, the underlying relationships among these correlated variables should be isolated. Multivariate analysis may be used to summarize such interrelationships. (The process of completely specifying Figure 1 would involve the estimation of an excessive number of differential equations in a way resembling the construction of a general equilibrium system.[9]) One approach to reducing these banking variable interrelationships to manageable proportions is factor analysis.

This technique seeks to isolate common dimensionality through the clustering together of interrelated variables. It is both an exploratory analysis that seeks to "map" domains of common influence and a method of data reduction. Factor analysis will outline the

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[8] The variable correlations range in value from -0.73 to 0.82. A value of ±1.0 would show a perfect fit, in which such variables would be identical. The variables thus embody multicollinearity ("many-on-the-same-line") that frustrates multiple-mode regression techniques generally used in banking analyses. "... when multicollinearity occurs, each variable in the collinear set may be sharing in the explanatory role of any and all variablesin the set. Consequently, it is very misleading to interpret the partial regression coefficient as the distinct effect of a separate, individual variable." James L. Murphy, Introductory Econometrics (Homewood, Ill.: Irwin, 1973), p. 369.

[9] Phillips, "Conceptual," pp. 35-40.

common patterns that underlie any large data set.[10]

Factor analysis is designed to reduce any correlation matrix, by a least squares fit, to a space containing the minimum dimensions that are necessary to explain the data's basic variability. As shown by Table 2, below, for any set of n variables $V_1$ through $V_n$, this procedure will estimate m statistically independent "factors," F1 through Fm, in a series of linear equations. In Table 2, the a's are the factor loadings that connect the derived factors F with the known variables V. These factor loadings are multivariate correlation coefficients that measure the extent of association between the factors and the variables. The m factors represent the basic "dimensions" (where m should be less than n) that explain the variation in the observed variables. Characteristics that are highly related will cluster onto a factor, while unrelated ones (being orthogonal to each other in factor space) will appear on different factors. In the last column of Table 2, communality is the proportion of total variance in a characteristic that is explained by all of the factors taken together. Communality, the sum of squared factor loadings across rows, is thus the analogue of $R^2$ in regression analysis. (The Appendix may further clarify the essence of this analytical technique for those

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[10]R. J. Rummel, Applied Factor Analysis (Evanston: Northwestern University Press, 1970.) Examples of its application in financial analysis include Saunders; Leonall C. Andersen and Jules M. Levine, "A Test of Money Market Conditions as a Means of Short-run Monetary Management," National Banking Review, IV (Sept., 1966), 45-48; and William L. Sartoris, "The Effect of Regulation, Population Characteristics, and Competition on the Market for Personal Cash Loans," Journal of Financial and Quantitative Analysis, VII (Sept., 1972), 1945-53.

Table 2. Factor Analysis Equation System

| Variables | Factors | | F1 | F2 | . . . | Fm | Communality |
|---|---|---|---|---|---|---|---|
| | $V_1$ | = | $a_{11}F1$ + | $a_{12}F2$ + | . . . + | $a_{1m}Fm$ | $\Sigma(a_1)^2$ |
| | $V_2$ | = | $a_{21}F1$ + | $a_{22}F2$ + | . . . + | $a_{2m}Fm$ | $\Sigma(a_2)^2$ |
| | $V_3$ | = | $a_{31}F1$ + | $a_{32}F2$ + | . . . + | $a_{3m}Fm$ | $\Sigma(a_3)^2$ |
| | . | | | . | | . | . |
| | . | | | . | | . | . |
| | . | | | . | | . | . |
| | $V_n$ | = | $a_{n1}F1$ + | $a_{n2}F2$ + | . . . + | $a_{nm}Fm$ | $\Sigma(a_n)^2$ |

who are unfamiliar with it, since the mathematics of factor analysis is too complex to be concisely discussed.)

## EMPIRICAL ANALYSIS

The empirical factor analysis of banking influences shown by Table 3 thus attempts to isolate the common causality present in highly correlated banking data.[11] This analysis captures over 64% of the total variance in the data set. It shows that thirteen independent dimensions exist among the fifty-three bank-related variables analyzed. The first thirteen columns of Table 3 are the factor loadings (exceeding 0.30 in absolute value) that connect the variables with the factors. The communality column shows that this analysis generally explains most of the variation in this data set. In particular, the communality for most of these traits exceeds the $R^2$ values generally obtained by micro-banking cross-sectional studies.

