BANKING FIRM MODEL: AN INTEGRATED VIEW OF REAL RESOURCE AND FINANCIAL ASPECTS OF BANKING ACTIVITIES

By

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CHAPTER I

INTRODUCTION

Significance of the Study

Although the major functions of banking -- the consolidation and transformation of risks, the production and maintenance of financial contracts, and the execution of transactions -- utilize real resources, the literature concerned with banking tends to emphasize the financial aspects and neglect the resource aspects. (Hereafter, "resources" mean real resources: labor and tangible materials.) A satisfactory model of the banking firm should give equal priority to both aspects and to the interaction of the banking firm with its environment. Therefore, the main objective of this study is to construct a theoretical model that not only combines the resource and financial aspects but also allows for the role of market structure and competition within the structural relations which the bank confronts. Thus, the model is intended to provide an analytical framework for applied research. Applications of the model to actual problems is beyond the scope of this study.

Statement of Issues

This study will analyze the major banking activities and then develop a model which integrates resource aspects with financial aspects. More specifically, this study deals with the following:

1. commercial lending activities and their revenues and expenses,
2. demand deposit service activities and their costs and revenues,
3. the bank's asset/liability management,
4. the major constraints on commercial-bank management,
5. the development of a conceptual model of asset/liability revenue-cost as a framework for analyzing the bank's strategic decisions.

Importance of Banking in Economic Activity

The financial sector plays an important role in the economy of the United States, currently accounting for about 15 percent of the Gross National Product (GNP). The financial sector is thus the third largest contributor to GNP (after manufacturing and trade). The financial sector employs 5.2 million people or 5 percent of the labor force to produce the 15 percent of GNP. This figure indicates that the financial sector is a highly productive sector since employment in both manufacturing and trade is proportionate to their contributions to GNP.

The most important segment of the financial sector is commercial banking. Commercial banks' total assets as a percentage of all major financial institutions were 38 percent in 1960, 38 percent in 1970, and 37 percent in 1980. In absolute terms the total assets of commercial banks were 1,386 billion dollars in 1980 and more than twice those of savings and loan associations, which were the second largest financial institutions. (See Mayer, Duesenbery and Aliber (1981), Campbell (1982), Cargill (1983), and Kaufman (1983) for more extended discussions of the quantitative importance of banking in economic activity.)

Financial Statements of Commercial Banks

The business activities of commercial banks can be divided into two broad categories: making loans and investments, and providing various services.

Commercial banks make loans and investments. They obtain funds from various sources (deposits, capital, etc.), and lend them to others. They also invest a portion of their funds in various types of securities. The return on these loans and investments generally exceeds the cost of obtaining the funds. Hence, banks make a profit on this difference.

Among the services provided by banks are the processing of coins and currency, clearing of checks, issue of cashier's checks and sale of money orders. Many banks also provide other bank related services such as data processing (often for other banks) and trust services. Banks generally receive a fee for these services.

Certainly this is not intended to be a complete listing of all of the various aspects of the business of banking. This listing is sufficient, however, to provide the basis for a review of a commercial bank's balance sheet and income statement. (For more details, see Baughn and Walker (1978), Crosse and Hempel (1980), Garcia (1979), and Reed (1963).)

Balance Sheet

A condensed version of a typical bank's balance sheet including all of the major categories of assets and liabilities is shown in Figure 1.

Commercial Banks typically obtain funds from at least four or five sources. These sources are listed on the liabilities side of the balance sheet.

Commercial Bank

Balance Sheet

Date

Assets		Liabilities	
Cash and due from banks	$...	Demand deposits	$...
Investment securities	...	Savings deposits	...
Federal funds sold	...	Time deposits	...
Loans	...	Federal funds purchased	...
Premises and equipment	...	Other liabilities	...
Other assets	...	Subordinated debt	...
Total	$...	Equity capital	...
		Total	$...

Figure 1. Typical Bank's Balance Sheet

Demand deposits are normally checking accounts deposited by individuals, partnerships, corporations, governmental bodies, or associations or groups of individuals. As the name indicates, the funds are payable on demand. These funds are withdrawn primarily by checks, and they also can be transferred by bank wire and through the various systems currently available in the form of electronic funds transfer systems.

Saving deposits are from individuals and nonprofit corporations. These ordinarily earn interest on balances and are generally evidenced by passbooks. Advance notice of withdrawal can be required, but in practice this is rarely invoked.

Time deposits are also from the same sources as the two categories mentioned above. These deposits have specified maturities or renewal dates. In certain cases, there are special withdrawal conditions. Deposits can be evidenced by certificates (either negotiable or non-negotiable) and other instruments. The interest paid varies with the amount and the stated maturity date.

Federal funds are purchased from other banks, mainly those that have excess reserves. Banks are required to maintain reserves of funds as specified by their regulatory authorities. These reserves are intended to provide a level of safety for customers' funds held on deposit. Some banks have excess reserves available whereas others do not have enough. These excess reserves are loaned, mostly on an overnight basis, by one bank to another. Because of various inter-bank relationships and services provided, it is not at all uncommon for a bank to utilize Federal funds purchased as a source of funds and simultaneously sell Federal funds to other banks as a use of funds. The interest expense (or income) rate on Federal funds varies daily, but it is generally near the Certificate of Deposit rate.

Other liabilities mainly represent assets or services for which the bank has not yet paid.

Subordinated debt is an additional source of funds utilized by many banks. The debt instruments are typically issued for seven years or more and are often viewed as quasi capital funds.

Equity capital is invested in a bank by the owners who purchase its capital stock and who leave with the banking company a portion of its profits. The bank pays its owners (shareholders) for the use of these capital funds by distributing a portion of its earnings to them in the form of dividends.

Having obtained funds from various sources, commercial banks then have several alternatives for their uses which are listed on the asset side of the balance sheet.

Cash and due from banks show the total of all coin and currency in the bank vault, plus all funds held in deposit accounts with other commercial banks. Included also are the checks on other banks that are in the process of collection (generally called float). For member banks, the required reserve balance that is kept with the Federal Reserve Bank is part of this account.

Investment securities show the total of all securities of the bank's own portfolio. Typically, most of these investments are municipal securities. These are comparatively long-term investments ranging from five to twenty years. In addition, banks also carry some U.S. Treasury obligations. These are shorter-term investments typically running from thirty days up to a few years. These short-term investments can be converted easily and quickly into cash and are carried to provide the

bank a degree of liquidity should its customers require more cash in withdrawals or loans than it has readily available.

Federal funds sold are the bank's excess reserves which are sold (that is loaned) to the other banks. Banks with collected funds in excess of the required allowances in the Federal Reserve account may sell (loan) these funds to other commercial banks that need the added balances in their reserve accounts. This category also includes re-purchase agreements, by which a bank purchases securities from somebody and simultaneously agrees to resell the identical or similar securities to them at a predetermined future date and price.

Loans are made to individuals, partnerships, corporations, financial institutions, other banks, brokers, dealers in securities, and governmental units and agencies, either on a secured or unsecured basis. The interest income of each loan always varies according to the type of loan, the amount borrowed, the credit worthiness of the customer, the term of the loan, as well as other factors. A major portion of a bank's resources are utilized to makes loans.

Premises and equipment are the book value of all fixed assets, such as land, buildings, leasehold improvements, and furniture and equipment. The book value is cost less depreciation charged and the account is shown on a net basis.

Other assets are such things as prepaid expenses, direct lease financing, real estate owned other than bank premises, and etc.

Income Statement

A condensed version of a typical bank's income statement which includes all the major items of revenues and expenses is shown in Figure

2. The income statement reflects the costs associated with the resources obtained and the income derived from their uses. The primary income and revenue items are stated below.

Interest and fees on loans include the interest and discount on all assets classified as loans, together with commitment fees, service charges, and other fees on loans. This item of revenue is ordinarily the principal source of income to a bank.

Interest and dividends on securities classify the income received from these sources by the type of securities from which they originate.

Income on Federal funds sold is normally recorded daily, since the interest is usually received when the funds are paid for these one business day transactions. Included also is interest earned from transactions covering securities sold under repurchase agreements.

Income from trust department consists of fees and commissions for services performed by the bank in a fiduciary capacity (personal trust or corporate trust work).

Service charges on deposit accounts are charges on checking accounts, based either on activity levels (i.e., ckecks paid, deposits made, checks deposited, etc.) or related to minimum deposit balance, or both. Such charges are usually collected monthly and are a part of the bank's income stream.

Other service charges and fees would include a variety of miscellaneous revenue sources such as loan participation fees, fees for issuing official checks, etc.

Other revenue includes such items as income from the rental of safe deposit boxes and capital gains or losses on the sale of furniture, fixtures, and equipment.

Commercial Bank

Income Statement

Date

Operating Revenue:	
Interest and fees on loans	$...
Interest and dividends on securities	...
Income on Federal funds sold	...
Income from trust department	...
Service charges on deposit accounts	...
Other service charges and fees	...
Other revenue	...
Total Operating Revenue	$...
Operating Expenses:	
Salaries, wages, and employee benefits	$...
Interest on deposits	...
Expense of Federal funds purchased	...
Interest on borrowed money	...
Net occupancy expense of bank premises	...
Furniture and equipment expenses	...
Provision for possible loan losses	...
Other expenses	...
Total Operating Expenses	$...
Income before income taxes and securities gain	$...
Applicable income taxes on operating earnings	$...
Security gains, net of income taxes	$...
Net income	$...

Figure 2. Typical Bank's Income Statement

Total operating revenue is the bank's gross income. From it, the expenses listed below are deducted to develop the net earnings figure.

Salaries, wages, and employee benefits include direct compensation of all officers and employees, plus benefits such as bonuses, contributions to pension or retirement plans, profit-sharing contributions, insurance premiums paid by the bank for hospitalization or life insurance and any other fringe benefits.

Interest on deposits represents interest paid on savings deposits and time deposits.

Expense of Federal funds purchased is booked and paid daily as the funds are borrowed and when the benefit is received. Also included in this item would be interest paid on transactions under which securities are sold under repurchase agreements.

Interest on borrowed money is interest paid on subordinated notes and debentures, along with any interest paid on current borrowings or bills payable.

Net occupancy expense of bank premises consists of staff expenses for operating and maintaining the bank premises, depreciation, rent paid, real estate taxes, and other operating expenses, less rental income received.

Furniture and equipment expenses include rent paid for office machines or data-processing machinery, repairs and maintenance of furniture and equipment, any taxes on equipment, and depreciation charges.

Provision for possible loan losses is the amount of the loan losses estimated by the bank management. The charge is based upon management's knowledge of the bank's loan portfolio.

Other expenses include a variety of outlays such as advertising expenses, insurance costs, and etc.

Total operating expenses are the total of the expense items listed above.

Income before income taxes and securities gain shows total operating revenue less total operating expenses.

Applicable income taxes on operating earnings are the aggregate of federal and other taxes applicable to operating earnings.

Security gains are the result of gains or losses for most longer-term securities when these investments are sold prior to their maturities.

Net income shows the net profit of the bank derived from adding the securities gains (net of taxes) to the results of subtracting the applicable income taxes on operating earnings from the income before income taxes and securities gains.

Data on Resource Costs and Financial Activities

Since this study focuses on the commercial bank activities, it is important at the outset to present a perspective on the trends of the data on resource costs and financial activities of commercial banks in the United States. (All commercial banks insured by the Federal Deposit Insurance Corporation (FDIC) are used to represent all commercial banks in this study.) The balance sheets of all insured commercial banks for 1979, 1980, and 1981 are shown in Table I. The income statements of all insured commercial banks for 1979, 1980, and 1981 are shown in Table II. (The number of all insured commercial banks for the three years was relatively stable, being about 14,000.)

To demonstrate the importance of commercial lending and deposit activities in banking business, two tables (Table III and Table IV) have been constructed. Table III presents selected items of the balance

TABLE I

BALANCE SHEETS OF ALL INSURED COMMERCIAL BANKS
FOR 1979, 1980, AND 1981, REPORT OF
CONDITION FOR DECEMBER 31
(DOLLARS IN THOUSANDS)

REPORT OF CONDITION ITEMS	1979	1980	1981
CASH & DUE FROM DEPOS INST...	306,601,551	331,909,343	327,409,968
U.S. TREASURY SECURITIES.....	88,426,476	104,466,190	103,708,770
OBLIG OF OTHER U.S. GOVT AGEN	49,362,671	59,078,250	69,102,812
OBLIG OF ST & POL SUBDIV.....	132,807,784	146,263,386	151,537,394
ALL OTHER SECURITIES.....	23,326,644	24,637,253	27,787,775
FED FUNDS SOLD & SEC PURCH...	61,276,639	70,321,804	91,147,440
NET LOANS.....	923,859,842	992,415,361	1,104,251,169
REAL ESTATE LOANS.....	249,291,258	269,111,604	291,348,326
LOANS TO FINAN INSTITUTIONS.	69,548,176	81,167,777	94,730,149
LOANS FOR PURCH SECURITIES..	14,475,538	13,713,119	16,762,668
LOANS TO FINANCE AGRI PROD..	31,441,881	32,259,790	33,708,954
COMMERCIAL & INDUSTRL LOANS.	351,126,743	390,930,841	454,591,066
LOANS TO INDIVIDUALS.....	192,718,057	187,375,654	192,945,685
ALL OTHER LOANS.....	46,294,783	48,940,842	52,618,822
LESS: UNEARNED INC ON LOANS.	21,853,119	21,031,743	21,039,793
LESS: ALLOW FOR POSS LN LOSS	9,183,475	10,052,982	11,414,707
LEASE FINANCING RECEIVABLES..	11,706,256	13,993,182	15,867,911
BANK PREM, FURN & FIXTURES...	23,549,846	26,652,394	30,378,101
REAL EST OTHER THAN BANK PREM	2,131,520	2,208,409	2,608,115
ALL OTHER ASSETS.....	68,968,672	83,742,215	105,181,237
TOTAL ASSETS.....	1,692,078,001	1,855,687,813	2,028,980,671

TABLE I (Continued)

REPORT OF CONDITION ITEMS	1979	1980	1981
DEMAND DEPOSITS OF IPC-DOM...	333.541.776	333.746.688	308;112.202
TIME & SAVINGS DEP OF IPC-DOM	580.951.772	674.047.804	795.770.762
IPC DEP IN FOREIGN OFFICES...	87.895.077	110.230.947	147.518.809
DEPOSITS OF U.S. GOVERNMENT..	3.692.384	3.500.842	3.560.698
DEPOSITS OF ST & POL SUBDIV..	83.336.558	81.451.293	82.525.016
ALL OTHER DEPOSITS.....	254.666.975	259.856.488	235.292.553
CERTIFIED & OFFICERS CHECKS..	19.043.569	18.326.671	16.002.470
TOTAL DEMAND DEPOSITS.....	430.775.791	431.539.363	384.273.230
TOTAL SAVINGS DEPOSITS.....	206.668.739	200.869.795	223.450.087
TOTAL TIME DEPOSITS.....	453.130.237	554.739.983	661.626.537
DEPOSITS IN FOREIGN OFFICES	272.493.380	294.011.578	319.432.639
TOTAL DEPOSITS.....	1.363.068.147	1.481.160.716	1.588.782.523
FED FUNDS PURCH & SEC SOLD...	112.346.888	133.290.703	163.818.211
INT-BRG DEM NOTES & OTH BORR.	39.526.304	42.172.415	45.431.648
MORTGAGE INDEBTEDNESS.....	2.119.449	2.241.626	2.547.735
ALL OTHER LIABILITIES.....	71.493.618	82.672.285	103.639.421
TOTAL LIABILITIES.....	1.588.584.406	1.741.537.730	1.904.219.551
SUBORDINATED NOTES & DEBEN...	6.252.770	6.553.582	6.460.299
PREFERRED STOCK - PAR VALUE..	125.890	134.562	170.861
COMMON STOCK - PAR VALUE.....	20.273.743	21.672.045	23.557.407
SURPLUS.....	35.328.623	37.775.850	40.300.914
UNDIVIDED PROFITS & CAP RES..	41.512.569	48.014.004	54.271.614
TOTAL EQUITY CAPITAL.....	97.240.825	107.596.467	118.300.803
NUMBER OF BANKS.....	14,364	14,430	14,413

Source: Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1980).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1981).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1982).

TABLE II

INCOME STATEMENTS OF ALL INSURED COMMERCIAL BANKS FOR 1979, 1980, AND 1981, (DOLLARS IN THOUSANDS)

REPORT OF INCOME ITEMS	1979	1980	1981
INTEREST & FEES ON LOANS.....	102,192,459	126,953,530	163,504,248
INTEREST ON BAL WITH DEPOS INST.	10,669,726	16,256,285	24,294,867
INC ON FED FUNDS SOLD & SEC PUR.	6,126,340	8,763,355	12,269,261
INT ON U.S. TREAS & OTH AGENCIES	10,686,277	13,463,771	18,107,473
INT ON OBLIG OF ST & POL SUBDIV.	6,955,222	8,170,117	9,703,154
INCOME FROM ALL OTHER SECURITIES	1,198,071	1,442,596	1,640,898
INC FROM DIRECT LEASE FINANCING.	1,073,254	1,370,626	1,751,278
INC FROM FIDUCIARY ACTIVITIES...	2,375,711	2,739,169	3,179,474
SERVICE CHARGES ON DEP ACCTS....	2,528,752	3,186,899	3,920,607
OTHER SERVICE CHARGES.....	3,641,607	4,359,833	5,308,472
OTHER OPERATING INCOME.....	2,834,934	4,062,387	5,118,477
TOTAL OPERATING INCOME.....	150,282,353	190,768,324	248,798,239
SALARIES & EMPLOYEE BENEFITS....	21,562,167	24,673,166	28,043,534
INT ON CD'S OF $100,000 OR MORE.	18,178,650	24,900,020	39,306,584
INT ON DEPOSITS IN FOREIGN OFF..	24,523,807	34,941,433	46,740,611
INTEREST ON OTHER DEPOSITS.....	29,185,414	38,577,977	53,393,782
EXP OF FED FUNDS PUR & SEC SOLD.	12,356,285	16,770,627	23,877,620
INT ON DEM NOTES & OTHER BORR...	3,167,247	4,386,518	5,904,454
INT ON SUB NOTES & DEBENTURES...	501,470	546,243	617,199
OCCUPANCY, FURN & FIX EXPENSES..	6,281,496	7,353,564	8,596,899
PROV FOR POSSIBLE LOAN LOSSES...	3,785,642	4,478,640	5,065,188
OTHER OPERATING EXPENSES.....	12,848,987	14,635,535	17,017,713
TOTAL OPERATING EXPENSES.....	132,391,165	171,263,753	228,568,028

TABLE II (Continued)

REPORT OF CONDITION ITEMS	1979	1980	1981
INCOME BEFORE TAXES & SEC TRANS.	17.891.188	19.504.570	20.230.176
APPLICABLE INCOME TAXES.....	4.742.118	5.018.663	4.626.281
INC BEFORE SEC GAINS OR LOSSES..	13.149.070	14.484.887	15.603.924
SECURITIES GAINS, GROSS.....	-649.686	-854.402	-1.583.326
APPLICABLE INCOME TAXES.....	-299.727	-362.089	-722.441
SECURITIES GAINS, NET.....	-349.962	-491.976	-857.230
NET INC BEF EXTRAORDINARY ITEMS.	12.799.112	13.992.817	14.746.559
EXTRAORDINARY ITEMS, NET OF TAX.	39.374	16.849	55.635
NET INCOME.....	12.838.487	14.009.628	14.802.174
CASH DIV ON CMN & PREF STOCK....	4.455.293	5.099.108	5.840.238
NET CHANGE IN EQUITY CAPITAL...	10.824.140	10.896.192	12.082.135
RECOVERIES CREDITED TO PLL ALLOW	1.198.985	1.281.116	1.535.190
LOSSES CHARGED TO PLL ALLOWANCE.	3.763.245	4.878.839	5.296.610
NUMBER OF FULL-TIME EQ EMPLOYEES	1.410.818	1.484.071	1.517.506
NUMBER OF BANKS.....	14.364	14.430	14.411

Source: Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1980).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1981).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1982).

