ECONOMIC ANALYSIS OF COMMERCIAL BANK--
FARM CREDIT SYSTEM COORDINATION

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PREFACE

This study is concerned with the use of external sources of funds by rural banks. The primary objective is to evaluate the alternative methods which commercial banks can use to increase loanable funds for agriculture. A linear programming model of a commercial bank is developed and used in the empirical analysis.

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CHAPTER I

INTRODUCTION

Agriculture is facing major problems in obtaining adequate financing, both at the firm and aggregate level. The changing structure of agriculture, rapid technological developments, increasing input costs, and the use of better management techniques have caused a substantial increase in the aggregate amount of capital investment in the agriculture sector. These developments have also resulted in larger units in farming, substantially fewer people employed in agriculture and thus increased per farm capital requirements. During the period 1950 to 1970, farm numbers and farm employment has declined about one-half because of the increasing size of the farm unit. This increasing size of farm units, along with technological change and rising input costs, has caused the investment per farm and per farm worker to increase more than five times since 1950.[1] The changes in farm size, input costs, and technology have also caused farmers to rely more on debt than they have in the past. Farmers' equity in their farm operations has decreased from 90.6 percent in 1950 to 81.3 percent in 1970.[2] Brake has estimated that this trend will continue for sometime.[3] Brake's estimates show that farmers' equity will have decreased to 71.6 percent by 1980.

The total U.S. farm debt increased from $12.4 billion in 1950 to $58.1 billion in 1970--or about 4½ times. On a per farm basis, the

rate of debt increase was approximately nine times because of the declining number of farms.[4] Brake's projected farm credit use for 1980 is $100 billion.[5] Facing this projected increase in the use of credit, "... survival in the agricultural economy of the future will depend largely upon the individual farmer's management ability and whether he has sufficient credit of the right type."[6]

These trends in the capital market for the agricultural sector have definite implications for the financial institutions serving agriculture. These financial institutions will be dealing with fewer and more sophisticated farm managers who will spend much time analyzing their financial matters. With the increasing need for credit by individual farmers, the farm manager will be willing to shop carefully for credit and invest any temporary surplus funds he may have.

Sources of Debt

There are several sources of agricultural debt or credit. These sources vary depending on whether the debt is for real-estate or non-real estate purposes. The major sources of real estate debt are: Federal Land Banks, Farmers Home Administration, Life Insurance Companies, Commercial Banks and "other" real estate lenders. The "other" real estate lenders consist mainly of individuals. The main suppliers of non-real estate debt are: Commercial Banks, Production Credit Associations, Federal Intermediate Credit Banks, and the Farmers Home Administration.

In the non-real estate debt market, Production Credit Associations have increased their share of the total outstanding debt from 13.7 percent in 1950 to 30.4 percent in 1971 (Table I). Commercial banks have

TABLE I

PERCENT OF NON-REAL ESTATE DEBT HELD BY VARIOUS INSTITUTIONAL LENDERS, UNITED STATES, SELECTED DATES, 1950-1971[a]

YEAR	TOTAL NON-REAL ESTATE DEBT	COMMERCIAL BANKS	PCA'S	FICB	FHA
	1,000 DOLLARS	PERCENT			
1950	2,833,769	72.3	13.7	1.8	12.2
1955	3,986,328	73.6	14.5	1.5	10.5
1960	6,667,699	72.3	20.4	1.3	6.0
1961	6,979,236	71.5	21.2	1.3	6.0
1962	7,550,936	70.4	21.7	1.3	6.6
1963	8,484,321	70.5	21.7	1.3	6.6
1964	9,477,123	70.2	22.2	1.3	6.3
1965	10,036,151	69.6	22.7	1.2	6.4
1966	11,112,322	69.1	23.2	1.3	6.4
1967	12,443,516	68.6	24.2	1.3	5.9
1968	13,764,021	67.4	25.9	1.3	5.8
1969	14,547,421	66.8	26.3	1.2	5.6
1970	15,827,534	65.3	28.4	1.4	5.0
1971	17,411,561	63.8	30.4	1.3	4.6

[a] Agricultural Finance Review, E.R.S., U.S.D.A., Vol. 32 Supplement (January, 1972), p. 20-21.

suffered significant declines in the relative amount of non-real estate debt supplied. Commercial banks' share of total non-real estate debt has decreased from 72.3 percent to 63.8 percent over the same period. Although commercial banks still supply the major portion of non-real estate credit, they have failed to maintain their share of a growing market.

The importance of the various institutional suppliers of real estate debt has also shifted since 1950 (Table II). Again, an agency which was created by the Federal Government has increased its share of a growing market. The Federal Land Banks now provide 24.2 percent of the real estate credit as compared to 16.2 percent in 1950. Commercial banks' share of the real estate market has decreased, but not as drastically as in the non-real estate market. Commercial banks now supply 15.0 percent of the real estate credit as compared to 16.8 percent in 1950.

In Oklahoma, banks have also declined in their importance as suppliers of non-real estate debt, but they are supplying a larger proportion of the real estate credit. Oklahoma banks supplied approximately $62 million of non-real estate credit or 71.6 percent of the total in 1950. By 1971, commercial banks were providing $373 million or 65.3 percent of the non-real estate credit. In the real estate market, Oklahoma banks supplied $9.7 million or 7.3 percent of the total in 1950. As of 1971, commercial banks in the state were providing $97.4 million which represents 15 percent of the total market.