## CLUSTERING OF BANKING TRAITS

The analysis is best visualized by reading down the factor loading columns. The signs of the loadings are meaningful only along

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[11]Technically, factors are extracted from the correlation matrix with unities in the main diagonal using the eigenvalue-one criterion, iterated through eight cycles of communality estimation. The factors are rotated through sixteen cycles to a varimax solution. Computer program BMD08M is utilized. BMD Biomedical Computer Programs, ed. W. J. Dixon (Berkeley: University of California Press, 1973), pp. 225-68. This technique is better suited than is Saunders' principal components for the isolation of common variance. Principal components forces most variables onto one or two "general" factors, with important sources of data variation being relegated to weaker, "bipolar" factors.

Table 3. Factor Analysis of Banking Data, rounded to two decimal places

| Variable | Factor | | | | |
|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 |
| $R_1$ | | | | | |
| $R_2$ | | | | | |
| $R_3$ | | | | | |
| $R_4$ | | 0.84 | | | |
| $R_5$ | | | | -0.76 | |
| $R_6$ | | -0.33 | | 0.79 | |
| $R_7$ | 0.31 | | | | |
| $R_8$ | -0.58 | | | | -0.33 |
| $R_9$ | | | | | |
| $S_1$ | -0.45 | | | | |
| $S_2$ | | 0.58 | | -0.32 | |
| $S_3$ | | 0.80 | | | |
| $S_4$ | | | | | |
| $S_5$ | -0.54 | 0.37 | | | |
| $S_6$ | | | | | |
| $S_7$ | | 0.86 | | | |
| $S_8$ | -0.42 | 0.48 | | | |
| $S_9$ | -0.67 | | | | -0.39 |
| $M_1$ | | | -0.31 | 0.68 | |
| $M_2$ | | | | -0.45 | |
| $M_3$ | | | 0.39 | | |
| $M_4$ | | | | | |

Table 3--continued

| Variable | Factor | | | | |
|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 |
| $M_5$ | | | -0.66 | | 0.49 |
| $M_6$ | | | -0.42 | | |
| $M_7$ | | | 0.71 | | |
| $M_8$ | 0.36 | | | 0.49 | -0.34 |
| $M_9$ | | | 0.74 | | |
| $M_{10}$ | | | | | |
| $M_{11}$ | | | 0.63 | | |
| $M_{12}$ | | | | | -0.51 |
| $M_{13}$ | | | | | -0.52 |
| $M_{14}$ | | | | | |
| $M_{15}$ | | | 0.31 | | |
| $M_{16}$ | | | 0.63 | | |
| $D_1$ | 0.77 | | | 0.36 | |
| $D_2$ | | | | -0.63 | |
| $D_3$ | -0.75 | | | | |
| $D_4$ | | 0.33 | | | |
| $D_5$ | -0.67 | | | -0.41 | |
| $D_6$ | -0.87 | | | | |
| $D_7$ | -0.80 | | | | |
| $D_8$ | -0.57 | | | | |
| $D_9$ | | | | | |
| $D_{10}$ | -0.67 | | | | |

Table 3--continued

| Variable | Factor | | | | |
|---|---|---|---|---|---|
| | F1 | F2 | F3 | F4 | F5 |
| $D_{69}$ | | | | | |
| $D_{70}$ | | | | | |
| $D_{71}$ | | | | | |
| $P_1$ | | | | | |
| $P_2$ | | | | | |
| $P_3$ | | | | | |
| $P_4$ | | | 0.40 | | |
| $P_5$ | | | | | |
| $P_6$ | | | | | |