TABLE III

SELECTED ITEMS OF THE BALANCE SHEET OF ALL INSURED COMMERCIAL BANKS, 1979-1981 (UNITS IN PERCENTAGES)

	1979	1980	1981
CASH & DUE FROM DEPOS INST	18.1	17.8	16.1
U.S. TREASURY SECURITIES	5.2	5.6	5.1
FED FUNDS SOLD & SEC PURCH	3.6	3.8	4.5
NET LOANS	54.6	53.5	54.4
REAL ESTATE LOANS	14.7	14.5	14.3
LOANS TO FINAN INSTITUTIONS	4.1	4.4	4.6
LOANS FOR PURCH SECURITIES	0.8	0.7	0.8
LOANS TO FINANCE AGRI PROD	1.8	1.7	1.6
COMMERCIAL & INDUSTRIAL LOANS	20.7	21.0	22.4
LOANS TO INDIVIDUAL	11.3	10.1	9.5
TOTAL ASSETS	100.0	100.0	100.0
TOTAL DEMAND DEPOSITS	25.4	23.2	19.0
TOTAL SAVINGS DEPOSITS	12.1	10.8	11.0
TOTAL TIME DEPOSITS	26.7	29.9	32.6
DEPOSITS IN FOREIGN OFFICES	16.1	15.8	15.7
TOTAL DEPOSITS	80.5	79.8	78.3
FED FUNDS PURCH & SEC SOLD	6.6	7.2	8.0
TOTAL LIABILITIES & EQUITY CAPITAL	100.0	100.0	100.0

Source: Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1980).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1981).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1982).

TABLE IV

OPERATING INCOME AND OPERATING EXPENSES OF ALL INSURED COMMERCIAL BANKS, 1979-1981 (UNITS IN PERCENTAGES)

	1979	1980	1981		1979	1980	1981
REVENUES AS THE PERCENTAGE OF TOTAL OPERATING INCOME				EXPENSES AS THE PERCENTAGE OF TOTAL OPERATING EXPENSE			
INTEREST & FEES ON LOANS	68.0	66.5	65.7	SALARIES & EMPLOYEE BENEFITS	16.3	14.4	12.3
INTEREST ON BAL WITH DEPOS INST	7.1	8.5	9.7	INT ON CDs OF $100,000 OR MORE	13.8	14.6	17.2
INC ON FED FUNDS SOLD & SEC PUR	4.1	4.6	4.9	INT ON DEPOSITS IN FOREIGN OFF	18.6	20.4	20.4
INT ON U.S. TREAS & OTH AGENCIES	7.1	7.1	7.3	INTEST ON OTHER DEPOSITS	22.0	22.5	23.4
INT ON OBLIG OF ST & POL SUBDIV	4.6	4.3	3.9	EXP OF FED FUNDS PUR & SEC SOLD	9.4	9.8	10.4
INCOME FROM ALL OTHER SECURITIES	0.8	0.8	0.7	INT ON DEM NOTES & OTHER BORR	2.4	2.6	2.6
INC FROM DIRECT LEASE FINANCING	0.7	0.7	0.7	INT ON SUB NOTES & DEBENTURES	0.4	0.3	0.3
INC FROM FIDUCIARY ACTIVITIES	1.6	1.4	1.3	OCCUPANCY, FURN & FIX EXPENSES	4.8	4.3	3.8
SERVICE CHARGES ON DEP ACCTS	1.7	1.7	1.6	PROV FOR POSSIBLE LOAN LOSSES	2.6	2.6	2.2
OTHER SERVICE CHARGES	2.4	2.3	2.1	OTHER OPERATING EXPENSES	9.7	8.5	7.4
OTHER OPERATING INCOME	1.9	2.1	2.1	TOTAL OPERATING EXPENSES	100.0	100.0	100.0
TOTAL OPERATING INCOME	100.0	100.0	100.0				

Source: Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1980).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1981).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1982).

TABLE V

INTEREST COSTS AND NONINTEREST COSTS OF ALL INSURED COMMERCIAL BANKS' TOTAL OPERATING EXPENSES, 1979-1981 (UNIT IN BILLION DOLLARS AND PERCENTAGES)

	1979	1980	1981
INTEREST COSTS			
ABSOLUTE TERM (BILLION DOLLARS)	87.91	120.12	169.85
PERCENTAGE OF TOTAL OPERATING EXPENSES (%)	66.40	70.14	74.31
NONINTEREST COSTS			
ABSOLUTE TERM (BILLION DOLLARS)	44.48	51.14	58.72
PERCENTAGE OF TOTAL OPERATING EXPENSES (%)	33.60	29.86	25.69
TOTAL OPERATING EXPENSE			
ABSOLUTE TERM (BILLION DOLLARS)	132.39	171.26	228.57
PERCENTAGE OF TOTAL OPERATING EXPENSES (%)	100.00	100.00	100.00

Source: Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1980).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1981).
Federal Deposit Insurance Corporation, FDIC Bank Operating Statistics (Washington, 1982).

sheets in Table I as the percentage of total assets. (Total assets equal total liabilities plus equity capital.) Table IV shows the revenue items and expense items of the income statement in Table II as the percentage of total operating income and total operating expenses, respectively.

Commercial and industrial loans item accounted for one-fifth of total assets: 20.7 percent for 1979, 21.0 percent for 1980, and 22.4 percent for 1981. It has been the largest item of the banks' total assets (see Table III) and it also has an increasing trend for the three years. From Table IV, theinterest and fees on loans item, which has the commercial and industrial loans as its major part, accounted for two-thirds of total operating income: 68.0 percent for 1979, 66.5 percent for 1980, and 65.7 percent for 1981. These figures illustrate the significance of the commercial lending activities to the banking firm. Therefore, this study has selected commercial loans as the representative asset of the banks.

Total demand deposits accounted for one-fifth of the total liabilities and equity capital for the three years: 25.4 percent for 1979, 23.2 percent for 1980, and 19.0 percent for 1981 (see Table III). Although this item was second in size to total time deposits in the liabilities and equity categories of the banks, it has been considered as the most important item of the liabilities and equity side of the banks' balance sheets for the following reasons.

In the savings and time deposit function, controls must be maintained and interest must be computed. However, relatively speaking, these are neither costly nor complicated operations. A typical transaction in a savings or time deposit account entails a simple debit and credit, usually made while the depositor is at the teller's window.

Not so with the demand deposits. Each transaction in demand deposit account involves several operations. Further, each operation requires a system of control to insure that each check and each deposit are handled promptly and accurately. So, it is obvious that the service which the banks rendered in connection with handling demand deposits was costly.

Thus, this study has selected the demand deposits as the representative liability of the banks.

The importance of financial revenues and costs in banking is undeniable. For instance, interest revenues were the largest portion (more than three-fourths) of total operating income for 1979, 1980, and 1981 (see Tables II and IV), and interest costs were about seven-tenths of total operating expenses for 1979, 1980, and 1981 (see Tables II and V). Perhaps this explains the neglect of the resource aspects, especially the resource costs, in the banking literature. This neglect is undesirable, however, for banking activities are essentially resource intensive. For instance, Pesek (1976) explained the significance of resource costs in banking as follows:

> The zero-cost banker's elysium exists only in the Wonderland of monetary theory. Any banker knows that exactly like any other manufacturer or service industry, he must hire resources and struggle daily with labor costs, energy costs, computer costs, building costs, and taxes. And he also knows that in his quest for infinite profits, to increase his deposits by a fraction of a percentage point above his current equilibrium would involve him in additional costs that would reduce his profits below their present equilibrium level. He would have to accept worse credit risk to place his deposits into circulation, supply more expensive services to all his depositors to keep them there, advertise more, etc. (p. 866).

Pesek (1976) presented data for the year 1974 to support his statement. Using more recent data, the present study has developed Table

V to show the importance of resource costs both in absolute terms and as a percentage of total operating expenses.

The interest costs item is composed of the interest on CDs of $100,000 or more, the interest on deposits in foreign offices, the interest on other deposits, the expenses of Federal funds purchased and securities sold, the interest on demand notes and other borrow, and interest on subordinated notes and debentures. The rest of the operating expense items is the noninterest cost item which has the resource costs as its major part.

Although the noninterest cost item as a percentage of total operating expenses has a decreasing trend: 33.60 percent for 1979, 29.86 percent for 1980, and 25.69 percent for 1981 (due mainly to the high interest rates in these years), it has an increasing trend in absolute (dollars) term: 44.48 billion dollars for 1979, 51.14 billion dollars for 1980, and 58.72 billion dollars for 1981. It also accounted for more than one-fourth of the total operating expenses. These figures showed the importance of the noninterest costs or resource costs in banking business.

Benston, Hanweck, and Humphrey (1982) also realized the significance of reource costs in banking. They stated the reasons for concern with bank's operating (resource) costs as follows:

> In most businesses, operating costs are a private matter. In banking, though, these costs receive wider attention. A bank's managers and owners clearly are concerned with costs since they profit if costs are controlled. A bank's customers also are concerned, since banking costs ultimately are passed on to users of the bank's services. In addition, legislators and those charged with bank regulation have a derivative concern; the more efficiently banks are operated, the larger the earnings flows that may improve safety by absorbing losses, the more efficiently the nation's payments system works and the more efficiently savings are channeled into investment (p. 6).

There are still more authors who recognized the importance of resource costs in banking such as Baltensperger (1980), Bell and Murphy (1968), Donahue and Bush (1983), Glazer (1980), Havrilesky and Boorman (1976), Humphrey (1981), Murphy (1969), Osborne (1982), Sealey and Lindley (1977), and Smart and Morton (1983). Yet we still lack a good model of resource costs, not to mention a model that integrates the resource and financial aspects of banking.

Review of Approaches to Banking Models

A number of authors have contributed to the development of banking models. The characteristic elements of their different approaches are not mutually exclusive. However, their works can be grouped and described according to the relative emphasis given to the different factors as follows: asset management models, liability management models, risk aversion models, imperfect market models and real resource models.

Asset Management Models

Most models belonging to this group are models of bank reserve and liquidity management. Essentially, they treat reserve and liquidity management as a problem of inventory optimization under stochastic demand. The basic concept of this type of model originated with Edgeworth (1888) and has been taken up by Orr and Mellon (1961), Porter (1961), Duesenberry (1963), Hester and Zoellner (1966), Poole (1968), Frost (1971), Baltensperger (1972), Pringle (1974), Niehans (1978), and others.

The various analyses that have been put forward since the 1950s fall into two broad categories: those that treat the three types of bank

assets (i.e., cash, loans, and securities) as homogeneous in themselves, and those that distinguish between the various assets in two of these types (loans and securities) according to the degree of risk involved.

Some of the models view the problem as that of choosing the fractions of total assets to put into cash, loans, and securities. In these models, the three types of assets mentioned are believed to represent the range of liquidity and earnings. Though obviously cash is the most liquid of the assets, it yields no earnings. Conversely, loans are the least liquid but yield the highest returns. Investment securities are intermediate in liquidity and earnings. Given the probability distribution of net deposit withdrawals and the anticipated yield on loans and securities, these models provide a portfolio mix that maximizes the expected value of the additions (profits) to the bank's net worth. The profits from a portfolio distributed among cash, loans and securities are determined as follows: average loan return times the dollar amount of loans, plus the average securities return times the dollar amount of securities, minus average or expected loss on securities sold to meet unexpected cash needs.

The mathematical model by Orr and Mellon (1961) is a good example of this type of model. Orr and Mellon explored the potential effects of uncertainty in bank's cash flows on the expansion of bank credit by using a stochastic optimization method like those employed to determine optimal inventory policy in business firms. They assumed that the bank's assets are either reserves or loans, and that some expense attends a conversion from loans to reserves. Consequently, they specified that the major problem facing a bank is how far its credit should be expanded,

given the random nature of its cash flows and the reserve requirement it has to meet. The bank's goal is to extend new credit in a volume which will maximize its expected profit. The expected profit is equal to the net interest earned on new loans made during the period (in response to the excess reserves on hand) minus the expected losses due to the fact that an increase in the volume of loans will increase the probability that the bank's reserve will fall below the reserve requirement. The expected loss is composed of a lum sum penalty representing costs of paperwork and administration which are incurred when the reserve requirement is violated and a variable penalty which is a linear function of the reserve deficiency. In mathematical terms, the profit function which the bank intends to maximize is:

$$\pi = r.D - [L. \int_{u}^{\infty} f(s).\, ds + P. \int_{u}^{\infty} s.\, f(s).\, ds]$$

where

π = total profit

r = rate of interest on loans

D = volume of new deposit liabilities created during the period, which equals the volume of new loans during the period since Orr and Mellon assume that the bank will use all the new deposits to make loans

L = lum sum penalty cost

s = loss of reserves during the period

f(s) = probability density function of s

$f(s) \sim N(kD, \sigma_s^2)$, k is constant ($0 \leq k \leq 1$). Orr and Mellon assume that f(s) is normal, with mean value linearly dependent on the level of new deposits, and variance which is independent of deposit liability.

P = variable penalty on each dollar of reserve which the bank is short

u = the largest volume of cash outflow which can occur without causing a reserve deficit, given by

$$u = (R_E - R_R \cdot D)/(1-R_R)$$

where

R_E = volume of excess reserve at the beginning of the evaluation period

R_R = legal reserve ratio, $0 < R_R < 1$

A necessary condition for the optimality of a lending policy is that $\partial \Pi / \partial D = 0$.

This model is a very useful reminder of the stochastic nature of banks' environment--a reminder that was long overdue in 1961 and that has stimulated much further work. Moreover, the model is operational in the sense that it yields the optimal credit expansion as a function of the excess reserves at the beginning of the evaluation period, the reserve requirement, the penalty costs for reserve deficiencies, the interest rate on loans, and the parameters of the probability density function of loss of reserve during the period.

While this is the right type of model for analyzing the main effect of stochastic reserve losses on the gross characteristics of bank portfolios, it is less useful for other problems. In particular, it altogether disregards the resource costs of extending loans and servicing deposits, and it cannot handle these costs without being changed beyond recognition (the costs, as shown in Chapters II and III below, are not functions of the variables of this model). In other words, this model focuses on one aspect of banking but is not well suited to the task of the present study.

Liability Management Models

Models of this type usually apply inventory theory to the determination of the bank's capital account and its supply of debt or deposits. This approach treats the level and structure of assets as given. Models of this type are found in Niehans (1978), Taggart and Greenbaum (1978), and Baltensperger (1980). The latter one will be discussed in detail as follows:

For the liability management model is his work, Baltensperger assumed that the (beginning-of-period) structure and level of the bank's assets (A) is exogenous (i.e., given to the bank), and the bank's income (I) from its assets for the decision period is known a priori in probabilistic form only, with density function h (I), due to uncertainty about (end-of-period) interest rates and asset prices, and default risk. The h(I) obviously depends on the structure and level of assets. The bank's end-of-period indebtedness will be D(1+i), if it promises to pay an interest rate (i) on an amount of deposits (D) issued at the beginning-of-period. The condition that the bank will have a negative end-of-period net worth is: $A+I-D(1+i) = (I-iD)+(A-D) < 0$ or $I < D(1+i)-A \equiv \bar{I}$. Note that the probability of this event is positively related to the size of D or negatively related to K(K=A-D) under ceteris paribus. Baltensperger then assumes that the cost of insolvency is directly proportional to the level of the capital deficiency $(\bar{I}-I)$, with the penalty cost per dollar of deficiency denoted as P. Consequently, the expected cost of solvency can be stated as:

$$C = \int_{-\infty}^{\bar{I}} P.\ (\bar{I}-I)\ .\ h(I).\ dI$$

By increasing equity capital (K) by one dollar, the bank has marginal opportunity cost equal to k-i and marginal return (which is given by the associated reduction in C) equal to:

$$C_K = \int_{-\infty}^{\bar{I}} P. \bar{I}_K . h(I).dI = - \int_{-\infty}^{\bar{I}} P. (1+i) . h(I)dI$$

and the condition for optimality is

$$k-i = -C_K$$

According to Baltensperger, the optimal demand for equity capital and deposits is determined by the opportunity cost of equity funds (k), the interest rate on deposits (i), the penalty cost per dollar of deficiency (P), and the density function h(I).

This liability model is a close complement to the Orr and Mellon model. Like that model, it analyzes the effects of uncertainty on a certain banking decision. It deals with different variables and different decisions, but in a remarkably similar way. In particular, from the point of view of the present study, Baltensperger's liability model disregards resource costs and is ill-suited to deal with such costs. Like the Orr and Mellon model, its expansion to deal with resource costs would change it in an essential way. In short, Baltensperger's liability model (and the other liability-management models, of which it is a representative type) is not designed to help with the present inquiry.

Risk Aversion Models

A number of models approach the theory of the banking firm by applying the general theory of portfolio behavior under the assumption of subjective risk aversion. These models treat the banking firm as a collection of financial assets (liabilities are "negative assets") with stochastic and exogenous rates of return.

The authors of these models suggest that consideration must be given to both the expected yield and the risk (variance) of the portfolio. In other words, they advocate that the portfolio should be constructed by taking actions that maximize the expected return and minimize the variability of this return. This formula provides a trade-off between the advantages of higher returns and disadvantages of greater variability of these returns. By this criterion a bank should select the portfolio whose expected return and variability have the highest utility, or the portfolio from among all possible portfolios for which the bank has the highest preference. Examples are found in Pierce (1967), Parkin (1970), Pyle (1971), and Hart and Jaffee (1974).

The most basic of these models is that of Pyle (1971). Pyle considers an intermediary that has a choice among three securities: a riskless security and two securities with an uncertain yield over the decision period. The two risky securities will be referred to as loans and deposits. All securities can be held in positive or negative amounts. Pyle's analysis focuses on the conditions under which a firm would be willing to sell deposits in order to buy loans. Denote the amounts of the three securities as G, L, and D, with $G+L+D=0$, and g, r, and i the corresponding yields per decision period. While g is certain, r and i are random variables with given means and (joint) distribution.