TABLE II

PERCENT OF REAL ESTATE DEBT HELD BY VARIOUS INSTITUTIONAL LENDERS, UNITED STATES, SELECTED DATES, 1950-1971[a]

YEAR	TOTAL FARM MORTGAGE DEBT	FEDERAL LAND BANKS	FHA	LIFE INSURANCE COMPANIES	BANKS
	1,000 DOLLARS	PERCENT			
1950	5,579,278	16.2	3.5	21.0	16.8
1955	8,245,278	15.4	3.5	24.9	14.7
1960	12,082,409	19.3	3.6	23.3	13.5
1961	12,820,304	19.8	3.8	23.2	13.2
1962	13,899,105	20.2	4.1	22.7	12.9
1963	15,167,821	19.9	3.9	22.4	13.6
1964	16,803,505	19.5	3.6	22.5	14.0
1965	18,894,240	19.5	3.3	22.7	14.1
1966	21,186,886	20.0	3.0	22.7	13.9
1967	23,301,235	21.1	2.5	22.4	13.6
1968	25,486,372	21.8	2.1	21.7	13.9
1969	27,139,309	22.4	1.8	21.2	14.2
1970	28,407,241	23.5	1.6	20.2	14.5
1971	29,532,521	24.2	1.2	19.0	15.0

[a] Agricultural Finance Review, E.R.S., U.S.D.A., Vol. 32 Supplement (January, 1972), p. 2.

Problem Statement

Rural banks face two types of problems in providing debt capital for agriculture. First, the loan demand in rural areas has increased faster than the loanable funds; and second, the size of the farm loan needed is increasing faster than the typical loan limit of rural banks.[7] Inadequate solutions to these problems provide the major explanation for the declining role of rural banks in the agricultural capital market.

With a loan demand that is increasing faster than deposits, banks face a liquidity problem that causes the loan to deposit ratio to reach critically high levels. Since 1950, the loan volume of Oklahoma banks has increased 65.6 percent--from approximately $500 million to $3.3 billion.[8] This increase in loan volume may not reflect the potential increase that banks might have experienced if sufficient funds to meet the loan demand had been available. During this same period, Oklahoma bank deposits increased only 32.4 percent and their capital accounts increased only 43.2 percent.[9] Whereas Oklahoma banks had a 30 percent loan to deposit ratio in 1950, this ratio was at the 59.6 percent level by 1970.[10] Although deposits and capital have increased substantially in the past, banks will face a serious liquidity problem if loan demand and deposit and capital accounts continue to grow at the same rate as has occurred in the last twenty years.

Rural banks are in a position to be a valuable asset to the progressive farmer. A bank can provide complete financial services at a local level. However, some banks are having increased difficulty in meeting the financial requirements of their regular customers.[11] As has been pointed out, individual farm loan demand has increased nine

times during the 1950-1970 period. Bank capital accounts have increased only 4½ times. These growth rates indicate a severe problem for banks, in that individual loan size has increased approximately two times faster than the average loan limit of Oklahoma banks.

A number of new institutions and changes in existing regulations and procedures have been proposed to solve the problems that rural banks face in supplying agricultural credit. However, before these changes can be evaluated, it is imperative that the current institutions and arrangements which can be used to augment loanable funds for rural banks are described and analyzed.[12]

External Sources of Funds

A number of alternative means are available to facilitate the acquisition of funds by commercial banks and increase the availability of debt capital in rural areas. A correspondent arrangement is the most frequently used method to increase funds availability for rural banks. Also, the Farm Credit System presently offers three methods for commercial banks to increase local loanable funds. These mechanisms are the Agricultural Credit Corporation (ACC), direct line discounting with the Federal Intermediate Credit Bank (FICB) and the Production Credit Association (PCA) participation agreement.

The purpose of an ACC is to make short and intermediate term loans to farmers and ranchers and to endorse and sell or discount those loans to the FICB. Controlling regulations regarding ACC's are contained in the Agriculture Credit Act of 1923 as amended by the Farm Credit Acts of 1933, 1956, and 1971.[13] Individual state regulations may also affect an ACC. A rediscount agreement must be entered into

by the ACC with the FICB and the set of requirements for formation of the ACC as enumerated by the FICB must be met before an ACC can become operational.

There are several instances where an ACC may prove to be quite helpful to a commercial bank. A large overline--or a loan request for an amount greater than the bank's legal loan limit--may be serviced by the ACC when it would not be possible to handle the customer in any other manner. Several variations of cases where the loan demand may exceed the bank's loanable funds can also be handled through an ACC.

The "direct line" is also a method of rediscounting with the FICB. Any commercial bank which enters into a rediscounting agreement with the FICB is allowed to send it's notes directly to the FICB. The direct line has not been used too extensively because the FICB has set a relatively low limit on the amount of discounting an individual bank may do. Also, notes discounted are on a recourse basis which requires the bank to repay the note to the FICB if the person who borrowed the money defaults. However, more banks may be willing to use this mechanism if it is found to be profitable to the bank.