Table 3--continued

| Variable | Factor | | | | |
|---|---|---|---|---|---|
| | F6 | F7 | F8 | F9 | F10 |
| $R_1$ | | | -0.75 | | |
| $R_2$ | | | | | |
| $R_3$ | | | 0.80 | | |
| $R_4$ | | | | | |
| $R_5$ | | | | | |
| $R_6$ | | | | | |
| $R_7$ | | | | | |
| $R_8$ | | | | | |
| $R_9$ | | | | | |
| $S_1$ | | | | | |
| $S_2$ | | | | | |
| $S_3$ | | | | | |
| $S_4$ | | 0.44 | | | |
| $S_5$ | | | | | |
| $S_6$ | | | | | |
| $S_7$ | | | | | |
| $S_8$ | | | | | |
| $S_9$ | | | | | |
| $M_1$ | | | | | |
| $M_2$ | | | | | |
| $M_3$ | | | | | |
| $M_4$ | | | | | |

Table 3--continued

| Variable | Factor | | | | |
|---|---|---|---|---|---|
| | F6 | F7 | F8 | F9 | F10 |
| $M_5$ | | | | | |
| $M_6$ | | | | | |
| $M_7$ | | | -0.38 | | |
| $M_8$ | | | | | |
| $M_9$ | | | | | |
| $M_{10}$ | -0.51 | | | | |
| $M_{11}$ | | | | | |
| $M_{12}$ | | | | | |
| $M_{13}$ | -0.40 | | | | |
| $M_{14}$ | -0.38 | | | | |
| $M_{15}$ | | | | | |
| $M_{16}$ | | | | | |
| $D_1$ | | | | | |
| $D_2$ | | | | | |
| $D_3$ | | | | | |
| $D_4$ | | -0.45 | | | |
| $D_5$ | | | | | |
| $D_6$ | | | | | |
| $D_7$ | | | | | |
| $D_8$ | | 0.52 | | | |
| $D_9$ | | 0.87 | | | |
| $D_{10}$ | | | | | |

Table 3--continued

| Variable | Factor | | | | |
|---|---|---|---|---|---|
| | F6 | F7 | F8 | F9 | F10 |
| $D_{69}$ | | | | | -0.83 |
| $D_{70}$ | | | | -0.83 | 0.48 |
| $D_{71}$ | | | | 0.86 | 0.46 |
| $P_1$ | -0.55 | | | | 0.32 |
| $P_2$ | | | | | |
| $P_3$ | -0.79 | | | | 0.32 |
| $P_4$ | | | | | 0.46 |
| $P_5$ | -0.83 | | | | |
| $P_6$ | | | | | |

Table 3--continued

| Variable | Factor F 11 | F 12 | F 13 | Communality |
|---|---|---|---|---|
| $R_1$ | | | | 0.63 |
| $R_2$ | | | | 0.11 |
| $R_3$ | | | | 0.71 |
| $R_4$ | | | | 0.77 |
| $R_5$ | | | | 0.71 |
| $R_6$ | | | | 0.78 |
| $R_7$ | 0.78 | | | 0.82 |
| $R_8$ | | | 0.33 | 0.66 |
| $R_9$ | -0.83 | | | 0.82 |
| $S_1$ | | | | 0.43 |
| $S_2$ | | | | 0.57 |
| $S_3$ | | | | 0.79 |
| $S_4$ | | | | 0.35 |
| $S_5$ | | | | 0.61 |
| $S_6$ | | | 0.79 | 0.68 |
| $S_7$ | | | | 0.85 |
| $S_8$ | | | -0.70 | 0.95 |
| $S_9$ | | | | 0.73 |
| $M_1$ | | | | 0.66 |
| $M_2$ | | | | 0.27 |
| $M_3$ | | | | 0.32 |
| $M_4$ | 0.34 | | | 0.24 |

Table 3--continued

| Variable | Factor F11 | Factor F12 | Factor F13 | Communality |
|---|---|---|---|---|
| $M_5$ | | | | 0.83 |
| $M_6$ | | -0.68 | | 0.72 |
| $M_7$ | | | | 0.79 |
| $M_8$ | | | | 0.63 |
| $M_9$ | | | | 0.61 |
| $M_{10}$ | | | | 0.45 |
| $M_{11}$ | | | | 0.49 |
| $M_{12}$ | | | | 0.33 |
| $M_{13}$ | | | | 0.60 |
| $M_{14}$ | | | | 0.39 |
| $M_{15}$ | | | | 0.19 |
| $M_{16}$ | | | | 0.53 |
| $D_1$ | | | | 0.83 |
| $D_2$ | | | | 0.59 |
| $D_3$ | | | | 0.79 |
| $D_4$ | | | | 0.57 |
| $D_5$ | | | | 0.76 |
| $D_6$ | | | | 0.87 |
| $D_7$ | | | | 0.85 |
| $D_8$ | | | | 0.75 |
| $D_9$ | | | | 0.82 |
| $D_{10}$ | | | | 0.77 |