The profit of the firm for the decision period is:

$$\Pi = g.G + r.L + i.D = L.(r-g) + D.(i-g)$$

Let the firm's objective function be F(L,D) which for the assumed expected utility maximization is given by:

$$F(L,D) = E[U(\Pi)]$$

The first derivatives of F with respect to L and D are

$$F_L(L,D) = E[U'(\Pi)\ (r-g)]$$

$$F_D(L,D) = E[U'(\Pi)\ (i-g)]$$

With $U(\Pi)$ or F(L,D) a strictly concave function, Pyle showed that if the expected marginal utility of loans evaluated at L=0 is positive for all non-positive D and the expected marginal utility of deposits evaluated at D = 0 is negative for all non-negative L, the optimum for $U(\Pi)$, if it exists, will imply intermediation (i.e., a positive loan position and a negative deposit position).

The most interesting characteristic of Pyle's model is its ability to explain (under the assumed conditions) the existence of financial intermediation is a rigorous manner. This is no mean accomplishment. However, the model does not deal with resource costs and does not seem equipped to do so.

Imperfect Market Models

Another class of banking-firm models focuses on monopoly power. These models determine bank scale and portfolio via net revenue maximization along market determined demand functions by the public for bank products. This class includes the model by Klein (1971) and Monti (1972).

Klein's model gives much insight into bank behavior. The key characteristic of Klein's model is that it emphasizes the structure of the

financial markets in which the bank operates. The essence of the Klein model can be summarized as follows.

The main purpose of the model is to determine the optimal structure of assets and liabilities (apart from the exogenous capital equity) and the total size of the bank. The bank is assumed to maximize expected profit.

The bank can select among three assets: cash reserve (C), homogenous government securities (G) and private securities or loans (L). The liabilities of bank are composed of demand deposits (D_1), time deposits (D_2) and equity capital (W).

The model's major assumptions are the downward-sloping demand curve for loan funds ($r_L=r_L(L)$, $r_L' < 0$, r_L = interest rate on L), the upward-sloping supply curves of deposits ($r_1=r_1(D_1)$, $r_1' > 0$, r_1 = interest rate on demand deposits, $r_2=r_2(D_2)$, $r_2' > 0$, r_2 = interest rate on time deposits), the perfectly elastic supply of government securities ($r_G \neq r_G(G)$, $r_G'=0$, r_G = rate of return on government securities), risk-neutrality on the part of the bank's shareholders (i.e., the stockholders are willing to accept a return on loans as low as the government securities rate, even though loans are risky), and a single decision period.

The bank's demand for cash reserves is determined by using an inventory management approach with stochastic flow of deposits as summarized in the section of asset management models. The reserve flow distribution is assumed to be a fixed distribution, independent of the composition of deposits, and homogenous of degree one in total assets. It implies that total cash reserve holding (C) and the expected cost on cash or liquidity management (C_c) are linear homogenous to total portfolio size and completely independent of deposit mix.

Given the essence of Klein's approach, the way in which the model works is clear. Since the rate of return on government securities (r_G) is exogenous, it follows that the bank will extend loans until the marginal revenue is equal to the exogenous rate: $r_L+L.r'_L = r_G$. This determines the bank's supply of loans. In addition, the bank will sell both demand and time deposits until the corresponding marginal expenditure is equal to the adjusted rate on government securities (nr_G, nr_G is equal to the rate paid on government securities after adjusting for the marginal cost of liquidity management): $r_1+D_1r'_1 = r_2+D_2.r'_2 = nr_G$. This determines the level of D_1 and D_2 or, expressed alternatively, the rates of r_1 and r_2. These levels, combined with the exogenous equity capital (W), determine total portfolio size. As mentioned above, cash reserves (C) are determined as a given portion of total portfolio (the size of this proportion depends on the rate on government securities, the parameters of reserve flow distribution, and the penalty cost per dollar of cash deficiency). This determines total earning assets and thus the bank's demand for government securities since the amount of loans (L) has been already determined.

An important result from Klein's model is that the optimal asset choice is independent of the optimal liability choice. In other words, the optimal loan policy of the bank is independent of the rate paid on deposits. This result has been questioned by Pringle (1973) and Baltensperger (1980) but supported by Langohr (1982).

The above summary of Klein's model has been slightly modified for easy presentation. The model shown here differs in one point from the original model. Klein actually made the interest rate on loans (r_L) depend on the share of loans in the total portfolio, not on the total volume of loans. For more details on the original one, consult Klein (1971).

Klein's model is very useful for analyzing problem in which resource cost can be disregarded. It is not so useful for problems in which such costs are important. Consider, for example, a bank that is debating whether to expand its lending activities. In comparing the incremental costs and revenues from expansion, the bank could not really concentrate exclusively on the financial variables emphasized in the model. The expansion might require non-negligible additions to the commercial lending staff and increased expenditures on credit investigations and the like. If these additional resource costs were proportional to the amount lent, they could be subtracted from the interest income and the analysis would proceed as Klein's model suggests. (The only difference would be the interpretation of r_L, which would now be the net revenue per dollar of loans.) The problem is that resource costs are not proportional to the amount lent. For one thing, many loan applications are rejected after investigation, and the investigation is not free; for another, the cost of investigating loan applications is largely independent of the amount of loan sought. Klein's model is a useful starting point for analyzing these matters but it requires considerable elaboration.

The other models of this category, too, have the same kind of problem with respect to resource costs as mentioned above.

Real Resource Models

There are also models that view the real resource aspects as a key element for understanding the behavior of banking firms. These models represent pure production cost models of banking. In other words, they explain the size and structure of bank assets and liabilities purely in

terms of the flows of real resource costs of generating and maintaining these assets and liabilities. Such models have been presented by Pesek (1970), Stillson (1974), Towey (1974), Adar, Agmon and Orgler (1975), Saving (1977), and Sealey and Lindley (1977). The latter will be reviewed in the following paragraphs.

The purpose of the Sealey and Lindley study is to develop a model within which the role of product and cost of financial firms can be analyzed. Sealey and Lindley define the output of the bank as its assets. They do not count the services provided to the depositors as output but as an input used to produce their output defined above.

The major defect of the Sealey and Lindley model is the way they specify their production function. Sealey and Lindley constructed their production function for the financial firm in the following manner.

They began, innocently enough, with the following balance sheet constraint:

$$R+\sum_u L_u + \sum_f G_f \leq \sum_i D_i \quad u=1,\ldots,m;\ f=1,\ldots,n;\ i=1,\ldots,p \tag{1}$$

where

R = required reserve

L_u = loan type u, $=1,\ldots,m$

G_f = securities type f, $f=1,\ldots,n$

D_i = deposits type i, $i=1,\ldots,p$

Given this balance sheet, "output" is constrained by the relation:

$$\sum_u L_u + \sum_f G_f \leq \sum_i (1-d_i)\, D_i \tag{2}$$

where

d_i = the legal reserve ratio on the i^{th} type of deposits.

Sealey and Lindley then assumed the production of deposit services to the ith type of deposits is related to the quantity of deposits by the following production function.

$$D_i = D_i\ (I_y^i) \qquad y = 1,\ldots,t \tag{3}$$

where

I_y^i = the yth variable input used to service the ith type of deposits.

The production of earning assets "output" requires not only loanable funds but other inputs such as capital, labors, etc. These inputs complement loanable funds in producing the earning assets of the financial firm. The services associated directly with the uth and fth types of loans and securities, respectively, are produced according to the following "production function":

$$L_u = L_u\ (I_y^u) \tag{4}$$

where

I_y^u = the yth variable inputs used to directly process the uth type of loans.

$$G_f = G_f(I_y^f) \tag{5}$$

where

I_y^f = the yth variable inputs used to directly process the fth type of securities.

Consequently, the production function of the financial firm is further constrained by:

$$\sum_u I_u + \sum_f G_f = \sum_u L_u\ (I_y^u) + \sum_f G_f(I_y^f) \tag{6}$$

Sealey and Lindley then made the appropriate substitutions with equations (2), (3), and (6) finally expressing the production function for the financial firm as:

$$\sum_u L_u + \sum_f G_f = \min \left[\sum_i (1-d_i) D_i(I_y^i); \sum_u L_u (I_y^u) + \sum_f G (I_y^f) \right] \qquad (7)$$

where min [ ] indicates that the production function is a minimal form function (i.e., total output is restricted by the minimum value of the two constraints (2) and (6).)

Sealey and Lindley do not apply their model to any empirical problem but they claim that it provides the proper framework for such applications--especially to problems in which resource costs figure in an essential way. Their model appears, however, to be virtually useless in such applications. Its main weakness is obvious: resoure costs are not functions of the "output". As mentioned above in connection with the Klein model, resource costs due to lending activities are not proportional to the amount lent; they vary with loan-evaluation activities, which depend on the number of loan applications received and other variables, but not on balance-sheet items. Thus Sealey and Lindley have defined "outputs" in a manner which precludes the derivation of cost functions.

For all models in this class (real resource models), another weakness is in their complete neglect of liquidity and solvency aspects of banking activities.

Outline of the Approach Using in This Study

The existing approaches in modeling banking activities do not contain a satisfactory model that explicitly combines the resource and financial aspects with equal priority. This study intends to construct such a model.

This study focuses on banking activities that use resources intensively and limits consideration to the main such activities, one on each side

of a bank's balance sheet: commercial lending function and demand deposits function. This study will develop the commercial loan revenue-expense model and build the demand deposit cost-revenue model by using Osborne's (1982) approach. The latter model will be the application of Osborne's deposit model. Finally, this study will integrate the two models and show that the combined model can be used to model the bank's decisions.

CHAPTER II

MODEL OF COMMERCIAL LENDING ACTIVITIES

Introduction

The commercial loan function has traditionally been the key profit center for commercial banks. Making commercial loans is also one of the most important services that banking renders to the business community.

As the name implies, the commercial loan is a loan to commercial or business enterprises. In terms of purpose and payment, commercial loans range from short-term, self-liquidating loans to finance the manufacture, storage, or shipment of commodities, through loans to supply working capital for varying periods, to long-term loans to acquire capital assets.

Commercial lending activities had been a subject of study by many authors such as Anderson and Burger (1969), Barro (1976), Baughn and Walker (1966), Brick (1980), Cohen and Hammers (1966), Corns (1967), Jaffee (1971), Long and Reich (1970), Orgler (1975), Pace and Simonson (1977), Robert Morris Associates (1978), Raussakis (1977), Sherod (1981), Sihler (1981), Smith (1972), Wood (1975), and Work (1967). By utilizing the knowledge from their works, this study presents an analysis of the commercial lending activities by, first, dividing the activities into two processes: the loan-portfolio planning and control process, and the loan evaluation process. These two processes are then analyzed before

a model is built to integrate the financial and resource aspects.

Loan Portfolio Planning and Control Process

The purpose of loan portfolio planning is to provide guidance to loan officers so that the bank's loan portfolio will be profitable and reasonably liquid while not over-commiting the bank's funds. The process may be said to begin once bank management has provided the policies and indicated the goals that commercial lending is expected to achieve. Given this information, the senior executive responsible for the commercial loan portfolio can begin to develop a plan.

In developing the plan, the executive must consider a number of factors. He must assess the present status of the commercial loan portfolio and attempt to forecast changes in the uncontrollable factors affecting commercial loans. Then he must devise a plan for influencing the controllable factors so the bank's commercial loan goals are attained. The primary inputs for the loan portfolio planning and control process are shown in Figure 3.

Fundamentally, planning for the commercial loan function requires balancing expected loan demand against expected loanable funds while achieving overall profit objectives. This is done by changing controllable factors such as loan policy and programmed expenditures for marketing and other business development purposes. A number of complicating factors must be considered in this process.

At the outset of the planning period, the loan portfolio consists of loans with a considerable range of maturities. Many loans will mature during the next period but others may remain in force into subsequent periods. Until a loan matures, the funds will be earning at

STATUS INFORMATION

- Present Status of the Bank
- Past Performance of the Bank

UNCONTROLLABLE FACTORS

- Economic and Market Forecast
- Regulation

CONTROLLABLE FACTORS

- Desired Commercial Loan Objectives
- Overall Bank Policies
- Planned Resources to be Provided

Figure 3. Primary Information Inputs for the Loan Portfolio Planning and Control Activities

the rate specified in the loan agreement. In periods of rising interest rates this means that generally there will be a lag in the average return on the portfolio as compared to the current structure of interest rates. The distribution of loan maturities (and the number of the potential loans) will govern the bank's ability to channel funds into higher rate loans or renew loans at the higher rates.

An important factor influencing expected loan demand is the extent of unused loan commitments. Commitments may take the form of credit lines or revolving loan agreements and generally represent a guaranty by the bank to lend funds up to the limit of the commitment. This guaranty may be quite formal where the customer has paid a fee or maintained a deposit balance to pay for the assurance that funds will be available. But even when the customer does not have such a formal agreement for a line of credit, the bank will feel a distinct obligation to meet its commitment in order to retain a desirable account. In any event, analyzing the status of unused commitments is an important element in forecasting loan demand -- particularly during periods of tight money. Similarly, a review of commitments and their expiration dates will provide some insight into the opportunity to reduce potential loan demand by reducing or eliminating commitments at the time of their expiration.

Another element to be considered is customer credit that is not covered by commitments but that represents the recurring financing needs of customers. These needs must be forecast, possibly by analyzing the historical borrowing patterns of those customers not already represented in the portfolio or having unused commitments. This forecast requires the use of internal data, but the executive must temper his

estimates by considering the external environment. The general levels of economic activity and interest rates will affect customer demand for loans in excess of normal credit needs. The banker's knowledge of the relationship between the economic environment and customer credit needs will help in the forecast of overall loan demand.

After obtaining a forecast, the senior commercial loan executive must consider the funds available for lending -- particularly the deposits of commercial customers. While commercial demand deposits may be relatively stable, time deposits are a volatile source of funds. For the larger bank the supply is highly elastic when interest rates are generally below the limits imposed by Regulation Q (Regulation Q is in the fade out process), but time deposits are subject to rapid run-off when money market rates exceed those that banks can offer. Depending on the circumstances, certificates of deposit may yield an additional source of funds.

Given the expectations for loan demand, the supply of funds, and the general level of interest rates, the senior commercial loan officer can determine what modifications of current loan policy may be necessary to balance loan demand with funds supply in order to achieve the desired profit objectives. Given these policies, the commercial loan function's profit contribution can be estimated. The estimate can then be compared to management's goal, and the acceptability of the overall plan can be judged. If it is unacceptable, it may be reexamined to determine whether loan policy decisions can be modified or whether the ground rules for the plan require modification. These ground rules would include the resources provided, overall bank policies and the original objective for the commercial banking function. Once an acceptable overall plan

is developed, the forecasts and expected policies can be used to guide loan officers.

The activities of commercial loan executive in the loan portfolio planning and control process with corresponding information needs can be summarized as shown in Figures 4 and 5.

Loan Evaluation Process

The loan evaluation process is generally handled by an heuristic procedure. The stages associated with a business loan relationship, such as formal application, periodic review, subsequent application for another loan, etc., require banks to make choices before all alternatives known. In other words, a loan officer has to choose the best alternative which has been found after a limited search.

There are many ways to describe the loan evaluation process and to divide it into a number of activities. By integrating and modifying the works of authors such as Baughn and Walker (1966), Brick (1980), Cohen and Hammers (1966), Corns (1967), Crosse and Hempel (1980), Long and Reich (1970), Pace and Simonson (1977), Robert Morris Associates (1978), Sherrod (1981), Smart and Morton (1983), and Work (1967), this study analyzes the loan evaluation process by dividing it into nine activities and then discusses each activity in detail. The nine activities are as follows:

1. consider the customer characteristics,
2. conduct the initial loan interview,
3. perform a credit investigation,
4. check on legal and policy restrictions,

PLANNING ACTIVITIES	PLANNING INFORMATION NEEDED
Formulate overall objectives and program for commercial loan function	Overall bank objectives and policies
Establish loan policy	Economic and market forecasts relating to level of interest rates, supply of deposits, and demand for loans
Plan for utilization of funds, personal, and other resources required	Evaluation of the effect of changes in loan policies on portfolio size, profit, risk, liquidity, and composition, plus the effect of customer relationships
Assign goals to loan officers	Regulatory limitations
	Market potential based upon customers and prospects in marketing territory
	Operating resource available: personnel, equipment, supplies, etc.
	Supporting marketing program

Figure 4. Loan Portfolio Planning Activities and Planning Information Needed

CONTROL ACTIVITIES	CONTROL INFORMATION NEEDED
Monitor portfolio performance against plan	Profitability of commercial banking function in relation to profit plan with reporting of sources of variances
Ensure that loan policies are being followed	Result from portfolio analyzing with respect to rate, risk, liquidity and composition
Monitor loan officer performance against goals	Notification of new loans made which deviate from loan policy
Review loan officer workload	Periodic report of loan officer performance against goals with exception reporting of significant accounts deviating substantially from profit objectives
Determine if loan policy requires modification due to changes in underlying conditions	Periodic summary of loan officer workload

Figure 5. Loan Portfolio Control Activities and Control Information Needed

5. conduct a field investigation,
6. appraise the loan characteristics,
7. recommend loan terms,
8. prepare the loan documentation, and
9. follow up and review.

Customer Characteristics

Major customer characteristics refer to the status of the customer (whether the firm is an established customer or a new customer), the current and potential values of the total customer relationship, the location of the business (local or non-local customer), type of business, etc.

If the applicant for a business loan has been a customer of the bank, its general reputation as a customer of the bank is considered. This is a comprehensive evaluation which depends partly on the bank's experience with the firm on previous loans, partly on the history of the firm's deposit balance in the bank, and partly on the bank's past experience with the firm in other ways.

If the loan applicant is not currently a customer of the bank, the loan officer has to answer at least two questions in forming his recommendation. (1) Is this firm a sound credit risk? Whether a potential new bank customer is a sound credit risk depends on the same factors which determines whether a present bank customer is a sound credit risk. (The details of credit risk evaluation can be found in Sihler (1981)). (2) Will this firm become a regular bank customer? In answering this question, the loan officer must determine the average size of the account which he feels can be obtained from this new customer over a long term

period (e.g., the length of time expected between periods of tight money or credit cycle) for four different types of relationships: deposit accounts, trust funds, employee trade accounts, and other bank business. Furthermore, it is reasonable to expect that a firm maintaining a relationship with a bank for an entire credit cycle will continue to be a regular customer as long as the bank adequately meets its credit needs.

Initial Loan Interview

The main objective of the initial loan interview is to obtain all the data necessary for the bank to reach a loan decision since information from commercial loan applications at most banks is usually not adequate for an intensive loan evaluation.

In commercial lending, problem loan collection is indirectly dependent on information obtained during the initial loan interview, since the loan is structured, secured, and guaranteed based on data and understandings generated through loan interviews. Successful collection, therefore, will also depend on the factors just mentioned.

For more details on the initial loan interview, consult Pace and Simonson (1977) or Robert Morris Associates (1978).