A participation agreement allows Production Credit Associations to lend funds to farmers jointly with commercial banks. The Farm Credit Administration has not set forth all of the guidelines to be used by the PCA in executing the papticipation agreement. However, any borrower whose loan involves PCA participation must apply for membership in the PCA, subscribe to the stock of the PCA and negotiate a note payable to the PCA.

A recent survey of agricultural bankers indicated only a limited number of them would participate with a PCA in making loans.[14] In the

Plains states, 35 percent of those surveyed indicated they would not participate, 31 percent indicated they would participate and 34 percent had no opinion. If the participation agreement was proven profitable to the bank, more bankers might be willing to use this mechanism for obtaining additional funds.

The last external funds source considered in this study is the correspondent arrangement. The use of correspondent overlines allows a rural bank to increase the availability of loanable funds if the correspondent balances are not too high and the correspondent bank is willing to carry the overlines. However, in many cases the rural bank is required to keep a substantial correspondent balance at the larger bank to compensate the correspondent for those services it provides.

Objectives

The primary objective of this study is to evaluate alternative methods which commercial banks can use to increase loanable funds for agriculture. Secondary objectives of this study are:

1. to describe the legal requirements concerning a PCA participation agreement, Agricultural Credit Corporation and FICB direct line discounting;
2. to determine under what conditions these above mentioned sources of external funds would be most profitable to the bank.

The information from this study can be useful for decision makers not only at the firm level but also at the policy level. Funds availability is a serious problem for many rural bankers. The results from this study will be useful in evaluating the profitability of

alternative sources of funds and the potential of using these sources to provide more credit for the agricultural sector.

Review of Literature

Prior to the early 1960's, most bankers tended to consider the sources of funds or the liability side of their balance sheet as exogenous or given. As markets developed for Certificates of Deposits, Fed Funds, Eurro-dollars and as the availability and cost of time and savings deposits increased, the concept of liability management developed.[15] This increased interest in the sources of loanable funds or the liability as well as the asset side of the balance sheet created a need for a whole firm analysis of bank management problems. One such method of whole firm analysis is linear programming.

The first work of any significance that applied linear programming to the simultaneous analysis of the asset and liability structure of a commercial bank was presented by Chambers and Charnes in 1959.[16] Chambers and Charnes used a five year intertemporal model to maximize returns over the five year planning horizon. The model considered the asset, liability, and capital structure of a bank along with the capital requirements and liquidity requirements as defined by the Federal Reserve System. Chambers and Charnes' model was not used extensively after its development. The model was purposely over-simplified because computer programs had not yet been developed to solve L.P. problems. Therefore, the study was of more theoretical than empirical value.

Waterman and Gee presented their adaptation of a single period linear programming model to a bank in 1963.[17] The model again was

over-simplified in that it only considered one period as was formulated only in terms of assets. Although the model did indicate an increase in profit over the planning period compared to traditional analysis procedures, the results remain questionable because the model only included one period and it did not consider the effect of the liability side of the balance sheet on the bank's profitability. Waterman and Gee suggested the use of Bayesian statistics and probabilities to incorporate uncertainty into the L.P. framework.

In 1967, Cohen and Hammer described in narrative form, a multi-period L.P. model they developed at Bankers Trust Company.[18] The model is an apparent improvement over the previous work although no empirical results were presented. The model includes risk constraints, several policy considerations, dynamic aspects, and economic and institutional conditions of the market place which are essential in making optimal asset management decisions.

Research into the problems of portfolio management and the availability of alternative sources of funds for rural banks is rather limited. Realizing that the previous models could not be used for rural conditions, Frey developed a L.P. model for rural commercial banks in 1970.[19] Frey determined the optimum asset allocation over a three year planning horizon for a rural bank with approximately $7,000,000 of deposits. Although Frey considered internal sources of funds and various policy changes, he did not evaluate all external sources of funds available to rural banks.

More recently, Benjamin has described the various external sources of funds available to rural banks.[20] He discussed some of the advantages and disadvantages of the various sources and to what

extent the external sources are currently being utilized. However, no empirical analysis was conducted. Barry and Hopkin developed an analytical model to evaluate the effectiveness of financial intermediation in agriculture.[21] They presented a decision model of a bank which incorporates asset and liability management decisions into a linear programming framework. Again, no empirical results were presented.

Organization of Study

In the following chapters the theoretical concepts and analytical procedures that can be used to evaluate various methods of increasing loanable funds for rural banks will be developed and applied. Chapter II will specifically discuss that economic theory applicable to this study and also describe the evolution of the concepts of portfolio management. Also, a detailed discussion of the legal requirements of the four external sources of funds will be presented in Chapter II. Chapter III will summarize the analytical model used in the empirical evaluation of these alternative funds sources. Chapter IV will present the results and analysis of the study, while Chapter V will contain the conclusions and make recommendations for further research.

FOOTNOTES

[1]The Balance Sheet of the Farming Sector, E.R.S., U.S.D.A., Bulletin No. 356 (December, 1971), p. 27.

[2]Ibid., p. 2.