Table 3--continued

| Variable | Factor | | | Communality |
|---|---|---|---|---|
| | F11 | F12 | F13 | |
| $D_{69}$ | | | | 0.71 |
| $D_{70}$ | | | | 0.92 |
| $D_{71}$ | | | | 0.97 |
| $P_1$ | | 0.44 | | 0.76 |
| $P_2$ | | | | 0.16 |
| $P_3$ | | | | 0.79 |
| $P_4$ | | | | 0.57 |
| $P_5$ | | | | 0.74 |
| $P_6$ | | 0.88 | | 0.90 |

one factor or as related to a variable loading on two or three common factors. These loadings, as correlation coefficients, measure relationships on a minus one to plus one scale (the -0.30 to 0.30 range, which explains less than 10% of the variance in common between a factor and a variable, is not worth reporting). For convenience, Table 4, below, characterizes the results of this analysis.

The first two factors show statewide trends. F1, clustering structural forces with demand, shows the association between limited holding company states, new entry, large average bank size, deposit inequality ($S_8$), nonbank competition, financial activity, population density, urbanization, per capita income, population growth, and households per banking office, in opposition to unlimited multibank holding company states, agricultural loans, and agricultural employment. It seemingly reflects some regional traits, illustrating one vector of higher-order (fourteen-variable) correlation present among this industry's possible sources of performance. F2, "state-concentration," clusters unlimited branching laws, mergers, the concentration ratio, large average bank size, Herfindahl concentration, deposit inequality, and the unemployment rate in a negative relationship with unit-only legislation. This factor illustrates the tendency for banks to branch, merge, and concentrate where permitted that some economists would describe as the search for real or financial economies of scale and other economists would describe as monopolization.

The third factor, "large-bank" influences, associates branch system banks, cash holdings, commercial and industrial loans, trust activity, the payout ratio, bank asset size, and time and savings deposit

Table 4. Characterization of Factors for Banking Data*

| Factor | Variables Included | Characterization |
|---|---|---|
| F1 | $R_8$, $S_1$, $S_5$, $S_8$, $S_9$, $D_3$, $D_5$, $D_6$, $D_7$, $D_8$, $D_{10}$<br>$R_7$, $M_8$, $D_1$ | State Structure-Demand |
| F2 | $R_4$, $S_2$, $S_3$, $S_5$, $S_7$, $S_8$, $D_4$<br>$R_6$ | State Concentration |
| F3 | $M_3$, $M_7$, $M_9$, $M_{11}$, $M_{15}$, $M_{16}$, $P_4$<br>$M_1$, $M_5$, $M_6$ | Large Banks |
| F4 | $R_5$, $S_2$, $M_2$, $D_2$, $D_5$<br>$R_6$, $M_1$, $M_8$, $D_1$ | Limited Branches Versus Units |
| F5 | $R_8$, $S_9$, $M_8$, $M_{12}$, $M_{13}$<br>$M_5$ | Financial Ratios |
| F6 | $M_{10}$, $M_{13}$, $M_{14}$, $P_1$, $P_3$, $P_5$ | Price and Cost |
| F7 | $S_4$, $D_8$, $D_9$<br>$D_4$ | Economic Growth |

*Variables are listed with the dominant-signed pattern on the first line and the opposing-sign pattern on the second line.