Credit Investigation

The primary purpose of the credit investigation is to determine the business reputation and responsibility of the firm involved. Does it have a history of paying as agreed? Is it experienced in its business? Are its managers good? What is their professional reputation among their bankers, customers, suppliers, and competitors? Prompt and

complete repayment of the loan with the interest depends, to a large extent, on the honesty and managerial ability of the borrowers. Whether they possess these qualities is one of the things determined through the credit investigation.

A thorough credit investigation should take into account not only the applicant's situation, but the economic, industry, and competitive situations as well. Coupled with an analysis of the applicant's financial condition, a credit investigation will help determine the business loan applicant's ability and willingness to repay debt. If outside support, such as guarantees are involved, the credit worthiness of the guarantees should also be checked. With each loan request, the loan officer must consider all relevant information before reaching a final decision.

The amount of information to be collected during the investigation depends on a number of factors including: how well the applicant is known to the bank; how much information, which must be verified, was obtained during the loan interview; the size and complexity of the loan; the borrower's financial strength; the value and liquidity of the collateral; the amount of information presently in the bank's credit files; and the risks perceived by the loan officer.

The source of information available for a credit investigation may be classified as internal or external. Internal sources refer to information that is readily available within the bank such as account history (current or previous borrowing and rating, checking account, and other deposit balances and histories), credit files (summary of the firm's relationship within the bank, and previously gathered information on the

borrower). External sources refer to information available outside of the bank; for instance, agencies (Dun and Bradstreet, Credit Bureaus), other banks and financial institutions, references provided by the borrower, public records, and etc.

An evaluation of a firm's credit-worthiness in relation to a particular loan application can be done by determining the firm's credit rating (or risk rating) according to the bank's rating scale. Most of the banks' overall credit rating scales are arbitrary scales and derived from four subsidiary factors: (1) a rating of management competence, (2) an outside credit rating (3) a rating based on the results of the bank's financial analysis, and (4) the firm's special features. (Another good technique to determine the risk rating can be found in the study by Sherrod (1981).)

Legal and Policy Restrictions

The loan officer checks every loan application against some gross legal and policy requirements, looking for highly unusual items that may require nonroutine attention. This check may also indicate that some loan applications are infeasible.

At the start of this activity, the amount of the proposal loan is checked against the bank's legal loan limit, which is established by bank regulatory authorities. If the proposed loan amount is more than the bank's legal limit, then the proposed loan requires the participation of one or more additional banks.

The loan officer then computes the ratio of the amount of the proposed loan to the firm's total assets and checks to see if the ratio exceeds an upper bound parameter. This parameter is a cutoff

point which determines when a loan is unreasonably large in relation to the size of the firm. The exact value of this cutoff point will vary depending on the particular industry the firm is in. Any loan application for which the ratio exceeds the upper bound parameter will be classified as infeasible.

For commercial term loans, the loan officer investigates whether the proposed maturity exceeds the bank's upper limit. In most banks, the maximum maturity of term loans is a policy variable which changes during the course of a credit cycle. Most banks are willing to make longer maturing term loans during periods of easy money than during periods of tight money. If the proposed maturity on a term loan application exceeds the bank's present upper limit, the loan officer regards the application as infeasible.

In practice, loan applications labled as "infeasible" at this or a later stage of processing will become special cases. In this event, the loan officer will carefully investigate to see if there are special circumstances which justify modifications in the bank's normal policies for these particular cases.

Field Investigation

Since the field investigation can be a valuable tool for the loan officer in getting vital information, available by no other means, the loan officer should consider the cost and benefit of a visit to the firm. Then a well-planned firm visit should be made, if he decides to have the field investigation.

In the event of a company visit, meetings are held with the key individuals of the organization. The visit is an excellent time to

review the company's activities such as production, accounting, marketing and finance, research and development.

Loan Characteristics

The loan officer analyzes the answers to the following questions: (1) For what purpose will the loan funds be used by the firm? (2) What is the proposed amount of the loan? (3) What is the source of loan repayment? (4) What is the expected actual maturity and the repayment schedule? (5) Is there a backup source of repayment?

It is important for the bank to know the purpose for which the loan is requested to ascertain that the indicated reason will be acceptable to the bank examining authorities. Though business loans are most often for working capital purposes, they may be used for any of several purposes including investment in short-term asset items and reduction of short-term liabilities. A close analysis of several recent interim financial statements will usually determine the true purpose of a working capital loan request.

If the proceeds are to be used to purchase fixed assets, the firm's need for the fixed assets should be investigated. In other words, the asset should be clearly appropriate to the business. A firm may wish to request a loan for speculative purposes. (A loan is speculative when the source of repayment comes from the future sale of the asset at a profit. If the speculative resale does not occur, the loan is in trouble). If the loan officer has found that the loan's real purpose is speculative in nature, he will probably refuse the loan.

After checking the proposed amount of loan against legal and policy restrictions, the loan officer still has to decide whether the proposed amount is reasonable.

Although the proceeds of the loan may be used appropriately, the loan might not be made unless the primary source of repayment is reasonably certain. There are only four possible sources of repayment: cash flow, sale of assets, outside capital injection, and borrowing elsewhere.

Cash flow is the after-tax profits retained in the business plus all non-cash expenses such as depreciation or depletion. By far the most favored source of loan repayment is future positive cash flow arising from operations. This cash flow should be sufficient to service the loan and allow the business to continue normally profitable operation; if not, the loan may not have an adequate source of repayment.

Seldom is it prudent to rely upon the future sale of a fixed asset to repay a loan. The loan request itself is firm evidence that the borrower is unwilling or unable to sell the asset at this time. Frequently, the loan applicant is speculating on a windfall profit, and when this profit does not materialize, the bank is left with a problem loan.

Nor is it wise to depend upon a future injection of capital as the primary source of loan repayment. If the business is profitable, capital will be accessible along with the profits which are the source of repayment. If the business is unprofitable, new investor capital probably will not materialize.

A loan request must be carefully scrutinized if the loan is to be repaid from another bank's loan proceeds. Why does not the customer borrow from that bank originally? Where does the bank stand if the other bank refuses the loan when the time comes?

To appraise the proposed maturity and repayment schedule, the loan officer performs an analysis of the loan applicant's ability to repay. The analysis could begin with a general forecast for the industry based on expected trends in the overall economy. The results would be stated in terms of expected percentage changes in factors such as sales and profits. This would provide a benchmark for comparison with percentage changes forecast by the loan applicant. Significant deviations between the borrower's own forecast and the forecast for the industry should be reconciled. Next, the performance of the firm relative to the industry can be examined. Specific criteria might include rate of growth, return on investment and cash flow.

Given a forecast for the firm's performance, the loan officer's next step is to predict cash flow for the firm. This information enables him to study the timing and amounts of the firm's financing needs and to determine the potential schedule for loan repayment.

Reliable backup or secondary sources of repayment are needed to prevent loan loss should the cash flow not materialize. If the venture being financed by the loan fails and the customer is financially strong, the bank probably can depend on the customer to liquidate other assets and repay the loan. Under these circumstances, an unsecured loan may be appropriate. Unsecured lending is appropriate for established, financially strong customers who have the capacity to repay even if the venture being financed is unsuccessful. All other customers should be required to secure their loans. Collateral is always a secondary source of repayment. The process of foreclosing on collateral is time-consuming, expensive, and creates much ill will. No matter how valuable the

collateral, its future sale is never the primary loan repayment source. On the other hand, collateral is usually the best secondary source of repayment, and the more collateral, the better. Collateral must cover interest during foreclosure, legal costs, and reduced price due to forced sale conditions. If the loan is well collateralized, the borrower will most likely liquidate the collateral, pay the loan, and retain the difference. If the loan is poorly collateralized the bank itself probably will be forced to liquidate the collateral at a value somewhat less than the loan amount and interest due.

Guarantors and co-makers are other secondary sources of repayment. A guarantor almost never volunteers to pay a loan at maturity. Collecting on a guaranty frequently requires litigation, which is expensive and time-consuming and results in much ill will between the borrower, the bank, and the guarantor.

After getting through the appraised activity, some loan applications may be classified as infeasible buisness loans, if their characteristics are not up to the bank's standards which specify in the loan policy.

Loan Terms

The entry of a loan application into this activity indicates that a preliminary recommendation to grant the loan has been made. The details of the proposed loan agreement must be developed on the basis of the earlier analyses. The result of this activity is a complete description of the loan arrangement and specifies what the loan applicant and bank will do. Included in the description will be such items as:

1. amount of loan and schedule of advances, if not drawn down at the time the agreement was made,
2. interest rate, other fees, and provisions for rate changes,

3. schedule of interest and principal payments,
4. collateral to be provided and the value required in relation to the loan and any other form of security provided by a third party,
5. compensating balance requirements,
6. penalties for failure to comply with terms, and
7. other features (e.g. dividend payment restriction).

The interest rate and compensating balance requirements are the major items in pricing the loan. The prime rate (i.e., the interest rate charged by large banks for business loans to their most credit worthy customer) and the interest rate differential (i.e., the incremental to be added to the prime rate) comprise the interest rate of all loans except the prime loans. The bank management, not the loan officer, sets the prime rate. Three broad categories of market rates provided major input into the prime-setting decision: (1) the rates on nonloan bank assets, (2) the rates on bank-acquired liabilities, and (3) the rates on corporate debt claims issued in lieu of bank borrowing. Because bank loan contracts remain in effect until the specific future dates, banker's expectations concerning the future course of market rates are more important than the current rates. Other important considerations are expected growth in depostis and expected loan demand. The loan officer, however, determines the interest rate differential which depends on the credit rating of the firm, the maturity of the loan, the extent to which it is fully secured, and etc. Compensating balance requirements (i.e., the minimum average demand deposit account balances that bank customers agree to maintain as partial renumeration for an array of bank services) might serve as means of raising effective loan

rates. Nominal loan rates are quoted in terms of the dollar sizes, or principal, of the loan. If a borrower uses part of the loan proceeds to meet compensating balance requirements, the effective loan rate on the funds actually available for the borrower's use will exceed the stated rate because the borrower is paying loan interest on funds committed to remain in his deposit account. Often, however, the compensating balance requirement can be met by the customer's normal working balance, so that it does not actually raise his cost.

At this stage of the loan evaluation process, recommendations are also made concerning the degree of follow-up and review required by the loans. In general, the degree of follow-up and review that the banks perform on loans to business firms seems to be determined by the following factors: the overall credit rating of the firm; the amount of loan relative to the bank's legal loan limit; the amount of loan relative to the firm's total assets; the extent to which the industry has exhibited growth and stability in earnings; and the extent to which forecasts made by the firm and other firms in the same industry have proved to be reliable. These factors will determine the proper review period (i.e., monthly, quarterly, annually) for any commercial loan.

After all the detail mentioned above has been specified, the loan officer will scrutinize them before reaching his final decision.

Loan Documentation

When the bank decides to grant the commercial loan, it establishes a legal contractual relationship with the loan applicant. The basic terms of the contract are these: the bank grants the loan applicant use of its funds for a specific period of time; the loan applicant

agrees to repay the money with interest on the specific date; and, in the case of a secured loan, the loan applicant promises to allow the bank to sell some of his assets and apply the funds received to the loan if he is unable to repay the money as originally agreed. The loan documentation, which the loan officer must prepare, refers to the writing of such a contract as just described so that the loan provisions are legally enforceable in substantially the same terms and conditions as originally agreed upon.

Documentation need not be difficult. In the case of a secured loan, it usually starts with a note and then proceeds to either a mortgage for real property collateral or to a pledge agreement or a general security agreement for personal property. Behind the note, mortgages and pledge agreements stand alone, but a simple security agreement does not. In the latter case, financing statements or title liens must always be filed. When the required filing of security agreements, financing statements or mortgages is undertaken, the loan officer can never be sure of its security position without a public records search.

Follow Up and Review

The follow up and review activity is essential in determining and maintaining several key items of information used to spot unfavorable trends which may require action on the outstanding loan and in processing subsequent application. The key items of information include: payment performance, quality of forecasts, and the average deposit level of the firm. Periodically, the demand deposit data should be analyzed to ensure that the compensating balance requirement is met. Also, the collateral should be periodically valued and compared to the requirements

of the loan agreement. The loan's recommended review period (monthly, quarterly, annually) which has been determined in the recommended loan terms stage is used as the tentative schedule for the loan officer in the follow up and review activity.

Commercial Loan Revenue - Expense Model

Based on the processes of loan-portfolio planning and control and the loan evaluation, the loan revenue-expense model can be constructed as follows:

Loan Revenue-Expense Function (LRE) =

Loan Interest Revenue (IR)

+ Loan Noninterest Revenue (NR)

- Loan Portfolio Planning and Control Expense (PE)

- Loan Evaluation Expense (EE)

- Loan Loss (LL)

where

$$IR = \sum_{u=1}^{aM} r_u \cdot m_u$$

$$NR = \sum_{u=1}^{aM} (nf_{1u} + nf_{2u})$$

$$PE = \sum_{v=1}^{V} PE_v [W, R, P, EI_v, KI_v, MI_v]$$

$$= \sum_{v=1}^{V} (W \cdot EI_v + R \cdot KI_v + P \cdot MI_v)$$

$$EE = \sum_{y=1}^{Y} \sum_{z=1}^{M} EE_{yz} [W, R, P, EI_{yz}, KI_{yz}, MI_{yz}]$$

$$= \sum_{y=1}^{Y} \sum_{z=1}^{M} (W \cdot EI_{yz} + R \cdot KI_{yz} + P \cdot MI_{yz})$$

$$LL = s \cdot \sum_{u=1}^{aM} m_u$$

IR = loan interest revenue in dollars

a = accepted portion of potential loan contracts or accepted rate

M = number of potential loan contracts

aM = number of realized loan contracts

r_u = interest rate charged on loan contract u (u=1,...,aM), in percentage

m_u = amount of loan on loan contract u (u=1,...,aM), in dollars

NR = loan noninterest revenue, in dollars

nf_{1u} = fee charge on loan contract u (u=1,...,aM), in dollars

nf_{2u} = other noninterest revenues, excluding fee, generated from loan contract u (u=1, ..., aM), in dollars

PE = loan portfolio planning and control expense, in dollars

PE_v = portfolio expense for activity v (v=1,...,V) in dollars

V = number of activities in loan portfolio planning and control process

W = row vector of wage rates, dollars per unit of time (These rates include fringe benefits and taxes.)

R = row vector of rental rates on capital (i.e., office spaces, rented computer, and etc.) in dollars per unit of utilization

P = row vector of material prices (These materials include office supplies, subscription fee of publication used in planning, and etc.) in dollars per unit of material

EI_v = column vector of employee inputs for activity v (v=1,...,V), (some activities perform by more than one employee), unit in time unit (i.e., hour, fraction of hour, etc.)

KI_v = column vector of capital inputs for activity v (v=1, ..., V), unit depends on type of capital input (i.e., unit in time unit for the computer use)

MI_v = column vector of material inputs for activity v (v=1,...,V), unit depends on type of material input

EE = loan evaluation expense, in dollars

Y = number of activities in loan evaluation process

M = number of potential loan contracts

EE_{yz} = loan evaluation expense for activity y (y=1,...,Y) on the potential loan contract z (z=1,...,M), in dollars

EI_{yz} = column vector of employee inputs for activity y (y=1, ..., Y) on the potential loan contract z(z=1, ..., aM), unit in time

KI_{yz} = column vector of capital inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., aM), unit depends on type of capital input

MI_{yz} = column vector of material inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), unit depends on type of material input

LL = amount of loan loss, in dollars

s = portion of loan which is expected to default or loan loss rate, in percentage

$\sum_{u=1}^{aM} m_u$ = total amount of loans (L), in dollars

So, the loan revenue-expense function can be presented in the mathematical form as follows:

$$LRE = \sum_{u=1}^{aM} r_u \cdot m_u + \sum_{u=1}^{aM} (nf_{1u} + nf_{2u}) - \sum_{v=1}^{V} (W \cdot EI_v + R \cdot KI_v + P \cdot MI_v) - \sum_{y=1}^{Y} \sum_{z=1}^{M} (W \cdot EI_{yz} + R \cdot KI_{yz} + P \cdot MI_{yz}) - s \sum_{u=1}^{aM} m_u$$

The following paragraphs state important issues that must be clarified before any detailed presentation can be made for the components of the commercial loan revenue-expense model.

Each potential loan contract has either positive value or zero value on every activity expense of the loan evaluation process; for example, it would have all positive value, if it must be processed through all activities.

Any outstanding loan contract which has maturity dated beyond the beginning of the period under consideration could be treated as a potential loan contract with the implicit condition that it finally must be one of the realized loan contracts for the period under consideration.

Although most banks do not hire employees in the commercial loan department on hourly basis, the employee service expense which is the result of multiplying the row vector of wage rates by the column vector of employee inputs could be justified by the following reasons:

a) The bank can assign employees of the commercial loan department to other tasks in their idle periods.

b) The bank can temporarily assign employees from other departments to perform the task in the commercial loan department when the commercial loan department has temporarily shortage employees but no need to hire new permanent ones.

Loan Interest Revenue

$$IR = \sum_{u=1}^{aM} r_u \cdot m_u$$

The loan interest revenue (IR) is the sum of the interest revenues generated from each realized loan contract computed by multiplying the interest rate charge (r_u) by its corresponding amount of loan (m_u) on each contract (u, u=1,..., aM). The number of realized loan contracts

(aM) has shown in the form of multiplication of two variables: the number of potential loan contracts (M) and the acceptance rate (a).

Note that the detail of interest rate charged on the loan had already been discussed in the recommended loan terms section of the loan evaluation process.

Loan Noninterest Revenue

$$NR = \sum_{u=1}^{aM} (nf_{1u} + nf_{2u})$$

The loan noninterest revenue (NR) is the sum of the noninterest revenues generated from each realized loan contract (u, u=1,..., aM). For each realized loan contract, the noninterest revenue is composed of the fee charge (nf_{1u}, such as prepayment penalty) and the other non-interest revenue excluding fee (nf_{2u}, such as revenue from liquidating a collateral).

Loan Portfolio Planning and Control Expense

$$PE = \sum_{v=1}^{V} PE_v [W, R, P, EI_v, KI_v, MI_v]$$

$$= \sum_{v=1}^{V} (W \cdot EI_v + R \cdot KI_v + P \cdot MI_v)$$

The loan portfolio planning and control expense (PE) is the sum of expenses occured by performing each activity (PE_v, v=1,..., V) in the loan portfolio planning and control process. The subscript 'v' identifies each activity in the process, and the total number of activities (V) in the process may vary from bank to bank. In this study, the loan portfolio planning and control process is composed of two activities (V=2): the loan portfolio planning activity and the loan

portfolio control activity. This study has assigned the value of 'v' to each activity in the following manner.

The 'v' equals '1' for the loan portfolio planning activity which includes formulating overall objective and program for commercial loan function, forecasting the customer loan demand in light of economic forecast, forecasting the level of deposits generated from customers in light of economics, forecasting the change in mix of sources of funds thus affecting loanable funds, establishing the loan policy, assigning goals to loan officers, planning the utilization of resources (employees, capital assets, materials), anticipating regulatory changes, and etc.