[3]John R. Brake, "Impact of Structural Changes on Capital and Credit Needs", Journal of Farm Economics, Vol. 48, No. 5 (December, 1966), p. 1541.

[4]The Balance Sheet of the Farming Sector-1970, E.R.S., U.S.D.A., Agriculture Information Bulletin No. 350, p. 2.

[5]Brake, Journal of Farm Economics, Vol. 48, No. 5.

[6]Robert B. Tootell, The Co-op Bank Messenger, Omaha Bank for Cooperatives (March, 1959), p. 4.

[7]Gene L. Swackhamer and Raymond J. Doll, Financing Modern Agriculture: Banking's Problems and Challenges, Federal Reserve Bank of Kansas City (May, 1969), p. 40-41.

[8]FDIC Operating Statistics, FDIC (1950-1970).

[9]Ibid.

[10]Ibid.

[11]Swackhamer, Financing Modern Agriculture: Banking's Problems and Challenges, p. 10-11.

[12]C. B. Baker, J. A. Hopkin, and C. K. Brinegar, "Research in Financial Intermediation with Respect to Agriculture", Research and Teaching Programs in Agriculture Finance, Agriculture Finance Program Report No. 2, Department of Agricultural Economics, University of Illinois (October, 1970), p. 7.

[13]United States Code, 1970 Edition and Supplements, United States Government Printing Office, Title 12, Chapter 7, Sec. 636-1148 (Washington: 1971).

[14]The American Bankers Association, "What Agricultural Bankers are Saying", Publication 731, Summary of the 1972 Agricultural Banker Opinion Survey (January, 1972).

[15]Paul S. Nadler, "Liability Management: Banking's Quiet Revolution", Banking, (March, 1967), p. 5. Walter G. Woodworth, "Bank Liquidity Management: Theories and Techniques", The Bankers Magazine, Vol. 150, No. 4 (Autumn, 1967), p. 66-78.

[16]D. Chambers and A. Charnes, "Inter-Temporal Analysis and Optimization of Bank Portfolios", Analytical Methods in Banking, Ed. Kalman J. Cohen and Frederick S. Hammer, Homewood: Richard D. Irwin, Inc. (May, 1966), pp. 67-86.

[17]Robert H. Waterman, Jr. and Robert E. Gee, "A New Tool for Bank Management: A Mathematical Model in Banking", Analytical Methods in Banking, Ed., Kalman J. Cohen and Frederick S. Hammer, Homewood: Richard D. Irwin, Inc. (May, 1966), pp. 55-62.

[18]Kalman J. Cohen and Frederick S. Hammer, "Linear Programming and Optimal Bank Asset Management Decisions", The Journal of Finance, Vol. XXII, No. 2 (May, 1967), pp. 147-165.

[19]Thomas L. Frey, "Optimal Asset Liability Decisions for a Rural Bank: An Application of Multiperiod Linear Programming", unpublished Ph.D. Thesis, University of Illinois (1970).

[20]Gary L. Benjamin, "Rural Bank Needs for External Funds", Business Conditions, Federal Reserve Bank of Chicago (May, 1972).

[21]Peter J. Barry and John A. Hopkin, "Financial Intermediation in Agriculture: A Suggested Analytical Model", Technical Article No. 9420, Texas Agricultural Experiment Station, Texas A&M (1972).

CHAPTER II

CONCEPTIONAL FRAMEWORK AND LEGAL REQUIREMENTS OF EXTERNAL SOURCES OF FUNDS

This chapter will just present a discussion of the economic theory applicable to the banking industry. Concepts of profit maximization of the firm and bank portfolio analysis will be reviewed. The theoretical discussion will be followed by a review of the coordination mechanisms identified in Chapter I, emphasizing legal and Farm Credit Administration requirements.

Theoretical Concepts

The Nature of Competition in Commercial Banking

Competition is regarded as that force which assures adequate market performance by a given group of firms in a given industry. Competition is generally classified as perfect or imperfect competition. In order for perfect competition to exist, an industry must exhibit the following characteristics: (1) homogeneity of the product, (2) many buyers and sellers in the market, (3) absence of artificial restraints on entry or exit from the market, (4) mobility of goods and resources existing in the economy, and (5) perfect knowledge on the part of consumers and producers.[1] Imperfect competition exists when one or all of the conditions for perfect competition do not hold.

The economic theory applicable to banking markets is most realistically monopolistic competition, since there are at least six ways banking departs from a perfect market.[2] These six ways are: product differentiation, small number of sellers, imperfect knowledge of market opportunities, collusion, limited entry and governmental price fixing.

Equilibrium conditions for a commercial bank operating in an environment of monopolistic competition are illustrated in Figure 1. First, consider the loan demand faced by the bank. The demand curve for loans is actually the marginal value production (MVP) curve of the farmer's and other individuals who borrows the bank's funds. The MVP curve represents the value to the borrower of an additional unit of borrowed capital from the bank. The bank faces a separate demand curve for each risk class and maturity of loan, because the borrower of the funds has alternative MVP curves depending on the risk involved and the maturity of the loan.