Table 4--continued

| Factor | | Characterization |
|---|---|---|
| F8 | $R_1$, $M_7$ | Bank Legal Status and Liquidity |
| | $R_3$ | |
| F9 | $D_{71}$ | Time |
| | $D_{70}$ | |
| F10 | $D_{70}$, $D_{71}$, $P_1$, $P_3$, $P_4$ | Banking Time Trends |
| | $D_{69}$ | |
| F11 | $R_7$, $M_4$ | Multibank Holding Companies |
| | $R_9$ | |
| F12 | $P_1$, $P_6$ | Bank Output Proxies |
| | $M_6$ | |
| F13 | $R_8$, $S_6$ | State Deposit Size Variation |
| | $S_8$ | |

interest rates in a negative direction from unit-type banks, time and savings deposit liabilities, and bank portfolio securities. F3 thus shows an association between bank product mix and size that makes casual observations in banking analysis highly dangerous. F4 is the limited branches versus units factor. It shows that limited branching states, bank mergers, moderately branching banks, manufacturing activity, and population density are generally clustered oppositely from unit states, unit-type banks, and agricultural activity. Interestingly, limited branching and not large branching banks seem to be the direct opposite of unit banks on this factor.

F5 assembles limited holding company states, nonbank competition, agricultural loans, low leverage, and labor expense in a largely financial pattern that is negatively related to the time and savings deposit ratio. F6 is an interesting price-cost relationship. It relates consumer and individual loans, labor expense, occupancy expense, adjusted revenue/assets, risk-adjusted loan interest, and the financial price-cost spread ratios to each other. This important factor is discussed in depth in the next section.

The seventh factor, reflecting statewide economic patterns, associates an increase in banking concentration positively with population growth and economic growth but negatively with the unemployment rate, reflecting the consolidation of bank resources that may be necessary to accommodate rapid economic growth. F8 captures bank legal status and liquidity, showing that national banks have higher cash ratios than expected while state nonmember banks have generally low pure liquidity ratios, reflecting their low levels of required cash reserves.

F9 is a rather definitional time pattern. F10, however, shows strong banking time trends. It associates adjusted revenue/assets, risk-adjusted loan interest, and deposit interest rates paid with the 1970 and 1971 years in opposition to the 1969 year, as discussed below.

The eleventh pattern clearly outlines a multibank holding company dimension. F12 is the bank output proxy factor. It shows that both the adjusted revenue/assets and loan/deposit ratios are negatively related to the bank portfolio securities ratio. (The historical function of a bank is, clearly, to lend and not to hold cash or to purchase debt securities at relatively low interest rates except for use as internal reserves.) The last factor, state deposit size variation, shows that limited holding company legislation and deposit size variability are oppositely related to bank size inequality.

CONCLUSIONS: PERFORMANCE VARIABLE RELATIONSHIPS

The communality column of Table 3 shows that this analysis has explained a large percentage of most of the banking variables of this study. For example, about 90% of the variance of the loan/deposit ratio ($P_6$) is explained by the factor analysis.

The factor analysis captures all but two variables: state bank membership and profitability. It would thus appear that bank profitability is not <u>strongly</u> related to any of the variables considered.[12] Tentatively,

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[12]Table 3 shows patterns of association, which are not necessarily causal in nature. However, traits highly conducive to any of the performance variables will load on the same factor with that variable. Irma Adleman and Cynthia T. Moriss, "A Factor Analysis of the Interrelationships Between Social and Political Variables and Per Capita Gross National Product," <u>Quarterly Journal of Economics</u>, LXXXIX (November, 1965), 555-78.

internal bank returns would appear to depend on intangible managerial quality to a larger extent than the other performance traits would. In particular, state bank membership per se (exclusive of reserve effects such as excessive cash requirements) would not appear to depress bank profitability, according to this analysis.

The performance variables $P_1$, $P_3$, and $P_4$ are evidently directly demand-determined on F10. The proximate supply determinants of the performance variables (except for profitability) appear on factors such as F3, F6, and F12, which largely contain portfolio and operating characteristics that are apparently internal to a bank. These supply traits may be indirectly related to other forces, however, such as bank regulation, as theoretically implied by Figure 1 and as empirically implied by the overlapping of some factors through the common factor loadings of variables such as $M_6$ and $P_1$.[13]

This adjusted revenue/assets ratio, $P_1$, first loads on F6, being related to price elements such as higher-yielding consumer loans and, as expected, the differential between adjusted loan interest rates received and time and savings deposit interest rates paid. It is also positively associated with both cost element ratios, since higher costs imply higher average prices. (Alternatively, costs may rise under imperfect competition to meet price.) Risk-adjusted loan interest, $P_3$, is associated on F6 with the same elements. Moreover, the financial