The 'v' equal '2' for the loan portfolio control activity which includes monitoring the portfolio performance against plan, ensuring that loan policies are being followed, monitoring the performance of loan officer against goals, reviewing loan officer workload, determining if loan policy requires modification due to changes in underlying conditions, and others.

The expense of each activity is composed of three input expenses: the employee input expense (i.e., the expense due to hiring executives and officers for commercial loan function), the capital input expense (i.e., the computer expense, the office space expense), and the material input expense (i.e., the office supply expense, the subscription fee paid for subscribing publications used in planning). The various factors which may affect the size of each input expense have already been discussed in the loan portfolio planning and control process section. Multiplication of each input prices vector (W, R, P) by the vector of corresponding input requirements (EI_v, KI_v, MI_v) yields the input expenses; then, summation of each input expense yields the expense of each activity. The mathematical forms of this calculation are shown below.

$$PE_1 = PE_1 [W, R, P, EI_1, KI_1, MI_1] = W \cdot EI_1 + R \cdot KI_1 + P \cdot MI_1$$

$$PE_2 = PE_2 [W, R, P, EI_2, KI_2, MI_2] = W \cdot EI_2 + R \cdot KI_2 + P \cdot MI_2$$

where

PE_1 = portfolio expense for the loan portfolio planning activity, in dollars

PE_2 = portfolio expense for the loan portfolio control activity, in dollars

W = row vector of wage rates (include fringe benefits and taxes), dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

EI_1 = column vector of employee inputs for planning activity, unit in time unit

KI_1 = column vector of capital inputs for planning activity, unit depends on type of capital input

MI_1 = column vector of material inputs for planning activity, unit depends on type of material input

EI_2 = column vector of employee inputs for control activity, unit in time unit

KI_2 = column vector of capital inputs for control activity, unit depends on type of capital input

MI_2 = column vector of material inputs for control activity, unit depends on type of material input.

Loan Evaluation Expense

$$
\begin{aligned}
EE &= EE_1 + \ldots + EE_y + \ldots + EE_Y \\
&= \sum_{z=1}^{M} EE_{1z} + \ldots + \sum_{z=1}^{M} EE_{yz} + \ldots + \sum_{z=1}^{M} EE_{Yz} \\
&= \sum_{z=1}^{M} (W \cdot EI_{1z} + R \cdot KI_{1z} + P \cdot MI_{1z}) + \ldots + \sum_{z=1}^{M} (W \cdot EI_{yz} + R \cdot KI_{yz} \\
&\quad + P \cdot MI_{yz}) + \ldots + \sum_{z=1}^{M} (W \cdot EI_{Yz} + R \cdot KI_{Yz} + P \cdot MI_{Yz}) \\
&= \sum_{y=1}^{Y} \sum_{z=1}^{M} (W \cdot EI_{yz} + R \cdot KI_{yz} + P \cdot MI_{yz}) \\
&= \sum_{y=1}^{Y} \sum_{z=1}^{M} EE_{yz} [W, R, P, EI_{yz}, KI_{yz}, MI_{yz}]
\end{aligned}
$$

where

EE = loan evaluation expense, in dollars

EE_y = expense of activity y (y=1, ..., Y) of loan evaluation process, in dollars

Y = number of activities in loan evaluation process

M = number of potential loan contracts

EE_{yz} = loan evaluation expense for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), in dollars

W = row vector of wage rates (including fringe benefits and taxes), dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

EI_{yz} = column vector of employee inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), unit in time

KI_{yz} = column vector of capital inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), unit depends on type of capital input

MI_{yz} = column vector of material inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), unit depends on type of material input.

The loan evaluation expense (EE) is the sum of expense of each activity (EE_y, y=1, ..., Y) in the loan evaluation process. The subscript 'y' identifies each activity in the process and the total numbers of activity (Y) in the process may vary from bank to bank. In this study, the loan evaluation process is composed of nine activities (Y=9). The activity, its corresponding value of subscript 'y' and its corresponding expense terms are shown below:

Activity	Value of 'y'	Activity's Expense Term
Consider the customer characteristics	1	EE_1
Conduct the initial loan interview	2	EE_2
Perform the credit investigation	3	EE_3
Check on legal and policy restrictions	4	EE_4
Conduct the field investigation	5	EE_5
Appraise the loan characteristics	6	EE_6
Recommend loan terms	7	EE_7
Prepare the loan documentation	8	EE_8
Follow up and review	9	EE_9

Each activity expense (EE_y, y=1, ..., Y) is computed by the following method: First step, calculating the activity expense of each potential loan contract (EE_{yz}, z=1, ..., M) by multiplying the input prices vector (W, R, P) by the vector of corresponding input requirement (EI_{yz}, KI_{yz}, MI_{yz}); the result is the loan evaluation expense for activity y on the potential loan contract z, EE_{yz}. Second step, summing

the loan evaluation expense for activity y of each potential loan contract ($\sum_{z=1}^{M} EE_{yz}$), the result is the expense of activity y of loan evaluation process.

Note that the loan evaluation expense for each potential loan contract can be calculated (which is $\sum_{y=1}^{y} EE_{yz}$ for z=1, ..., M) and it always varies from loan to loan.

The details on various factors that could affect the size of the loan evaluation expense had already discussed in the loan evaluation process section.

Loan Loss

$$LL = s \sum_{u=1}^{aM} m_u$$

where

s = portion of loans which is expected to default (loan loss rate) in percentage

m_u = amount of loan on loan contract u (u=1, ..., aM), in dollars

$\sum_{u=1}^{aM} m_u$ = total amount of loan (L), in dollars

Multiplication of loan loss rate (s) by the total amount of loan (L) yields the amount of loan loss (LL).

There are several ways to estimate loan loss rate, e.g. by using the Federal Reserve's Function Cost Analysis. From Functional Cost Analysis: 1978 Average Bank's, for banks with deposits up to 50 million dollars, from 50 to 200 million dollars and over 200 million dollars, the five-year average amount of loan losses, expressed as percentages of loans outstanding, are 0.15 percent, 0.16 percent and 0.21 percent, respectively.

Summary

This study analyzed the commercial lending activities by dividing them into two processes, the loan portfolio planning and control process and the loan evaluation process, and examining each process in detail. Using the knowledge from analyzing both processes, this study then developed the commercial loan revenue-expense model which is composed of five components: interest revenue, noninterest revenue, loan portfolio planning and control expense, loan evaluation expense, and loan loss. Integrating the real resource and financial aspects of the commercial lending activity is the essence of the model. The model, thus, should provide an analytical framework for applied research in the commercial lending area which concerns both real resource and financial aspects.

CHAPTER III

MODEL OF DEPOSIT SERVICE ACTIVITIES: THE APPLICATION OF OSBORNE'S DEPOSIT MODEL

Introduction

The demand deposit function has traditionally been a major source of funds that commercial banks use to generate income through the dual media of loans and investments.

In banking, the term demand deposit refers to money that may be withdrawn on demand or against which checks may be written. A check which is a major instrument of demand deposit function is a written order from a checking-account depositor directing his or her bank to make funds available to a specific person or to "cash" (anyone presenting the check for payment).

This study deals not only with demand deposits but also with new types of transaction deposits, and calls all of them "demand deposits" for simplicity.

Transaction deposits are defined by the Board of Governors of the Federal Reserve System (1981) as:

> All deposits on which the account holder is permitted to make withdrawals by negotiable or transferrable instruments, payment orders of withdrawal, telephone and preauthorized transfers (in excess of three per month), for the purpose of making payments to third persons or others (p. A8).

Up to the present time, demand deposits at the commercial banks are the most widely used transaction deposit. However, new types of transaction deposits were introduced primarily by nonbank depository institutions during the 1970s. These new types were closed substituted for banks' demand deposits and also paid an explicit interest rate. In contrast, banks are prohibited by law from paying explicit interest on demand deposit accounts. These new types of transactions deposits include credit union share draft accounts, automatic transfer service (ATS) accounts, and negotiable order of withdrawal (NOW) accounts.

The latest major development in financial sector in the 1980s is that the Deregulation and Monetary Control Act of 1980 gave authority to all depository institutions (both banks and nonbanks) to issue these new types of transaction balances.

This study will analyze the demand deposit service activities by process analysis and will develop the demand deposit model which include the resource expense, the interest expense, and the service charge revenue.

Demand Deposit Service Process

There are many ways to describe the demand deposit service process and to divide it into a number of activities. But this study will go into only one approach, which is originated and utilized by D. K. Osborne (1982). For details of other approaches, consult Bell and Murphy (1968), Boyd (1976), Corns (1967), Davis, Ceto, and Rabb (1982), Murphy (1969), and Trautz (1977).

The demand deposit service process can be divided into five activities:

1. teller handling,
2. back-room handling and storage,
3. contractor handling and processing,
4. shipping to and from the contractor, and
5. statement mailing.

Each of these five activities will be seperately discussed.

Teller Handling

For the demand deposit function, the tellers have the principal responsibility of accepting teller items which depositors or depositors' payees tender to the bank.

Transactions may be made in person at the tellers windows located in the lobby; at the walk-up window located in the wall of the building facing the sidewalk and adjacent to the parking area; or at one of the drive-up windows located in the wall of the building bordering the areaway into and through the parking area.

Back-room Handling and Storage

Back-room operators receive teller items from the tellers and non-teller items from the mail, the night depository and the clearing system. They microfilm these items and pack them for shipment to the processing contractors. The back-room operators also receive the processed items from the contractors. They then file the processed items and assemble them at statement time. The operators work in a back-room work station which is located in the bank building.

Contractor Handling and Processing

The contractor performs all of the processing and recordkeeping. The contractor receives both teller items and nonteller items through daily shipment from the bank. The contractor also computes each depositor's liability for service charges, computes each depositor's interest revenue, prepared monthly statements, and daily return all items and balance memos to the bank.

The contractor could be one of the bank departments. In the case that the bank also sells the check-processing to other banks, the processing cost is the revenue foregone by processing the bank's items instead of the other banks' items.

Shipping To and From the Contractor

The shipping to and from the contractor can be performed by the bank itself via the bank's shipping unit or the contractor via his shipping unit or the independent shipping service. Regardless of the type of transportation, the cost of shipment depends on distance and weight or volume of all items. In general, there are two shipments for every working day: one is the shipment from the bank to the contractor, the other is the shipment from the contractor to the bank.

Statement Mailing

The statement mailing is performed by the bank's back-room operators. The back-room operators put statement and processed items in the envelope for each demand deposit account. Every stuffed envelope must be run through a postage meter or have a stamp affixed at the expense of labor

time and minimum first-class postage rates even if it contains few items. In general each depositor received the statement with processed items from the bank once a month.

Demand Deposit Service Cost-Revenue Model

Based on the knowledge from analyzing the demand deposit service process, the demand deposit net cost function or the demand deposit service cost-revenue model can be constructed as follows:

Demand Depost Net Cost Function (DDNC) = Demand Deposit Service Cost (DDC)

+ Demand Deposit Interest Cost (DDI)

- Service Charge Revenue (SCR)

where

$$DDC = \sum_{h=1}^{H} DD_h$$

$$DD_1 = \sum_{i=1}^{A} T_i \ (W \cdot ED_1 + R \cdot KD_1 + P \cdot MD_1)$$

$$DD_2 = \sum_{i=1}^{A} (T_i + N_i) \ (W \cdot ED_2 + R \cdot KD_2 + P \cdot MD_2)$$

$$DD_3 = A \cdot d_1 + \sum_{i=1}^{A} (T_i + N_i) \cdot d_2$$

$$DD_4 = \sum_{i=1}^{A} (W \cdot ED_{4i} + R \cdot KD_{4i} + P \cdot MD_{4i})$$

$$DD_5 = \sum_{i=1}^{A} (W \cdot ED_{5i} + R \cdot KD_{5i} + P \cdot MD_{5i})$$

$$DDI = \sum_{i=1}^{A} I_{di} \cdot b_i$$

$$SCR = \sum_{j=1}^{J} SC_j$$

$$SC_1 = \sum_{i=1}^{A} c_{1i}$$

$$SC_2 = \sum_{i=1}^{A} c_{2i}$$

$$SC_3 = \sum_{i=1}^{A} c_{3i} \cdot [\max (0, T_i + N_i - c_{fi})] = \sum_{i=1}^{A} c_{3i} \cdot c_{ei}$$

$$SC_4 = \sum_{i=1}^{A} c_{4i} \cdot T_i$$

The description of each major component of the demand deposit net cost function and the definition of each variable's symbol used in each of them will be presented in the following sections.

Demand Deposit Service Cost

$$DDC = \sum_{h=1}^{H} DD_h \qquad h=1, \ldots, H$$

$$DD_1 = \sum_{i=1}^{A} T_i \, (W \cdot ED_1 + R \cdot KD_1 + P \cdot MD_1)$$

$$DD_2 = \sum_{i=1}^{A} (T_i + N_i) \, (W \cdot ED_2 + R \cdot KD_2 + P \cdot MD_2)$$

$$DD_3 = A \cdot d_1 + \sum_{i=1}^{A} (T_i + N_i) \cdot d_2$$

$$DD_4 = \sum_{i=1}^{A} (W \cdot ED_{4i} + R \cdot KD_{4i} + P \cdot MD_{4i})$$

$$DD_5 = \sum_{i=1}^{A} (W \cdot ED_{5i} + R \cdot KD_{5i} + P \cdot MD_{5i})$$

where

DDC = demand deposit service cost, in dollars

DD_h = cost of activity h (h=1, ..., H) of demand deposit service process, in dollars

H = number of activities in demand deposit service process

DD_1 = cost of teller handling, in dollars

DD_2 = cost of back-room handling and storage, in dollars

DD_3 = cost of contractor handling and processing, in dollars

DD_4 = cost of shipping to and from the contractor, in dollars

DD_5 = cost of statement mailing, in dollars

A = number of accounts

T_i = number of teller items per period on account i (i=1, ..., A)

N_i = number of nonteller items per period on account i (i=1, ..., A)

W = row vector of wage rates (including fringe benefits and taxes), dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

ED_1 = column vector of employee inputs per teller item for teller handling activity, unit in time unit

KD_1 = column vector of capital inputs per teller item for teller handling activity, unit depends on type of capital input

MD_1 = column vector of material inputs per teller item for teller handling activity, unit depends on type of material input

ED_2 = column vector of employee inputs per item for back-room handling and storage activity, unit in time unit

KD_2 = column vector of capital inputs per item for back-room handling and storage activity, unit depends on type of capital input

MD_2 = column vector of material inputs per item for back-room handling and storage activity, unit depends on type of material input

d_1 = contractor charge per account for contractor handling and processing activity, in dollars

d_2 = contractor charge per item for contractor handling and processing activity, in dollars

ED_{4i} = column vector of employee inputs for shipping to and from contractor activity on account i (i=1, ..., A), unit in time unit

KD_{4i} = column vector of capital inputs for shipping to and from contractor activity on account i (i=1, ..., A), unit depends on type of capital input

MD_{4i} = column vector of material inputs for shipping to and from contractor activity on account i (i=1, ..., A), unit depends on type of material input

ED_{5i} = column vector of employee inputs for statement mailing activity on account i (i=1, ..., A), unit in time unit

KD_{5i} = column vector of capital inputs for statement mailing activity on account i (i=1, ..., A), unit depends on type of capital input

MD_{5i} = column vector of material inputs for statement mailing activity on account i (i=1, ..., A), unit depends on type of material input

The demand deposit service cost (DDC) is the sum of cost of each activity (DD_h, h=1, ..., H) in the demand deposit service process. In this study, the demand deposit service process is composed of five activities (H = 5): the teller handling, the back-room handling and storage, the contractor handling and processing, the shipping to and from the contractor, and the statement mailing. The following paragraphs illustrate the cost of each activity in detail.

The cost of teller handling (DD_1) is the sum of each account's teller handling cost which is calculated by multiplying the number of teller items (T_i, i=1, ..., A) by the cost of teller handling per item.

The cost of teller handling per item is composed of three input costs: the employee input cost, the capital input cost, and the material input cost. Multiplication of each input prices vector (W, R, P) by the vector of corresponding input requirements (ED_1, KD_1, MD_1) yields the input costs. Summation over the input costs then yields the cost of teller handling per teller item ($W \cdot ED_1 + R \cdot KD_1 + P \cdot MD_1$).

The cost of back-room handling and storage (DD_2) is the sum of each account's back-room handling and storage cost which is calculated by multiplying the summation of teller items and nonteller item ($T_i + N_i$, i=1, ..., A) by the cost of back-room handling and storage per item. The cost of back-room handling and storage per item is composed of three input costs: the employee input cost, the capital input cost and the material input cost. Multiplication of each input prices vector (W, R, P) by the vector of corresponding input requirements (ED_2, KD_2, MD_2) yields the input costs. Then, summation over the input costs yields the cost of back-room handling and storage per item ($W \cdot ED_2 + R \cdot KD_2 + P \cdot MD_2$).

The cost of contractor handling and processing (DD_3) is composed of two parts: the cost of paying fixed charge per account of all accounts and the expense of paying charge per item of all accounts. The cost of paying fixed charges per account of all accounts is computed by multiplying the number of accounts (A) by the contractor charge per account (d_1). The expense of paying charge per item of all accounts is the summation of each account's expense of paying charges per item. For each account, the expense is calculated by multiplying the number of all items ($T_i + N_i$, i=1, ..., A) by the contractor charge per item (d_2).

The cost of shipping to and from the contractor (DD_4) is the summation of each account's shipping cost. For each account, the

shipping cost is composed of three input costs: the employee input cost, the capital input cost, and the material input cost. Multiplication of each input prices vector (W, R, P) by the vector of corresponding input requirements (ED_{4i}, KD_{4i}, MD_{4i}) yields the input costs. Then, summation over the input costs yields the shipping cost of each account ($W \cdot ED_{4i} + R \cdot KD_{4i} + P \cdot MD_{4i}$).

The cost of statement mailing (DD_5) is the summation of each account's statement mailing cost. For each account, the statement mailing cost is the combination of three input costs which are the employee input cost, the capital input cost, and the material input cost. Multiplication of each input price vector (W, R, P) by the vector of corresponding input requirement (ED_{5i}, KD_{5i}, MD_{5i}) yields the input costs. Summation over the input costs then yields the statement mailing cost of each account ($W \cdot ED_{5i} + R \cdot KD_{5i} + P \cdot MD_{5i}$).

For another form of demand deposit service cost function, consult Osborne (1982).

Demand Deposit Interest Cost

$$DDI = \sum_{i=1}^{A} I_{di} \cdot b_i$$

where

DDI = demand deposit interest cost, in dollars

A = number of account

I_{di} = interest rate paid on account i (i=1, ..., A), in percentage

b_i = average balance of the account i (i=1, ..., A), in dollars

The demand deposit interest cost (DDI) is the sum of the interest cost paid to each demand deposit account computed by multiplying the

interest rate paid (I_{di}) by its corresponding average balance (b_i) on each account (i, i=1, ..., A).