A bank's demand curve slopes downward and to the right. Each additional unit of capital adds less to the farmer's total product, assuming the farmer is in Stage II on his production surface and diminishing marginal returns exist for his operation. The downward sloping MVP curve which the bank faces indicates declining returns to the bank and declining interest cost to the borrower. The bank can only increase its quantity of loans of a given maturity and risk if it is willing to accept a lower rate of interest for the increased loan volume. The marginal revenue (MR) curve is derived from the demand curve in the usual manner.

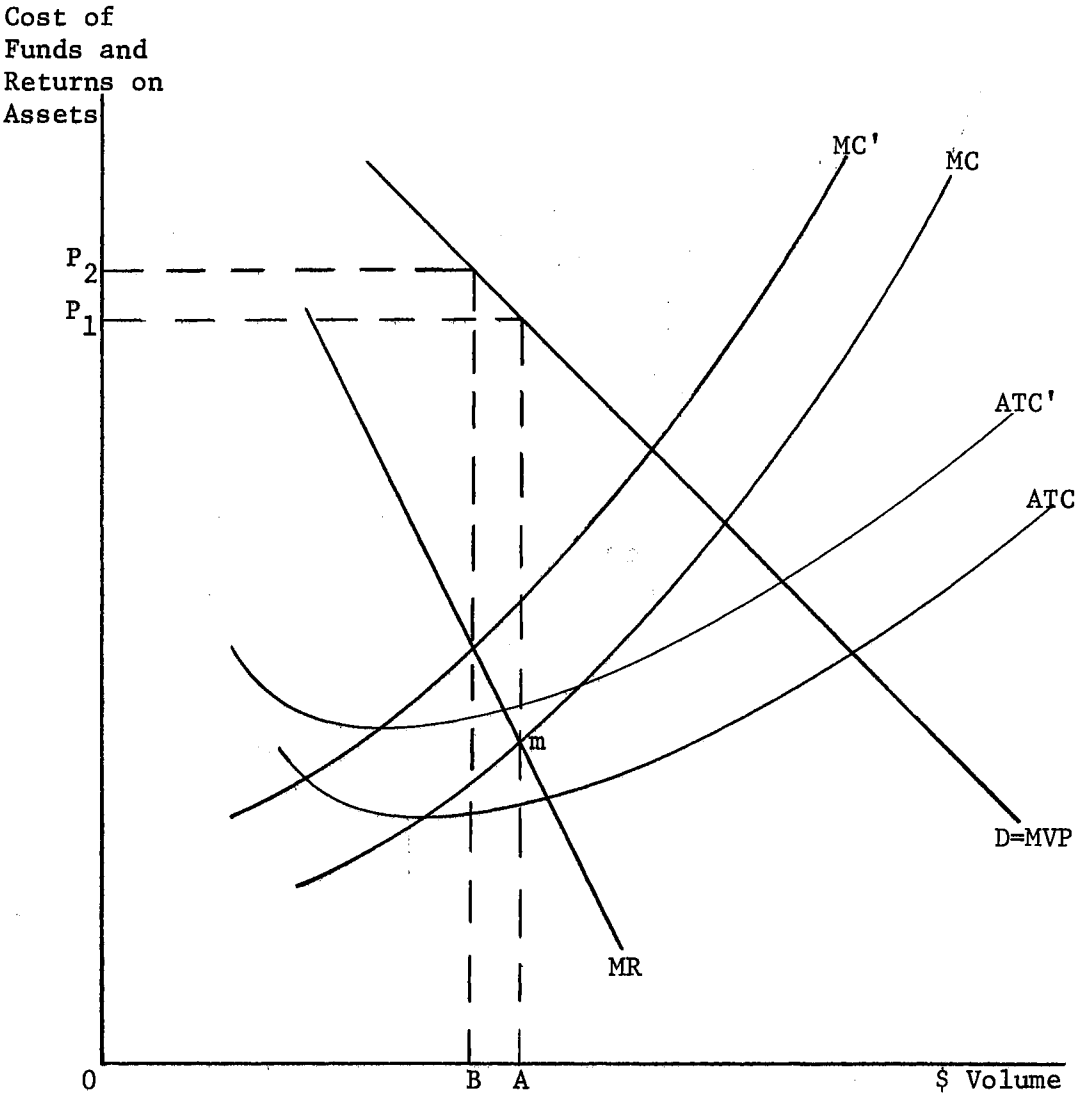

Figure 1. Theoretical Point of Operation for the Bank

The average total cost (ATC) function of Figure 1 represents the cost that is required to obtain funds from the public. The bank, in order to attract the maximum volume of loanable funds, must be willing to increase its cost. By increasing the rate paid on savings accounts or offering negotiable certificates of deposits, the bank can attract additional funds. Thus, the ATC curve and the related marginal cost (MC) curve are traditionally shaped.

The firm which is operating in an imperfect market maximizes profits at the point where MR equals MC.[3] This point is denoted by M in Figure 1. The unconstrained profit maximizer will provide OA of loanable funds at a price of OP_1 under these conditions. But, for a commercial bank, the equilibrium point may lie elsewhere.

Banks are required by law to hold "legal reserves" in non-interest bearing form against their deposit liabilities. This requirement necessarily reduces the productivity, or yield, of a bank's aggregate asset structure.[4] Assuming a bank has fifteen percent of its assets in non-earning assets (legal reserves), it cannot act as an unconstrained profit maximizer or it cannot push volume to the point where MC equals MR in Figure 1.