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[13]Either principal components or "oblique rotation" would show even greater overlapping of variable loadings. Rummel, pp. 338-45, 395-432.

price-spread ratio, $P_5$, is associated with labor and physical-capital costs as well as with price elements on F6. To the extent that the costs of the complementary inputs to time and savings deposits are at high levels, such costs would be expected to keep output low and, hence, to keep the average financial "price of intermediation services" of a bank with high labor and physical-capital costs at a high level. $P_5$ is also associated on F6 with relatively uncontrolled loan rates to a far greater extent than it is with deposit interest rates paid. This tendency clearly reflects the depressing effects of Regulation Q on time and savings deposit interest rates during this period.

The adjusted revenue/assets ratio also loads on F12. It thus seems to share some of the traditional bank output characteristics of the loan/deposit ratio ($P_6$),[14] with its associated low portfolio securities ratio.

The time and savings deposit interest rate, $P_4$, appears in the F3 pattern. This price is, to a considerable degree, associated with large-bank influences such as branching systems and banks that extend relatively large amounts of loans--particularly commercial loans.

Somewhat surprisingly, given the demand-depressing recession occurring during part of this period, the adjusted revenue/assets, loan interest, and deposit interest variables all exhibit a rising time trend pattern from 1969 through 1971. This result is independent of any other measure of competition on F10. Thus, the relatively tight-money environment of 1970 and 1971 clearly raised average bank rates received on both

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[14] Broaddus, p. 7.

loans and total assets relative to those of 1969.[15] The liberalization of Regulation Q during 1970 also strongly appears in the loading of $P_4$ on this factor. These effects are consistent with an external increase in the nominal demand for banking services. Short-term time trends, as well as microeconomic characteristics, accordingly seem to influence banking performance very strongly. Banking law based on the experience of the Great Depression, over thirty years ago, may thus be somewhat invalid in the 1970's.

Clearly, many interactive relationships are present in the environment of the banking industry. Researchers examining banking performance should carefully note such clusters of characteristics before attempting to strictly define banking causality. The use of numerous correlated variables (loading on one or more common factors) in regression may thus give rise to econometric inconsistencies in banking studies.[16] More importantly, given these complex patterns, policy makers should not be surprised if attempts to restrict banking competition lead to unanticipated, if not undesirable, effects on the nation's financial structure, conduct, or performance.

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[15] Although some interest rates declined in 1971, the average yields on bank earning assets remained greater in 1971 than they were in 1969. FDIC, Bank Operating Statistics (Washington: FDIC, 1969 and 1971, n.p.).

[16] As examples, deposit inequality ($S_8$) and agricultural loans ($M_8$) would be poor regressors, since they load on three factors. On the other hand, the variable loadings on F1 support the variable deletions made because of multicollinearity before regression by Eric Brucker, "A Microeconomic Approach to Banking Competition," Journal of Finance (December, 1970), 1133-41.

## APPENDIX: FACTOR ANALYSIS ILLUSTRATED

The nature of the banking-variable factor analysis may be clarified by an identical analysis of simpler variables whose nature is known in advance. The reduction of multicollinearity and isolation of common variance by factor analysis may be illustrated by factoring physical-object data to a conceptually greater extent than that resulting from a discussion of the hyperellipsoidal projections of vectors in m-space that underlie factor analysis.[17]

For this example, a length "L" and width "W" dimension is estimated for each of one hundred rectangles, each of which is denoted by the subscript "i." Variables are created, including a one-digit random number e introduced as a "noise" element, by the formulas shown in Table 5.[18]

Table 5. Rectangle Data Formulas

$$X_{1i} = L_i$$

$$X_{2i} = W_i$$

$$X_{3i} = 10L_i + e_{3i}$$

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[17]For example, the reader unfamiliar with factor analysis is unlikely to find his knowledge significantly increased by the statement that it begins by finding "the orthonormal eigenvectors of the matrix for which a similarity transformation is its eigenvalue matrix" (Rummel, p. 99) to create the original factors that are subject to later, more complex, transformations.