Note that the "demand deposit" stated here refers to all types of transaction deposits offered by banks, and some types of transaction deposits such as negotiable order of withdrawal (NOW) accounts generate interest revenue for depositors.

Service Charge Revenue

$$SCR = \sum_{j=1}^{J} SC_j$$

$$SC_1 = \sum_{i=1}^{A} c_{1i}$$

$$SC_2 = \sum_{i=1}^{A} c_{2i}$$

$$SC_3 = \sum_{i=1}^{A} c_{3i} \cdot [\max (0, T_i + N_i - c_{fi})] = \sum_{i=1}^{A} c_{3i} \cdot c_{ei}$$

$$SC_4 = \sum_{i=1}^{A} c_{4i} \cdot T_i$$

where

SCR = service charge revenue, in dollars

SC_j = service charge revenue on type j (j=1, ..., J), in dollars

J = number of type of service charges

SC_1 = fixed service charge revenue, in dollars

SC_2 = miscellaneous service charge revenue, in dollars

SC_3 = variable service charge revenue, in dollars

SC_4 = teller service charge revenue, in dollars

A = number of accounts

c_{1i} = fixed service charge on account i (i=1, ..., A), in dollars

c_{2i} = miscellaneous service charge on account i (i=1, ..., A), in dollars

c_{3i} = charge per additional item on account i (i=1, ..., A), in dollars

c_{4i} = surcharge per teller item on account i (i=1, ..., A), in dollars

c_{fi} = number of free item allowance per period of account i (i=1, ..., A)

T_i = number of teller items per period on account i (i=1, ..., A)

N_i = number of nonteller items per period on account i (i=1, ..., A)

c_{ei} = number of items that exceed the number of free item allowance

$= [\max (0, T_i + N_i - c_{fi})]$

Note that

$$[\max (0, T_i + N_i - c_{fi})] = 0, \text{ if } T_i + N_i - c_{fi} \leq 0$$

$$= T_i + N_i - c_{fi}, \text{ if } T_i + N_i - c_{fi} > 0$$

The service charge revenue (SCR) is the sum of service charge revenue from each type of the bank's service charge. In this study, the service charge revenue is the combination of revenues from four types (J = 4) which are fixed service charges, miscellaneous service charges, variable service charges, and teller service charges.

The fixed service charge revenue (SC_1) is the summation of the fixed service charge revenues on each account (c_{1i}). The fixed service charge on accout i (c_{1i}) may be either minimum charge or flat charge or zero according to the service charge schedule negotiated between the bank and each demand depositor.

The miscellaneous service charge revenue (SC_2) is the sum of each account's miscellaneous service charge (c_{2i}). The miscellaneous service charges are all types of service charges except the fixed service charge, the variable service charge, and the teller service charge. For example,

the overdraft charge and stop-payment charge are classified as the miscellaneous service charges.

The variable service charge revenue (SC_3) is the summation of the variable service charge on each account. For each account, the variable service charge is calculated by multiplying the charge per additional item (c_{3i}) by the number of items that exceeds the number of free item allowance (c_{ei}). The number of items that exceeds the number of free item allowance is either zero or the positive value of the result from subtracting the number of free item allowance (c_{fi}) from the number of all items ($T_i + N_i$): it equals to zero, if the number of all items is less than or equal to the number of free item allowance; it equals the result from subtracting the number of free item allowance from the number of all items, if the number of all items is greater than the number of free item allowance.

The teller service charge revenue (SC_4) is the sum of each account's teller service charge. For each account, the teller service charge is the multiplication of the surcharge per teller items (c_{4i}) by the number of teller items (T_i). Up to the present time, most of the banks do not have the teller service charge. But the teller service charge has a trend to be one type of service charge for many banks in the future.

Most of commercial banks have more than one schedule for service charges offered to their demand depositors. Some depositors are not required to pay any service charge, if they can meet the required balance specified in the schedule. In this case, all service charge price parameters (c_{1i}, c_{2i}, c_{3i}, c_{4i}) of their accounts equal to zero. However, they must pay some type of service charge such as miscellaneous service charge, if they could not meet the required balance specified in the

schedule. Some banks may not have all types of service charges presented in this study but it should not cause any problem in using the demand deposit net cost function of this study.

Other interesting aspects of banks' service charges can be found in Jessup (1969), Osborne and Wendel (1978), Osborne and Wendel (1981), and Sheshunoff (1978).

Summary

This study analyzed the demand deposit service function by dividing it into five activities: the teller handling, the back-room handling and storage, the contractor handling and processing, the shipping to and from the contractor, and the statement mailing, and then examining each activity in detail. From the knowledge of analyzing these activities, this study built the demand deposit cost-revenue model which is composed of three components: the demand deposit service cost, the demand deposit interest cost, and the service charge revenue. This model, therefore, could be utilized as an analytical framework for applied research in the demand deposit activities of commercial banks.

CHAPTER IV

MODEL OF ASSET/LIABILITY REVENUE-COST

Introduction

Although each bank function can be analyzed seperately, for the benefit of thorough understanding, it is necessary to view them as a group of interrelated parts that can be analyzed as a whole. It is much more realistic and more practical for a bank to adopt a system perspective. By so doing, a bank can appropriately decide, for instance, if it should make fixed-rate or floating-rate loans, buy ninety-day or five-year securities, offer interest on demand deposit account or not, and etc.

In banking, the framework for visualizing a bank as interrelated parts being grouped in an integrated manner is called the asset/liability management. As the term suggests, there is a joint relationship or linkage between the management of assets and liability. The asset/liability management is a complex process that must encompass a thorough understanding of the particular bank's asset and liability mix, customer behavior and how these related to the external economic and competitive pressures that the structure will encounter.

The asset/liability management of banking firm has been the theme of study by many authors such as Baker (1978), Baltensperger (1980), Baughn and Walker (1978), Brick (1980), Brodt (1980), Bryan (1972) Cohen

and Hammers (1966), Crosseand Hempel (1980), Eatman and Sealey (1979), Goldfeld (1966), Graddy and Kyle (1979), Klein (1971), Langohr (1982), Meyer Zu Selhausen (1977), Monti (1972), O'Hara (1983), Pringle (1973), and Weston (1980). Using their works and the models in previous chapters (loans and deposits models) as the basic knowledge, the present study attempts to develop a model of asset/liability management.

After presenting a conceptual model of asset/liability revenue-cost, this study will briefly describe the regulatory and legal constraints on commercial bank management. Then, the formalization of the asset/liability problem in commercial banking will be presented.

Conceptual Model of Asset/Liability Revenue-Cost

Due to the complexity of the banking institution, any model of the banking firm must be relatively abstract. The nature and degree of the abstraction is determined by the author's conception of what is particularly important about a banking firm. Therefore, it is important at this point to set forth a general way in which this study views a banking firm. The key assumptions of this study in developing the asset/liability model are as follows:

1. The bank's major assets are reserves, securities, and commercial loans (see Figure 6).
2. The bank's major liabilities are demand deposits, negotiable certificates of deposits (CD) and equity capital (see Figure 6).
3. The bank's major activities are making loans and investments, obtaining funds from deposits and equity, and servicing demand deposit customers.

Simplified Balance Sheet
Date

Assets		Liabilities	
Reserve	$....	Demand deposits	$....
Securities	....	Negotiable Certificates of Deposit	....
Loans	....	Equity Capital	....
TOTAL	$....	TOTAL	$....

Figure 6. Simplified Balance Sheet

4. The bank's major real resources inputs are employee inputs, real capital inputs and material inputs.
5. The risk return trade-off, the important concept of finance theory (see, for example, Brealey and Myers (1981) and Lee (1983)), is incorporated in the model through the variation of the values of controllable factors (both financial and real resource factors) which are influenced or manipulated by the bank management within the constraints caused by uncontrollable factors. The bank management seeks to strike the particular balance between risk and profitability that maximizes the value of the bank.

The conceptual model of asset/liability revenue and cost is developed by integrating the models from the previous chapters with three new components. The models from the previous chapters are the commercial loan revenue-expense model and the demand deposits service cost-revenue model. The new components are the securities net revenue, the negotiable certificates of deposit net cost and the adjusted shareholder dividend. Therefore, the asset/liability profit function or the conceptual model of asset/liability revenue and cost can be constructed as follows.

Asset/Liability Profit Function (ALP) = Securities Net Revenue (SR)
+ Loan Interest Revenue (IR)
+ Loan Noninterest Revenue (NR)
+ Service Charge Revenue (SCR)
- Demand Deposit Interest Cost (DDI)
- Negotiable Certificates of Deposit Net Cost (CDN)
- Adjusted Shareholders Dividend (ASD)

- Loan Portfolio Planning and Control Expense (PE)
- Loan Evaluation Expense (EE)
- Demand Deposit Service Cost (DDC)
- Loan Loss (LL)

The details of each component will be seperately presented and the classification of each component -- financial component and resource component -- will also be identified.

Securities Net Revenue (Financial Component)

$$SR = \sum_{f=1}^{F} g_f \cdot G_f$$

where

SR = securities net revenue, in dollars

F = number of securities lots which are held by the bank

g_f = fully taxable net interest rate on securities lot f (f=1, ..., F), in percentage

G_f = amount of securities on securities lot f (f=1, ..., F), in dollars

The above function is a simplified form of securities component of the model. The form which explicitly shows both financial and resource aspects is presented in Appendix A.

Loan Interest Revenue (Financial Component)

$$IR = \sum_{u=1}^{aM} r_u \cdot m_u$$

where

IR = loan interest revenue, in dollars

a = accepted portion of potential loan contracts or accepted rate

M = number of potential loan contracts

aM = number of realized loan contracts

r_u = interest rate charged on loan contract u (u=1, ..., aM), in percentage

m_u = amount of loan on loan contract u (u=1, ..., aM), in dollars

Loan Noninterest Revenue (Financial Component)

$$NR = \sum_{u=1}^{aM} (nf_{1u} + nf_{2u})$$

where

NR = loan noninterest revenue, in dollars

a = accepted portion of potential loan contract or accepted rate

M = number of potential loan contracts

aM = number of realized loan contracts

nf_{1u} = fee charge on loan contract u (u=1, ..., aM), in dollars

nf_{2u} = other noninterest revenue, excluding fee, generated from loan contract u (u=1, ..., aM), in dollars

Service Charge Revenue (Financial Component)

$$SCR = \sum_{j=1}^{J} SC_j$$

$$SC_1 = \sum_{i=1}^{A} c_{1i}$$

$$SC_2 = \sum_{i=1}^{A} c_{2i}$$

$$SC_3 = \sum_{i=1}^{A} c_{3i} \cdot [\max (0, T_i + N_i - c_{fi})] = \sum_{i=1}^{A} c_{3i} \cdot c_{ei}$$

$$SC_4 = \sum_{i=1}^{A} c_{4i} \cdot T_i$$

where

SCR = service charge revenue, in dollars

SC_j = service charge revenue on type j (j=1, ..., J), in dollars

SC_1 = fixed service charge revenue, in dollars

SC_2 = miscellaneous service charge revenue, in dollars

SC_3 = variable service charge revenue, in dollars

SC_4 = teller service charge revenue, in dollars

A = number of accounts

c_{1i} = fixed service charge on account i (i=1,..., A), in dollars

c_{2i} = miscellaneous service charge on account i (i=1, ..., A), in dollars

c_{3i} = charge per additional item on account i (i=1, ..., A), in dollars

c_{4i} = surcharge per teller item on account i (i=1, ..., A), in dollars

c_{fi} = number of free item allownaces per period of account i (i=1, ..., A)

T_i = number of teller items per period on account i (i=1, ..., A)

N_i = number of nonteller items per period on account i (i=1, ..., A)

c_{ei} = number of items that exceed the number of free item allownace

$= [\max (0, T_i + N_i - c_{fi})] = 0$, if $T_i + N_i - c_{fi} \leq 0$

$= T_i + N_i - c_{fi}$, if $T_i + N_i - c_{fi} > 0$

Demand Deposit Interest Cost (Financial Component)

$$DDI = \sum_{i=1}^{A} I_{di} \cdot b_i$$

where

DDI = demand deposit interest cost, in dollars

A = number of accounts

I_{di} = interest rate paid on account i (i=1, ..., A), in percentage

b_i = average balance of the account i (i=1, ..., A), in dollars

Negotiable Certificates of Deposit (CD) Net Interest Cost (Financial Component)

$$CDN = \sum_{q=1}^{Q} I_{cq} \cdot b_{cq}$$

where

CDN = negotiable certificates of deposit (CD) net interest cost, in dollars

Q = number of negotiable certificates of deposit issues

I_{cq} = net interest rate paid on the CD issue q (q=1, ..., Q), in percentage

b_{cq} = the amount (size) of the CD issue q (q=1, ..., Q), in dollars

The above function is a simplified form of CDs component of the model. The form which explicitly shows both financial and resource aspects is presented in Appendix B.

Adjusted Shareholders Dividend (Financial Component)

$$ASD = k \cdot K = \frac{k_o}{1-t_x} \cdot K$$

where

ASD = adjusted shareholders dividend, in dollars

k = fully taxable dividend rate on equity capital, in percentage

$$= \frac{k_o}{1-t_x}$$

k_o = normal dividend rate, in percentage

t_x = banking corporate tax rate, in percentage

K = amount of equity capital, in dollars

Loan Portfolio Planning and Control Expense

(Resource Component)

$$PE = \sum_{v=1}^{V} PE_v$$

$$PE_1 = (W \cdot EI_1 + R \cdot KI_1 + P \cdot MI_1)$$

$$PE_2 = (W \cdot EI_2 + R \cdot KI_2 + P \cdot MI_2)$$

where

PE = loan portfolio planning control expense

V = number of activities in loan portfolio planning and control process

PE_1 = portfolio expense for the loan portfolio planning activity, in dollars

PE_2 = portfolio expense for the loan portfolio control activity, in dollars

W = row vector of wage rates (including fringe benefits and taxes), dollar per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

EI_1 = column vector of employee inputs for planning activity, unit in time unit

KI_1 = column vector of capital inputs for planning activity, unit depends on type of capital

MI_1 = column vector of material inputs for planning activity, unit depends on type of material

EI_2 = column vector of employee inputs for control activity, unit in time unit

KI_2 = column vector of capital inputs for control activity, unit depends on type of capital

MI_2 = column vector of material inputs for control activity, unit depends on type of material

Loan Evaluation Expense (Resource Component)

$$EE = \sum_{y=1}^{Y} EE_y$$

$$= \sum_{y=1}^{Y} \sum_{z=1}^{M} EE_{yz}$$

$$= \sum_{y=1}^{Y} \sum_{z=1}^{M} (W \cdot EI_{yz} + R \cdot KI_{yz} + P \cdot MI_{yz})$$

where

EE = loan evaluation expense, in dollars

EE_y = expense of activity y (y=1, ..., Y) of loan evaluation process, in dollars

Y = number of activities in loan evaluation process

M = number of potential loan contracts

EE_{yz} = loan evaluation expense for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), in dollars

W = row vector of wage rates (including fringe benefits and taxes), dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

EI_{yz} = column vector of employee inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), unit in time unit

KI_{yz} = column vector of capital inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), unit depends on type of capital

MI_{yz} = column vector of material inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M), unit depends on type of material

In this study, the loan evaluation process is composed of nine activities (Y = 9). The activity, its corresponding value of subscript 'y' and its corresponding expense terms are shown below.

Activity	Value of 'y'	Activity's Expense Term
Consider the customer characteristics	1	EE_1
Conduct the initial loan interview	2	EE_2
Perform the credit investigation	3	EE_3
Check on logal and policy restrictions	4	EE_4
Conduct the field investigation	5	EE_5
Appraise the loan characteristics	6	EE_6
Recommend loan terms	7	EE_7
Prepare the loan documentation	8	EE_8
Follow up and review	9	EE_9

Demand Deposit Service Cost (Resource Component)

$$DDC = \sum_{h=1}^{H} DD_h$$

$$DD_1 = \sum_{i=1}^{A} T_i \, (W \cdot ED_1 + R \cdot KD_1 + P \cdot MD_1)$$

$$DD_2 = \sum_{i=1}^{A} (T_i + N_i) \, (W \cdot ED_2 + R \cdot KD_2 + P \cdot MD_2)$$

$$DD_3 = A \cdot d_1 + \sum_{i=1}^{A} (T_i + N_i) \cdot d_2$$

$$DD_4 = \sum_{i=1}^{A} (W \cdot ED_{4i} + R \cdot KD_{4i} + P \cdot MD_{4i})$$

$$DD_5 = \sum_{i=1}^{A} (W \cdot ED_{5i} + R \cdot KD_{5i} + P \cdot MD_{5i})$$

where

DDC = demand deposit service cost, in dollars

DD_h = cost of activity h (h=1, ..., H) of demand deposit service process, in dollars

H = number of activities in demand deposit service process (H=5 in this study)

DD_1 = cost of teller handling, in dollars

DD_2 = cost of back-room handling and storage, in dollars

DD_3 = cost of contractor handling and processing, in dollars

DD_4 = cost of shipping to and from the contractor, in dollars

DD_5 = cost of statement mailing, in dollars

A = number of accounts

T_i = number of teller items per period on account i (i=1, ..., A)

N_i = number of nonteller items per period on account i (i=1, ..., A)

W = row vector of wage rates (including fringe benefits and taxes), dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

ED_1 = column vector of employee inputs per teller item for teller handling activity, unit in time unit

KD_1 = column vector of capital inputs per teller item for teller handling activity, unit depends on type of capital input

MD_1 = column vector of material inputs per teller item for teller handling activity, unit depends on type of material input

ED_2 = column vector of employee inputs per item for back-room handling and storage activity, unit in time unit

KD_2 = column vector of capital inputs per item for back-room handling and storage activity, unit depends on type of capital input

MD_2 = column vector of material inputs per item for back-room handling and storage activity, unit depends on type of material input

d_1 = contractor charge per account for contractor handling and processing activity, in dollars

d_2 = contractor charge per item for contractor handling and processing activity, in dollars

ED_{4i} = column vector of employee inputs for shipping to and from contractor activity on account i (i=1, ..., A), unit in time unit

KD_{4i} = column vector of capital inputs for shipping to and from contractor activity on account i (i=1, ..., A), unit depends on type of capital input

MD_{4i} = column vector of material inputs for shipping to and from contractor activity on account i (i=1, ..., A), unit depends on type of material input

ED_{5i} = column vector of employee inputs for statement mailing activity on account i (i=1, ..., A), unit in time unit

KD_{5i} = column vector of capital inputs for statement mailing activity on account i (i=1, ..., A), unit depends on type of capital input

MD_{5i} = column vector of material inputs for statement mailing activity on account i (i=1, ..., A), unit depends on type of material input

Loan Loss (Financial Component)

$$LL = s \sum_{u=1}^{aM} m_u$$

where

LL = amount of loan loss, in dollars

a = accepted portion of potential loan contracts or accepted rate

M = number of potential loan contracts

aM = number of realized loan contracts

s = portion of loans which is expected to default or loan loss rate, in percentage

m_u = amount of loan on loan contract u (u=1, ..., aM), in dollars

$\sum_{u=1}^{aM} m_u$ = total amount of loan (L), in dollars

Thus, the conceptual model of asset/liability profit function can be presented in the mathematical form as follows:

$$
\begin{aligned}
ALP = {} & \sum_{f=1}^{F} g_f \cdot G_f + \sum_{u=1}^{aM} r_u \cdot m_u + \sum_{u=1}^{aM} (nf_{1u} + nf_{2u}) + \sum_{i=1}^{A} c_{1i} \\
& + \sum_{i=1}^{A} c_{2i} + \sum_{i=1}^{A} c_{3i} \cdot c_{ei} + \sum_{i=1}^{A} c_{4i} \cdot T_i - \sum_{i=1}^{A} I_{di} \cdot b_i \\
& - \sum_{q=1}^{Q} I_{cq} \cdot b_{cq} - k \cdot K - (W \cdot EI_1 + R \cdot KI_1 + P \cdot MI_1) \\
& - (W \cdot EI_2 + R \cdot KI_2 + P \cdot MI_2) - \sum_{y=1}^{Y} \sum_{z=1}^{M} (W \cdot EI_{yz} + R \cdot KI_{yz} \\
& + P \cdot MI_{yz}) - \sum_{i=1}^{A} T_i \, (W \cdot ED_1 + R \cdot KD_1 + P \cdot MD_1) - \sum_{i=1}^{A} (T_i + N_i) \\
& (W \cdot ED_2 + R \cdot KD_2 + P \cdot MD_2) - A \cdot d_1 - \sum_{i=1}^{A} (T_i + N_i) \cdot d_2 \\
& - \sum_{i=1}^{A} (W \cdot ED_{4i} + R \cdot KD_{4i} + P \cdot MD_{4i}) - \sum_{i=1}^{A} (W \cdot ED_{5i} + R \cdot KD_{5i} \\
& + P \cdot MD_{5i}) - s \sum_{u=1}^{aM} m_u
\end{aligned}
$$

Discussion of Typical Approach of Asset/Liability Management and How Its Major Characteristics Were Incorporated or Presented (Both Explicitly and Implicitly) in the Conceptual Model of Asset/Liability Revenue-Cost

The conceptual model is derived from the typical approach to asset/liability management, which consists of three key aspects: the explicit consideration of uncertainty, the differentation of risk, and a concentration on the overall position. The rest of this section is the discussion of each key aspect in turn.