A bank incurs the same total cost regardless of whether it can invest all of its funds in earning assets or not. In Figure 1 the ATC and MC curves indicate the unit cost when all funds are invested in earning assets as is the case for the unconstrained profit maximizer. The ATC' and MC' curves show the unit cost when the bank has fifteen percent required reserves in non-earning assets. Thus, the bank is constrained such that even though it has a given amount of funds for investment, only a percentage of these funds can be actually invested.

Thus, banks are neither willing or able to increase volume to the point OA (MC = MR), the profit maximizing point for the unconstrained firm. The bank is forced to operate at volume OB and charge a price of OP_2. This point is where MR = MC' and the bank operates at this point because of the legal reserve requirements.

Although the bank profit maximization problem can be solved in the above manner assuming a given maturity and risk level, it is difficult to simultaneously solve for the profit maximizing point when all combinations of risk and maturity are considered. Over the years, several methods have been used to arrive at the profit maximizing point for commercial banks.

Portfolio Management and Analysis for Banks

Bank portfolio management is concerned with the optimal combination of sources and uses of funds by banks to maximize profits. Cohen and Hammer suggest that there are five concepts of portfolio management with which bank management personnel should be concerned: (1) the trade off between yield and liquidity, (2) the interactions among the various balance sheet accounts, (3) the dynamic aspects of portfolio management, (4) the implications for cost accounting and information systems, and (5) the recognition of uncertainty.[5] Recognizing these concepts, various methods of portfolio management have been developed.

Pooled Funds Approach

The pooled funds approach to portfolio management was predominant in the 1930's and 1940's.[6] The banker which used this approach "pooled" all of his funds available for investment. He then invested

these funds in the various assets without recognizing the varying velocity and cost of the funds invested or the yield from the investment. Bankers were able to approach asset management in this fashion due to the large amount of excess reserves in the banking system. This approach ignored the need for liquidity because there were substantial excess reserves in the banking system. As the banking system's excess reserves deteriorated and loan demand increased, banks were forced to compete for loanable funds. Banks thus became more reliant on interest bearing time deposits rather than interest free demand deposits, and a need was created for a more sophisticated method of asset management.

There are two major weaknesses associated with the pooled funds approach to asset management. The first weakness is that the composition of a bank's assets should not be determined independently of the composition of its liabilities.[7] The interactions between assets and liabilities are ignored by the pooled funds approach. The second major weakness is that the pooled earnings rate misrepresents the relative desirability of different sources of funds.[8] The pooled funds approach assumes that each dollar of liabilities and capital funds is invested proportionately in all assets. Thus, the relative profitability of different funds sources is not recognized.

Asset Allocation

The asset allocation concept of portfolio management developed when bankers were required to determine whether it was profitable to bid for savings deposits to increase their loanable funds.[9] Asset allocation assumes funds are invested in various asset categories in direct relation to the sources of funds.[10] This "earmarking" of funds

is accomplished by considering the velocity (turnover rate) of the source of funds. The velocity of the source of funds determines the type of asset in which the funds should be invested. Thus, relatively stable funds (time deposits) are invested in longer term, higher yielding assets while demand deposits which are less stable are invested in short-term loans or other highly liquid assets. An empirical comparison of pooled fund and asset allocation approaches to funds management proved asset allocation to be superior. Asset allocation resulted in a reduction of vault cash and changes in investments by the bank. These changes resulted in an increase in yield on investments from 3.69 percent to 4.16 percent. This increase in yield resulted in an increase in net earnings of nearly 13 percent for the bank.[11]

However, there are problems with the asset allocation approach as indicated by Cohen and Hammer.[12] The first problem stems from the basic premise that available funds should be used to support assets of similar velocity. This argument implies, for example, that demand deposits should be used for short-term loans or investments because of their high velocity. However, it is possible for a large portion of a bank's demand deposits to be highly stable. Thus, they could be used for longer term, higher yielding investments and loans. Another problem with asset allocation is that it is basically a static analysis and completely ignores the time aspect of portfolio management. By ignoring the time aspect, too much emphasis is placed on shortrun decisions. This could possibly reduce the banks profitability in the longer run.

Management Science

The management science approach to portfolio management is a total system approach based on an optimization plan for the bank. This approach does not represent a new definition of problems associated with portfolio management, but the adaptation of more powerful analytical methods to the problems. One of the new methods used in the management science approach is linear programming (L.P.) analysis. Linear programming can determine an optimum that considers the characteristics of both assets and liabilities as well as all of the interrelationships between the various groups of assets and liabilities.

A linear programming model can be specified to maximize a revenue function or minimize a cost function subject to a set of linear inequalities which define the input constraints on the various processes in the model. In the earlier discussion concerning the profit maximizing point for the bank, a marginal analysis model with continuous and differentiable functions was used. Although the L.P. approach and the marginal analysis approach do not have exactly the same underlying assumptions--both methods maximize profit subject to the respective cost and production function. The pooled funds and asset allocation approaches are not based on concepts of economic theory. In contrast, the L.P. approach of management science uses the concepts of economic theory and indicates the point of maximum profit based on these concepts.