[18]The data are taken from William Cooley and Paul Lohnes, Multivariate Procedures for the Behavioral Sciences (New York: Wiley, 1962), pp. 154-57. Copyright 1962 by John Wiley and Sons, Inc., and used with its permission.

$$X_{4i} = 10W_i + e_{4i}$$

$$X_{5i} = 20L_i + 10W_i + e_{5i}$$

$$X_{6i} = 20L_i + 20W_i + e_{6i}$$

$$X_{7i} = 10L_i + 20W_i + e_{7i}$$

$$X_{8i} = 40L_i + 10W_i + e_{8i}$$

As would be expected, these interactive variables generate an extremely multicollinear correlation matrix, whose elements are shown in Table 6.

Table 6. Rectangle Data Correlation Matrix

| Variables | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ |
|---|---|---|---|---|---|---|---|---|
| $X_1$ | 1.000 | .140 | .987 | .168 | .931 | .804 | .597 | .980 |
| $X_2$ | | 1.000 | .160 | .930 | .491 | .693 | .887 | .331 |
| $X_3$ | | | 1.000 | .185 | .927 | .807 | .608 | .972 |
| $X_4$ | | | | 1.000 | .489 | .671 | .835 | .347 |
| $X_5$ | | | | | 1.000 | .962 | .848 | .984 |
| $X_6$ | | | | | | 1.000 | .950 | .903 |
| $X_7$ | | | | | | | 1.000 | .743 |
| $X_8$ | | | | | | | | 1.000 |

Clearly, less than eight independent dimensions exist in these data, since these correlation coefficients are almost all significant at the 0.10 level of a two-tailed test. A statistically independent data set, in contrast, would generate insignificant, low correlation coefficients near zero. The two underlying independent dimensions in these data are shown by Table 7, below.

Table 7. Factor Analysis of Rectangle Data, rounded to two decimal places

| Variable | Factor 1, "L" | Factor 2, "W" | Communality |
|---|---|---|---|
| $X_1$ | 1.00 | 0.06 | 1.00 |
| $X_2$ | 0.08 | 1.00 | 1.00 |
| $X_3$ | 0.98 | 0.08 | 0.98 |
| $X_4$ | 0.11 | 0.93 | 0.87 |
| $X_5$ | 0.91 | 0.42 | 1.00 |
| $X_6$ | 0.77 | 0.63 | 0.99 |
| $X_7$ | 0.55 | 0.84 | 1.00 |
| $X_8$ | 0.97 | 0.26 | 1.00 |

Clearly, factor 1 outlines length (variables $X_1$, $X_3$, $X_5$, $X_6$, $X_7$, and $X_8$), while factor 2 captures width (variables $X_2$, $X_4$, $X_5$, $X_6$, and $X_7$). Variables $X_5$, $X_6$, and $X_7$, being derived from both length and width elements, load on both factors. These factors can also be seen as plotted in two-space by Figure 2, below. If some of the variables had negative relationships, more than one quadrant of the figure would possess variable points.

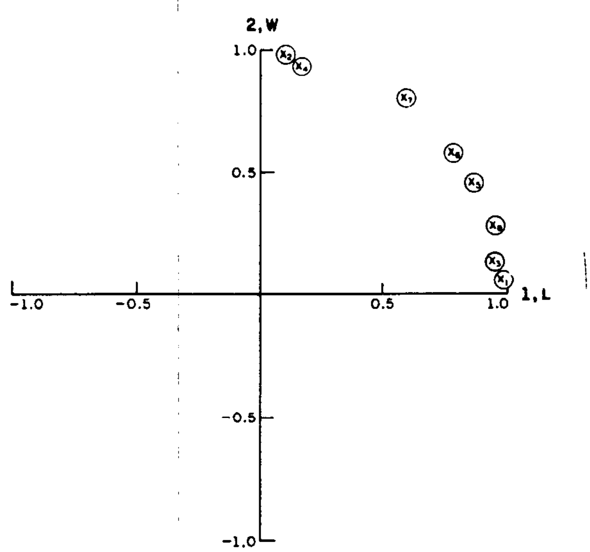


Figure 2. Plot of Rectangle Factor Analysis