Explicit Consideration of Uncertainty. The first key aspect of asset/liability management is explicit consideration of uncertainty. The first step in adherence to this aspect is forecasting the economic and financial environment. With a forecast in hand, the evaluation of alternative strategies is possible. But there is uncertainty associated with forecast. For that reason, in testing or simulating a proposed strategy, it is necessary to consider not only the most likely economic outlook, but also possible variations. The goal is not necessarily to develop an asset/liability management strategy which will maximize the bank's profit. What should be aimed for is the highest potential profit under expected economic conditions while providing protection on the downside in the event the most likely scenario is not realized.

There are many different ways to look at the impact that variations from the most likely scenario would have on the bank's profit. By assigning probabilities to various economic scenarios, it is possible to use the expected value concept to evaluate different strategies.

In the conceptual model, the major results concerning this aspect is the loan portfolio planning and control expense derived from the loan planning and control activities.

Differentiation of Risk. The second key aspect of asset/liability management is differentiation of risk. The risks associated with the asset/liability management can be classified into three types: interest rate tisk, credit risk, and liquidity risk.

Interest rate risk is the risk that earnings will be influenced by changes in the level of interest rates such as a change in the prime rate.

Credit risk is the risk that the full value of the asset may not be realized at maturity. Customer selectivity serves to reduce this type of risk. It is for the purpose of trying to measure this risk that banks perform credit analyses of loan applicants. The more inputs (employee, capital, material) are utilized in the loan evaluation process, the more accurate credit risk (or credit rating) that bank must assign to its loan applicants. But utilizing more inputs creates more expenses or less return to the bank.

Liquidity risk is the risk that a shortage of funds will require some assets to be funded through the liquidation of other assets under unfavorable conditions, or the acquisition of additional funds on an unfavorable basis.

The most significant components concerning interst rate risk and credit risk in the conceptual model include the loan evaluation expense, the loan interest revenue, the loan noninterest revenue, and the loan loss provision. The loan evaluation expense derives from the loan evaluation activities which involves both interest rate risk and credit risk. The loan interest revenue is a function of the number of realized loan contracts, the amount of loan on each contract, and the interest rate charged on each loan contract. The interest rate charged on each loan contract involves both interest rate risk and credit risk because it is composed of the prime rate (involved interest rate risk) and the interest rate differential (involved credit risk). The loan noninterest revenue and loan loss provision mainly involve credit risk.

The securities net revenues, the CDs net cost, and the demand deposit interest cost are of most concern for liquidity risk in the

conceptual model. But the major results are the securities net revenue due to the securities activities because the short-term securities can be converted quickly and easily into cash and are carried to provide the bank degree of liquidity should its customers require more cash in withdrawals or loans than it has readily available.

Concentration on Overall Position. The third key aspect of asset/liability management is the concentration on overall position. This means that the bank's total position is considered rather than viewing situations in isolation. From this aspect, it is possible in certain situations to substitute one type of risk for another. It is not, however, always desireable to do so. It has already been pointed out that credit risk may be reduced by customer selectivity. In different ways, interest rate risk and liquidity risk may also be altered. For example, the pricing of a loan can affect the interest rate risk of loan, while the method of funding may alter the liquidity risk.

The result concerning the concentration of overall position in the conceptual model is the asset/liability profit function (or the conceptual model itself) which involves all the major activities of the bank.

Regulatory and Legal Constraints on Commercial Bank Management

In essence, banking has been subject to regulatory and legal constraints in order that depositors be protected against loss, that formation of monopolies or cartels be prevented, and that the volume

of money and credit be controlled. Consequently, it is necessary to discuss the constraints on commercial bank's activities before presenting the implication of the asset/liability profit function in the strategic decisions of the commercial bank management.

A number of authors have written about regulatory and legal constraints in banking, for instance, Baughn and Walker (1978), Beazer (1975), Campbell (1982), Garcia (1979), Gies and Aplilado (1971), Haegele (1982), Havrilesky and Boorman (1976), Kalay and Robinovitch (1978), Kaufman (1983), Maisel (1981), Mingo and Wolkowitz (1977), Mullins (1976), Taggard and Greenbaum (1978), and Weston (1980). Derived from their works, the commercial banks' regulatory and legal constrains presented in this study are covered with respect to purposes, sources of funds, and uses of funds.

Both in raising funds and in using funds, commercial banks operate within a massive body of laws, regulations, and supervisory standards. Although most laws, regulations, and supervisory standards that constrain the financial operations of banks are intended to promote the soundness of the banking system, they are sometimes used to serve other social purposes as well. Occasionally a constraint that is originally imposed for one purpose comes to be used for another.

An example of change in the purpose served by a governmental restraint is provided by reserve requirements imposed by the Federal Reserve System. Member banks must hold reserves, either in currency or in noninterest-bearing deposit balances at Federal Reserve Banks, equal to specified percentages of deposits that are set by the Federal Reserve Board within ranges allowed by statute. These requirements were part of the Federal Reserve Act of 1913, whose major purpose was

to bring to an end the liquidity crises that had afflicted the nation. Requiring cash reserves was considered an important way to assure that the banks would maintain adequate liquidity.

As the role of the central bank has become better understood, however, and as its responsibility for the general health of the economy has broadened, reserve requirements have come to be considered mainly as an instrument of monetary policy. Having reserve requirements enables the central bank to exert a more precise influence on the total amount of commercial bank deposits, credit, and thereby, it is believed, the level of Gross National Product. Furthermore, discretionary changes in reserve requirements provide a powerful method of creating excess reserves, or reserve shortages, on an overnight basis, should the Federal Reserve want to do so. Thus, the function of reserves as a source of liquidity now received little emphasis.

The following paragraphs deal with major constraints on the way banks raise funds and the ways they place funds.

Major Constraints on Sources of Funds

Constraints on Deposits. Most of the significant restraints on ways banks raise funds are related to competition for deposits. Some insight into the complexity of the regulation of deposit competition may be grasped by consulting the monthly Federal Reserve Bulletin (Board of Governors of the Federal Reserve System, Washington, D.C.), which reports the vast array of ceiling rates on various types and maturities of time and savings deposits offered by banks.

The very definition of deposit (as opposed to, e.g., bank debt or Federal funds) and the distinction between time and demand deposits, are largely creatures of government regulation. Not only does the Federal Reserve Act set different ranges of reserve requirements for different types of deposits, but the Banking Act of 1933, by providing for time deposit rate ceilings and a flat statutory prohibition of interest on demand deposits, has made necessary a detailed and tortuous system of regulations and rulings as to what constitutes a deposit of each type.

By passing the Depository Institution Deregulation and Monetary Control Act of 1980, Congress has permitted the commercial banks and thrift institutions to effectively circumvent the statutory prohibition of interest on demand deposits by issuing special NOW (negotiable orders of withdrawal) savings account against which checks may be drawn. Under Federal and state regulations, ownerships of these accounts is restricted to households and not-for-profit institutions.

Constraints on Nondeposit Sources of Funds. Aside from deposits, commercial banks raise most of their funds from sale of capital stock and subordinated debt, retained earnings, and Federal fund loans.

The sale of bank capital instruments is subject to both Federal and state regulation, including registration of public issues. Much supervisory effort is expended in attempting to assure that banks maintain adequate capital.

Federal funds borrowing involves mainly overnight loans of balances at Federal Reserve Banks. Such short term borrowing, along with the use of short term, large denomination CDs (negotiable certificates of deposits) is subject to scrutiny by bank supervisory authorities who

see excessive use of "managed liabilities" as a potentially harmful source of illiquidity.

Major Constraints on Uses of Funds

Most restrictions on the uses of bank funds find their origins in legislative or regulatory agency concern with the closely allied goals of protecting depositors and the soundness of the banking system. As was pointed out earlier, intervention designed for one purpose sometimes takes on other purposes as well. Statutory limitations prohibit banks from holding certain assets, or exceeding certain specified limits in the allocation of their funds among particular uses.

Constraints on Loans. Loans are the most important uses of bank funds. Statutory loan limits, conventionally expressed as percentages of capital accounts, govern the maximum amount a bank can lend to any one borrower. For national banks, the limit is ten percent of capital accounts; for state-chartered banks, the limit is typically less restrictive. Numerous exceptions to the general rules, both for national and state banks, provide for more liberal limits in the case of specified types of secured loans or to loans to certain public agencies.

Important restrictions are placed on stock market loans (i.e., loans secured by stocks, warrants, and convertible bonds). The Federal Reserve Act requires the Board of Governors to specify, for all lenders, the maximum ratios of such loans to the values of the securities used as collateral. The primary purpose of these margin requirements is to restrain stock market speculation, though they also limit risk taking by banks.

Constraints on Securities Investment. Statutory limits on securities investments tend to be similar to those applied to loans to single borrowers. Holdings of securities of any one issure are typically limited to a specified percentage of total capital account except for the U.S. Treasury and Federal agency debt and the general obligations of state and local government.

Constraints on Reserve. Banks must maintain minimum reserve requirements on their transaction deposit accounts, and certain other types of deposits in a noninterest-bearing form. According to the Depository Institutions Deregulation and Monetary Control Act of 1980, all depository institutions, not simply commercial banks which are members of the Federal Reserve System, have to maintain reserves.

Formalization of the Asset/Liability Problem in Commercial Banking

A detailed examination of the commercial bank's strategic decisions is beyond the scope of this study. Nevertheless, the preceding model has a number of implications respecting the strategic decisions of the bank. In addition, such an analysis has implications for future research in the banking area and for this reason it is important to make a preliminary attempt at providing a framework for the implementation of such analysis.

After briefly describing the optimazation approach (i.e., one of the major approaches in banking strategic decisions), this study will attempt to formalize the asset/liability problem in banking activities in terms of the conceptual model of asset/liability revenue-cost, and the regulatory and legal constraints on commercial bank management.

Optimization Approach

The optimization approach is focused on certain mathematical relationships which represent the performance of a system and the restrictions to which this performance must conform. The mathematical relationship which represents the performance of a particular system is referred to as the objective function, and the mathematical restrictions imposed on the system's performance functions are referred to as constraints. Collectively, the objective function and constraint relationships represent a traditional mathematical model of the system.

Optimization problems have as their goal an attempt to establish a set of values for the model variables which yield the best or optimal value for the model's objective function. The best performance takes one of two characters: minimization (for example, of a measure of system cost) or maximization (for example, of a measure of system profit). One of these two characteristics of system performance is then the optimizing objective.

The optimization models are very useful in banking applications because of the trade-offs between earnings, liquidity, and risk with which commercial bank must deal. Banking is unique when compared to all other industries because of the low levels of equity capital held relative to assets, the need for safety in balance sheet management to protect the thin level of capital, the need to maintain substantial liquidity as protection against cash drains, and the fact that the banking industry is subject to substantial government regulation. However, some problems in this complex environment can be solved by using the optimization models. An optimum portfolio of funds sources

and uses can also be estimated by utilizing optimization model if bank management is able to state its goals in measurable form.

Construction of the Optimization Problem in Banking Decisions

In banking strategic decisions process, bank management can use the asset/liability profit function and the regulatory and legal constraints on commercial bank management presented in this study to form the optimization model. The steps in constructing the banking optimization problem are as follows.

Identify Decision Criteria. The decision criteria refer to the objectives pursued by bank management. The following objectives proved to be relevant: profit, liquidity, and limitation of risk.

Define Decision Variables. The variables which can be controlled by the bank management are the potential decision variables. In this study the decision variables are:

r_u = interest rate charged on loan contract u (u=1, ..., aM), in percentage

c_{1i} = fixed service charge on deposit account i (i=1, ..., A), in dollars

c_{2i} = miscellaneous service charge on account i (i=1, ..., A), in dollars

c_{3i} = charge per additional item on account i (i=1, ..., A), in dollars

c_{4i} = surcharge per teller item on account i (i=1, ..., A), in dollars

c_{fi} = number of free items allowed per period on account i (i=1, ..., A)

I_{di} = interest rate paid on account i (i=1, ..., A), in percentage

I_{cq} = net interest rate paid on the CD issue q (q=1, ..., Q), in percentage

k = fully taxable dividend rate on equity capital, in percentage

b_m = minimum of average balance on demand deposit account, in dollars

Z_m = minimum credit rating of loan contract

CB_m = minimum compensating balance of loan contract, in dollars

Define Exogenous Variables. The exogenous variables affect the behavior of a banking firm but are not affected by it. The major variables are:

g_f = fully taxable net interest rate on securities lot f (f=1, ..., F), in percentage

C_R = minimum reserve requirement, in percentage

I_R = ceiling rate of interest paid on demand deposit accounts, in percentage

Z_u = credit rating of loan u (u=1, ..., aM), in dollars

W = row vector of wage rates, dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

Specify Function Form of Endogeneous Variables. The endogeneous variables are those variables that values of which are determined by the model. The endogeneous variables as a function of other variables such as decision variables, exogeneous variables, and random variables ($e_w \sim N(0,\sigma_{e_w}^2)$, w = 1, 2, ..., 18) are stated below, with the sign of each derivative with respect to decision variables shown above each function.

$a = a(\bar{g}_f, \overset{+}{r}_u, \bar{I}_{di}, \bar{I}_{cq}, \bar{k}, \bar{Z}_m, \bar{CB}_m, e_1)$

= accepted portion of potential loan contracts or accepted rate

$M = M(\bar{r}_u, \bar{Z}_m, \bar{CB}_m, e_2)$

= number of potential loan contracts

$A = A(\overset{+}{I}_{di}, \bar{c}_{1i}, \bar{c}_{2i}, \bar{c}_{3i}, \bar{c}_{4i}, \overset{+}{c}_{fi}, \bar{b}_m, e_3)$

= number of demand deposit accounts

$T_i = T_i(\overset{+}{c}_{4i}, e_4)$

= number of teller items per period on account i (i=1, ..., A)

$N_i = N_i(\bar{c}_{4i}, e_5)$

= number of nonteller items per period on account i (i=1, ..., A)

$b_i = b_i(\overset{+}{I}_{di}, \overset{+}{b}_m, e_6)$

= average balance of the account i (i=1, ..., A), in dollars

$Q = Q(\overset{+}{r}_u, \overset{+}{I}_{di}, \bar{I}_{cq}, \overset{+}{k}, \bar{Z}_m, e_7)$

= number of negotiable certificates of deposit issues

$K = K(\overset{+}{r}_u, \overset{+}{I}_{di}, \overset{+}{I}_{cq}, \bar{k}, \bar{Z}_m, e_8)$

= amount of equity capital, in dollars

$EI_1 = EI_1(\overset{+}{a}, \overset{+}{M}, \bar{W}, \overset{+}{R}, e_9)$

= column vector of employee inputs for planning activity, unit in time unit

$KI_1 = KI_1(\overset{+}{a}, \overset{+}{M}, \overset{+}{W}, \bar{R}, e_{10})$

= column vector of capital inputs for planning activity, unit depends on type of capital

$MI_1 = MI_1(\overset{+}{a}, \overset{+}{M}, \bar{P}, e_{11})$

= column vector of material inputs for planning activity, unit depends on type of material

$EI_2 = EI_2(\overset{+}{a}, \overset{+}{M}, \bar{W}, \overset{+}{R}, e_{12})$

= column vector of employee inputs for control activity, unit in time unit

$KI_2 = KI_2(\overset{+}{a}, \overset{+}{M}, \overset{+}{W}, \bar{R}, e_{13})$

= column vector of capital inputs for control activity, unit depends on type of capital

$MI_2 = MI_2(\overset{+}{a}, \overset{+}{M}, \bar{P}, e_{14})$

= column vector of material inputs for control activity, unit depends on type of material

$EI_{yz} = EI_{yz}(\overset{+}{a}, \overset{+}{M}, \overset{+}{Z}_m, \bar{W}, \overset{+}{R}, e_{15})$

= column vector of employee inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M) unit in time unit

$KI_{yz} = KI_{yz}(\overset{+}{a}, \overset{+}{M}, \overset{+}{Z}_m, \overset{+}{W}, \bar{R}, e_{16})$

= column vector of capital inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M) unit depends on type of capital

$MI_{yz} = MI_{yz}(\overset{+}{a}, \overset{+}{M}, \overset{+}{Z}_m, \bar{P}, e_{17})$

= column vector of material inputs for activity y (y=1, ..., Y) on the potential loan contract z (z=1, ..., M) unit depends on type of material

$s = s(\overset{+}{a}, \overset{+}{M}, \bar{Z}_m, e_{18})$

= portion of loans which is expected to default or loan loss rate, in percentage

Note that the "e_w" terms (w=1, ..., 18) are random variables normally distributed with zero means and finite variances.