Further advantages of using linear programming in determining optimal portfolio management are enumerated by Gee and Waterman.[13] These advantages are: (1) the construction of a model gives the bank additional insight into its everyday operations, (2) the model gives

the bank management personnel a way of testing and quantifying the effects of policy decisions, (3) the portfolio designed by the model gives the bank a way to set goals and evaluate performance, and (4) the model lends itself to an effective technique for planning future investments in the face of uncertainty.

External Funds Sources

The management science approach can be used not only for internal funds management, but also to assist in evaluating alternative external funds sources. However, to accurately incorporate these sources in the analysis, their legal, financial and operating characteristics must first be identified.

Agricultural Credit Corporations

A commercial bank which is using an Agricultural Credit Corporation (ACC) to rediscount loans with the Federal Intermediate Credit Bank (FICB) faces numerous regulatory bodies. The bank must adhere to state corporate laws, state and national bank regulations and Federal Intermediate Credit Bank regulations.

State Corporate Laws

A bank or any other party which desires to form an ACC must first meet state corporate requirements before they can enter into the rediscounting agreement with the FICB. If the ACC is not complying with state laws, the FICB can revoke the rediscounting privilege.[14]

Articles of incorporation must be filed with the Secretary of State and must be approved before the corporation can become a legal

entity. In addition to the numerous state requirements for incorporation, the articles of incorporation must contain the following items as required by the Wichita FICB.[15] The ACC's purpose is: (1) to make loans or advances to persons engaged in producing or producing and marketing agricultural products, including all crops and livestock; (2) to endorse and sell or discount to the FICB any obligation received from a person to whom the ACC has made a loan; (3) to guarantee the repayment of the loan; (4) to transfer to the FICB any chattel mortgages or other securities which the ACC may require in transacting business; (5) to own, hold, or sell any real or personal property as the purpose of the ACC may require in transacting business; (6) to borrow money from the FICB under the provisions of the Agricultural Credit Act of 1923. The articles must also indicate that the ACC shall make no loans to any person unless the loan is for agricultural purposes.

State Banking Laws

The Oklahoma state banking laws contain only one regulation which specifically concerns the formation and operation of an ACC.[16] A bank may not invest more than 10 percent of the capital stock and surplus plus undivided profits, or an amount exceeding the undivided profits, whichever is greater in an ACC. Oklahoma banking laws do not prohibit state banks from jointly forming an ACC. They do not require the ACC to make any reports to the State Bank Commissioner's office nor are regular state examinations required. However, the Bank Commissioner's office does have the authority to examine or require reports from the

ACC if the office should choose. The State Banking Code does not regulate loan limits of an ACC.

Farm Credit System and FICB Regulations

The 1971 Farm Credit Act specifies a number of criteria which must be met before a rediscount agreement with an ACC will be approved. In general, the ACC must prove

> ...that there is a continuing need for such discounts...to continue to serve the volume of agricultural loans at least equal to its average volume of such loans for the past three years, and that the need is not the result of denial or restrictions on discount privileges or other means of obtaining lendable funds customarily available to it.[17]

Specifically, the following criteria must also be met.

1. The commercial bank involved as an applicant or parent of an ACC shall have not less than 25 percent of its total loan portfolio in agricultural loans.

2. The gross loan to deposit ratio of the bank shall not be less than 60 percent at the seasonal peak.

3. The participation approach with the Production Credit Association is either unavailable or would not be of assistance to the institution in serving the credit needs of its borrowing farmers and ranchers, but the failure of the institution to participate with a Production Credit Association shall not of itself be cause for denial or revocation of borrowing or discount privileges.

These general criteria also apply to the approval of direct line discounting which will be discussed later.

In addition to these general criteria, District Federal Intermediate Credit Banks have the authority to specify operational procedures and loan requirements of Agricultural Credit Corporations within their district. The following regulations specified by the Wichita District FICB provide an insight into the operational requirements and procedures of ACC's.[18]

Formation and Operation. FICB regulations concerning formation of Agricultural Credit Corporations are quite explicit. The minimum paid-in-capital currently required for a new corporation is $200,000. In addition, eligible ACC's are required to pledge to the FICB acceptable securities equal to ten percent of the ACC's approved discount line. Such securities as cash, government issued securities, FICB debentures, consolidated Federal Farm Loan Bonds, consolidated Bank for Cooperatives Debentures, Federal Home Loan Bank notes, state or municipal bonds (which are rated "A" or better in Moody's)or negotiable certificates of banks in the Ninth Farm Credit District (not to exceed $20,000 from any one bank) are acceptable. A fidelity bond of $100,000 is required for active employees of the ACC as long as the approved discount line is $2 million or less. If the ACC has an approved line of over $2 million, each employee must be covered by a $200,000 fidelity bond.

The maximum discount line for any Agricultural Credit Corporation is limited to ten times pledged collateral or seven times paid-in and unimpaired capital and surplus. Even though this is the legal limit, the Wichita district limits the discount line to seven times the pledged collateral. A new ACC in the Wichita district is limited to a maximum initial discount line of four times the unimpaired capital and surplus. This initial limit is usually lifted after one year of operation or after the FICB has made the first examination of the ACC. The Executive Committee of the District FICB is the governing body in setting discount lines of ACC's.