Set Objective Function. The objective function formalizes the connection between the decision criterion and the variables. In this study, the objective function which the banking firm intends to maximize is the expected profit function. The bank's profit function is represented by the conceptual asset/liability revenue-cost (profit) function:

Asset/Liability Profit Function (ALP) =

Securities Net Revenue (SR)
+ Loan Interest Revenue (IR)
+ Loan Noninterest Revenue (NR)
+ Service Charge Revenue (SCR)
- Demand Deposit Interest Cost (DDI)
- Negotiable Certificates of Deposit Net Cost (CDN)
- Adjusted Shareholders Dividend (ASD)
- Loan Portfolio Planning and Control Expense (PE)
- Loan Evaluation Expense (EE)
- Demand Deposits Service Cost (DDC)
- Loan Loss (LL)

Identify Constraints. The banking firm operates under many regulatory and operational constraints. This study considers only the major constraints which are stated below.

Balance sheet constraint ($C + \sum_{f=1}^{F} G_f + \sum_{u=1}^{aM} (m_u - CB_u) = \sum_{i=1}^{A} b_i + \sum_{q=1}^{Q} b_{cq} + K$) is an equality constraint: summation of reserve and total amount of securities and total amount of loans after adjusting for compensating balance equals to summation of total amount of demand deposits and total amount of CDs and equity capital.

Reserve requirement constraint ($C \geq C_R$) is either inequality constraint or equality constraint: reserve is greater than or equals to minimum reserve requirement.

Liquidity constraint ($C \geq h_i \cdot \sigma_{dD}$) is either inequality constraint or equality constrint: reserve is greater than or equals to the liquidity parameter times the estimated standard deviration of total-demand-depsots change per period.

Capital adequacy constraint ($K \geq h_2 \cdot \sum_{u=1}^{aM} (m_u - CB_u) + h_3 \cdot \sum_{i=1}^{A} b_i + h_4 \cdot \sum_{q=1}^{Q} b_{cq}$) is either inequality constraint or equality constraint: equity capital is greater than or equals to capital-adequacy parameter (h_2) times total amount of loans after adjusting for compensating balance, plus capital-adequacy parameter (h_3) times total amount of demand deposits, plus capital-adequacy parameter (h_4) times total amount of CDs.

Amount of loan constraint ($m_u \leq h_5 \cdot K$, u=1, ..., aM) is inequality constraint or equality constraint: amount of loan on each loan contract is less than or equals to loan-limit parameter time equity capital

Service charge constraint ($T_i + N_i - c_{fi} \geq 0$, i=1, ..., A) is either inequality constraint or equality constraint: for each demand deposit account, number of teller items per period plus number of nonteller items per period minus number of free item allowance per period is greater than or equals to zero.

Interest ceiling constraint ($I_{di} \leq I_R$, i=1, ..., A) is either inequality or equality constraint: for each demand deposit account, interest rate paid is less than or equals to ceiling rate of interest specified by law or regulation.

Minimum of average balance constraint ($b_i \geq b_m$, i=1, ..., A) is either inequality constraint or equality constraint: for each demand deposit account, average balance is greater than or equals to minimum of average balance on demand deposit account.

Credit rating constraint ($Z_u \geq Z_m$, u=1, ..., aM) is either inequality constraint or equality constraint: credit rating of each loan contract is greater than or equals to minimum credit rating of loan contract.

Compensating balance constraint ($CB_u \geq CB_m$, u=1, ..., aM) is either inequality constraint or equality constraint: Compensating balance of each loan contract is greater than or equals to minimum compensating balance of loan contract.

Besides the explanation of constraints presented in this study, the details of constraints can be found in Baltensperger (1972), Beazer (1975), Charnes and Cooper (1959), Chiang (1974), Cohen and Hammers (1966), Henderson and Quandt (1981), Intriligator (1971), Maisel (1981), Meyer Zu Selhausen (1977), Schmidt and Davis (1981), and Weston (1980).

State the Optimization Problem of Banking Firm in a Mathematical Form. The final step in this construction is to summarize and show the optimization problem in the mathematical format (the flow diagram of the problem has shown in Figure 7).

The essence of the optimization process of the banking-firm problem in this study is to find the set of values of the decision variables

(r_u, c_{1i}, c_{2i}, c_{3i}, c_{4i}, c_{fi}, I_{di}, I_{cq}, k, b_m, Z_m, and CB_m) to maximize the objective function that is the asset/liability profit function (ALP = SR + IR + NR + SCR - DDI - CDN - ASD - PE - EE - DDC - LL) subject to the constraints which are balance sheet constraint (C1), reserve requirement constraint (C2), liquidity constraint (C3), capital adequacy constraint (C4), amount of loan constraint (C5), service charge constraint (C6), interest ceiling constraint (C7), minimum of average balance constraint (C8), credit rating constraint (C9), and compensating balance constraint (C10). The mathematical expression of the optimization problem of banking firm is written as follows:

$$\text{Maximize} \qquad E(ALP) \quad ,$$

$$r_u,\ c_{1i},\ c_{2i},\ c_{3i},\ c_{4i},\ c_{fi},$$

$$I_{di},\ I_{cq},\ k,\ b_m,\ Z_m,\ CB_m$$

$$\begin{aligned}
E(ALP) = {} & \sum_{f=1}^{F} g_f \cdot G_f + \sum_{u=1}^{aM} r_u \cdot m_u + \sum_{u=1}^{aM} (nf_{1u} + nf_{2u}) \\
& + \sum_{i=1}^{A} c_{1i} + \sum_{i=1}^{A} c_{2i} + \sum_{i=1}^{A} c_{3i} (T_i + N_i - C_{fi}) + \sum_{i=1}^{A} c_{4i} \cdot T_i \\
& - \sum_{i=1}^{A} I_{di} \cdot b_i - \sum_{q=1}^{Q} I_{cq} \cdot b_{cq} - k \cdot K \\
& - (W \cdot EI_1 + R \cdot KI_1 + P \cdot MI_1) - (W \cdot EI_2 + R \cdot KI_2 + P \cdot MI_2) \\
& - \sum_{y=1}^{Y} \sum_{z=1}^{M} (W \cdot EI_{yz} + R \cdot KI_{yz} + P \cdot MI_{yz}) \\
& - \sum_{i=1}^{A} T_i (W \cdot ED_1 + R \cdot KD_1 + P \cdot MD_1) - \sum_{i=1}^{A} (T_i + N_i) (W \cdot ED_2 \\
& + R \cdot DI_2 + P \cdot MD_2) \\
& - A \cdot d_1 - \sum_{i=1}^{A} (T_i + N_i) \cdot d_2 - \sum_{i=1}^{A} (W \cdot ED_{4i} + R \cdot KD_{4i} + P \cdot MD_{4i}) \\
& - \sum_{i=1}^{A} (W \cdot ED_{5i} + R \cdot KD_{5i} + P \cdot MD_{5i}) - s \sum_{u=1}^{aM} m_u
\end{aligned}$$

subject to

$$C + \sum_{f=1}^{F} G_f + \sum_{u=1}^{aM} (m_u - CB_u) = \sum_{i=1}^{A} b_i + \sum_{q=1}^{Q} b_{cq} + K \qquad (C1)$$

$$C \geq C_R \qquad (C2)$$

$$C \geq h_1 \cdot \sigma_{dD} \qquad (C3)$$

$$K \geq h_2 \cdot \sum_{u=1}^{aM} (m_u - CB_u) + h_3 \cdot \sum_{i=1}^{A} b_i + h_4 \cdot \sum_{q=1}^{Q} b_{cq} \qquad (C4)$$

$$m_u \leq h_5 \cdot K \quad , u=1, \ldots, aM \qquad (C5)$$

$$T_i + N_i - c_{fi} \geq 0 \quad , i=1, \ldots, A \qquad (C6)$$

$$I_{di} \leq I_R \quad , i=1, \ldots, A \qquad (C7)$$

$$b_i \geq b_m \quad , i=1, \ldots, A \qquad (C8)$$

$$Z_u \geq Z_m \quad , u=1, \ldots, aM \qquad (C9)$$

$$CB_u \geq CB_m \quad , u=1, \ldots, aM \qquad (C10)$$

where

h_1 = liquidity parameter

σ_{dD} = estimated standard deviation of total-demand-deposits change per period

h_2 = capital-adequacy parameter for total amount of loan

h_3 = capital-adequacy parameter for total amount of demand depsits

h_4 = capital-adequacy parameter for total amount of CDs

h_5 = loan-limit parameter

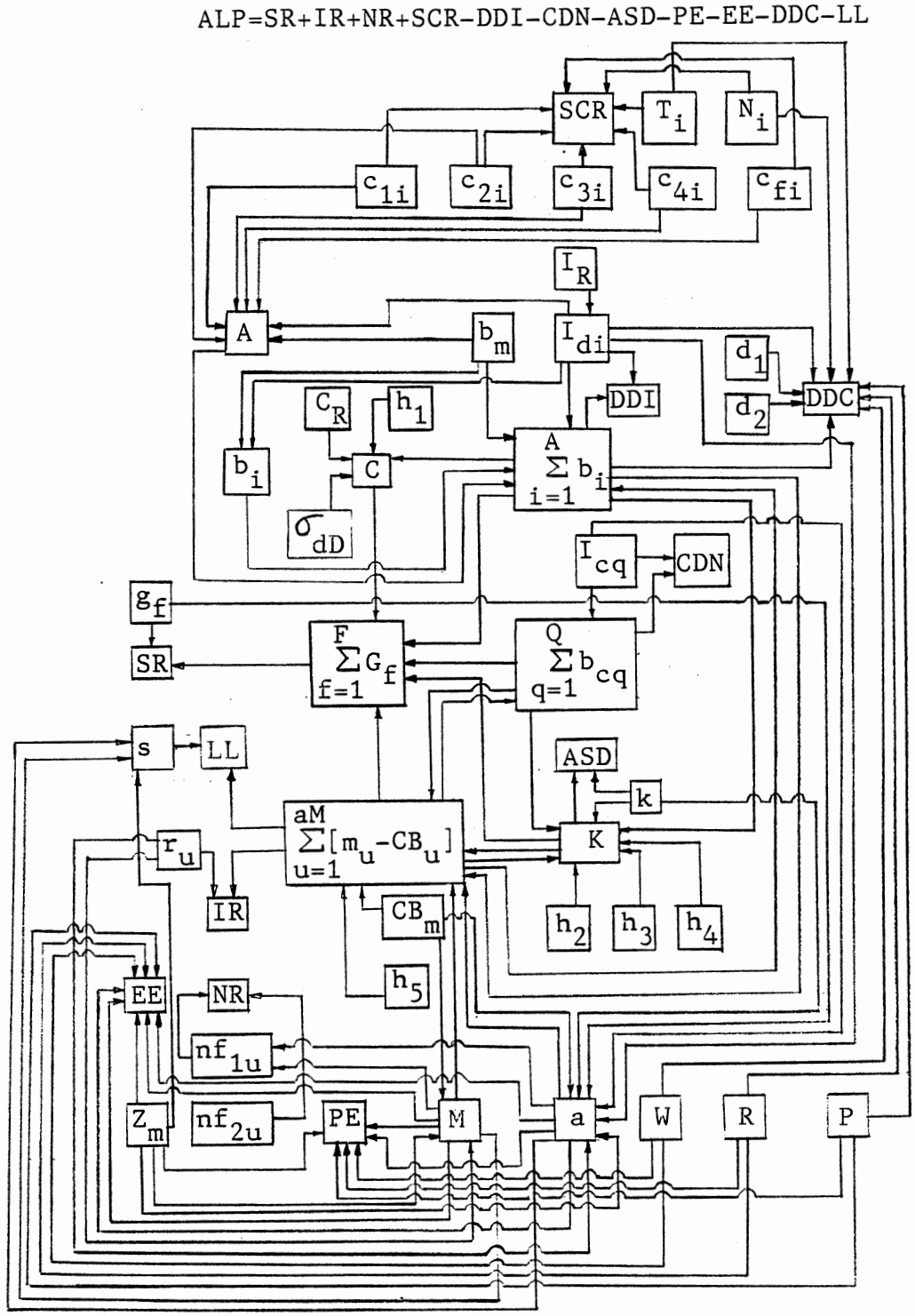

Figure 7. Flow Diagram of the Optimization Problem of Banking Firm

Summary

For the asset/liability management function, the commercial bank should be looked at as a complete system. By utilizing the commercial lending model and the demand-deposit service model from the previous chapters as basic elements, the present study constructed the conceptual model of asset/lability revenue-cost. The conceptual model takes into consideration both resource aspects and financial aspects with equal priority, and it does not assume that operating and transaction costs are proportional to assets or liabilities. In the banking business, cost functions usually do not have the same set of explanatory variables as revenue functions. Consequently, bank's operating costs in the present study are a function of resource inputs (labor, real capital, materials), number of potential loan contracts in case of lending, number of accounts and transactions in case of demand-deposit services, etc. After explaining the constraints on commercial bank activities, this study formalized the asset/liability decision problem in banking as an optimization problem. The procedure for solving the problem is beyond the scope of the present study.

Thus, the conceptual model of asset/liability revenue-cost could be utilized as an analytical framework for applied research in many areas of the banking business.

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APPENDIXES

APPENDIX A

NOTE ON SECURITIES REVENUE AND COST

Most of the time the subject of a bank's securities investment is treated entirely independently of its loan portfolio. But both of them are to a considerable extent alternative uses of the same pools of funds and therefore closely related. The formulation of investment policy which leads to the acquisition of the securities portfolio (sometimes referred to as residual investments because it represents a use of funds that are left over after all acceptable loan demand has been satisfied) depends to a large extent on the bank's loan opportunities, its outstanding loans, and its expectations of loan demand in the future. It is thus very difficult to generalize about the objective of investment policy. This policy must reflect the type and extent of loan demand experienced by the bank, not only at the present but also the form it may reasonably take in the future. Furthermore, if a bank frequently encounters abrupt, extensive seasonal loan fluctuations, it will probably be necessary for that bank to have greater overall liquidity in its asset structure and, therefore, a differently constructed securities portfolio than that held by a bank not having such fluctuations.

Realizing the common need for liquidity and the great importance attached to it by banks, why do they invest in assets that may not be very liquid? The answer lies in the fact that such investment provides an additional source of income. Clearly, for the bank management to fulfill his responsibility to the bank's shareholders, a maximum amount

of funds should be actively employed in the production of income. So, the major objective of securities investment is to maximize profit subject to the reasonable level of risks. Therefore, the securities profit function or the securities revenue-cost model can be developed in the following way.

Securities Profit Function (SPF) = Securities Gross Revenue (SGR)
- Securities Portfolio Planning and Control Cost (SPC)
- Securities Transaction Cost (STC)

where

$$SGR = \sum_{f=1}^{F} gg_f \cdot G_f$$

$$SPC = W \cdot ES_1 + R \cdot KS_1 + P \cdot MS_1$$

$$STC = \sum_{f=1}^{F} (W \cdot ES_{2f} + R \cdot KS_{2f} + P \cdot MS_{2f}) + \sum_{f=1}^{F} db_f$$

SGR = securities gross revenue, in dollars

F = number of securities lots which are held by the bank

gg_f = fully taxable gross interest rate on securities lot f (f=1, ..., F), in percentage

G_f = amount of securities on securities lot f (f=1, ..., F), in dollars

SPC = securities portfolio planning and control cost, in dollars

W = row vector of wage rates (include fringe benefits and taxes), dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollars per unit of material

ES_1 = column vector of employee inputs for securities portfolio planning and control activities, unit in time unit

KS_1 = column vector of capital inputs for securities portfolio planning and control activities, unit depends on type of capital input

MS_1 = column vector of material inputs for securities portfolio planning and control activities, unit depends on type of material input

STC = securities transaction cost, in dollars

ES_{2f} = column vector of employee inputs for transaction activities on the securities lot f (f=1, ..., F), unit in time unit

KS_{2f} = column vector of capital inputs for transaction activities on the securities lot f (f=1, ..., F), unit depends on type of capital input

MS_{2f} = column vector of material inputs for transaction activities on the securities lot f (f=1, ..., F), unit depends on type of material input

db_f = dealer cost or brokerage cost on the securities lot f (f=1, ..., F), in dollars

This completed function has been replaced in text by the simpler version shown in Chapter IV. Since resource costs on the asset side have already incorporated in the commercial loan revenue-expense model, this simplification is acceptable.

APPENDIX B

NOTE ON NEGOTIABLE CERTIFICATES OF DEPOSIT COST

A negotiable certificate of deposit (CD) is a receipt issued by a bank in exchange for the deposit of funds. The bank agrees to pay the amount deposited, plus interest, to the bearer of the receipt on the date specified on the certificate. Because the CD is negotiable, it could be traded in the secondary market before maturity.

For the small-sized bank and the moderate-sized bank, the market for large CDs, those in amounts of at least 100,000 dollars, will be confined to those few of its own corporate customers who from time to time may have excess cash to invest. To be effective in this market, a bank must be large enough and well-known enough so that its CDs will trade in the secondary market at reasonable rate.

In liability management, banks actively seek more flexibility in expanding their lending capability in line with their profitable lending opportunities instead of adjusting their lending to deposits received more or less passively. Banks can do this by increasing their CDs when loan demand is strong and by allowing them to run off when loan demand turns sluggish. THe reason that banks can manipulate the amount of their CDs is that the CDs are an attractive short-term, liquid investment for individuals, business firms, municipalities, and other organizations with large amounts of temporarily investable cash balances.

The cost function of the negotiable certificates of deposit can be expressed in the following form:

Negotiable Certificates of Deposit Cost Function(CDC) = CDs Interest Cost (CDI)
+ CDs Transaction Cost (CDT)

where

$$CDI = \sum_{q=1}^{Q} GI_{cq} \cdot b_{cq}$$

$$CDT = \sum_{q=1}^{Q} (W \cdot EC_q + R \cdot KC_q + P \cdot MC_q)$$

CDI = CDs interest cost, in dollars

CDT = CDs transaction cost, in dollars

Q = number of CDs issued

GI_{cq} = gross interest rate paid on the CD issue q (q=1, ..., Q), in percentage

b_{cq} = the amount (size) of the CD issue q (q=1, ..., Q), in dollars

W = row vector of wage rates (including fringe benefits and taxes), dollars per unit of time

R = row vector of rental rates on capital, dollars per unit of utilization

P = row vector of material prices, dollar per unit of material

EC_q = column vector of employee inputs for making a transaction of the CD issue q (a=1, ..., Q), unit in time unit

KC_q = column vector of capital inputs for making a transaction of the CD issue q (a=1, ..., Q), unit depends on type of capital input

MC_q = column vector of material inputs for making a transaction of the CD issue q (q=1, ..., Q), unit depends on type of material input

This extensive function has been replaces in text by the simpler version presented in Chapter IV. The simplification is acceptable because resource costs on the liability side have already incorporated in the demand deposit service cost-revenue model.

VITA 2

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