Agricultural Credit Corporations are also required to invest in FICB participation certificates in the amount of five percent of the

total approved discount line. This investment does not have to be made at one time, but one-third of the required investment must be made upon initial approval of the discount line. The ACC is allowed a maximum of two years to complete the required investment. If the ACC should request and receive an increase in their discount line, they must then invest in additional FICB participation certificates until they reach the level of five percent of the approved discount line.

Requirements for Short and Intermediate Term Loans. The following discussion of loan requirements is concerned with both short and intermediate term loans. The Wichita District FICB has specified additional regulations dealing with intermediate term loans only. These regulations, which deal with maturities, down-payment, and amount of the purchase, will be discussed later.

An ACC can charge the borrower only an interest rate of four percent over the current discount rate being charged by the FICB. The FICB rate is determined by the average interest rate being paid on their debentures, plus a predetermined spread. This limits the Agricultural Credit Corporation to a four percent spread on existing loans.

All loans of an Agricultural Credit Corporation must be strictly for agricultural purposes. The individual who secures the loan must be engaged in farming, ranching or other agricultural production. The loans that the FICB rediscounts should be of such character as to assure liquidation of the note within a reasonable time period. The Federal Intermediate Credit Bank must approve every loan they rediscount, so the ACC usually sends only quality loans for rediscounting.

Limits are specified on the maturity of loans discounted with the FICB. The maximum maturity is seven years. The FICB, in many cases,

must give prior approval on loans of over five years. Livestock loans should usually not be for a period of over 12 months.

If an ACC should desire to make a loan which exceeds fifty percent of the paid-in and unimpaired capital and surplus or $50,000, whichever is greater, the Farm Credit Administration must approve the loan before it can be rediscounted with the district FICB. An ACC should try to receive prior approval on any large loans so they can be sure it will be accepted by the FICB.

An ACC cannot borrow money from any other lender other than the FICB. There is one exception to this rule, however. An ACC which is affiliated with a bank may borrow money from that bank under the following conditions: the loan must mature within 15 days, the total liabilities of the ACC shall not exceed the maximum liability-to-capital ratio as set by the FICB, and any such loans to the bank affiliated ACC must be reported to the FICB.

The ACC must take full responsibility for all notes it discounts with the FICB. All notes must be endorsed with full recourse by the ACC. Thus, if for some reason a farmer cannot pay the note, the ACC is liable for the amount of the loan.

Additional Requirements for Intermediate Term Loans. Loan maturities may not exceed forty months on equipment purchased for $6,000 or less. This includes dairy equipment. On all equipment, except dairy, a one-third down payment is required. The down payment is based on actual cost, not list price. On dairy equipment, where payments are to be made on a monthly basis, up to eighty-five percent of the actual cost can be loaned to an operator. The ACC can make machinery loans

with a maturity of five years if the amount of the loan is in excess of $6,000. Down payment requirements are the same for loans under $6,000.

The ACC can also make real estate loans, although they probably are not too practical. The main hindrance to making real estate loans is that all loans an ACC makes must be repaid in seven years. If a farmer should borrow the maximum he is allowed of 85 percent of current market value, it would be difficult to repay the note in this seven year period. The FICB will not accept second mortgages on real estate, only first mortgages or trust deeds.

It is possible for a borrower to have more than one intermediate term loan with the ACC at a time. Each loan is treated separately by the FICB. Each loan must stand on its own merits and be properly documented before the FICB will discount the note. The FICB will not allow any renewals of intermediate term notes past the original maturity date. A borrower who needs additional funds can receive additional advances if the schedule payments on the additional advance have the same payment date as the dates of the remaining installments due on the original loan. Extensions may be made on the final installment, but only on the final installment.

Participation Agreement

The Farm Credit Act of 1971 allows commercial banks and Production Credit Associations (PCA) to cooperate in extending loans to farmers.[19] For example, the participation agreement would allow commercial banks to send their overlines to a PCA. As of the writing of this thesis the Farm Credit Administration has not set up all the guidelines to

be used in executing the participation agreement. However, PCA participations have been used on a trial basis for two years in the Spokane Farm Credit District. The guidelines used during this trial period were: (1) the PCA could reject participation in any loan proposed by the commercial bank, (2) loand should be limited to annual maturities, (3) provisions restricting the borrower's right to full PCA financing should be avoided, (4) the commercial bank should provide the maximum loan permitted by the banking regulations to which it is subject, but in no event provide an amount less than fifty percent of the total loan, (5) the participation agreement shall clearly define the provisions for disbursement and repayment of the loan funds, division or assignment of collateral, collection procedures, loss-sharing and conditions for termination of the agreement.

Any borrower whose loan involves PCA participation must execute a proper application for PCA membership and subscribe to the stock and equity reserve as prescribed by PCA by-laws. It would appear that the final guidelines for the participation agreement will be similar to those used during the trial period.

FICB Direct Line Discounting

The direct line involves a direct rediscounting arrangement between a commercial bank and the FICB. The bank makes a loan to one of its customers and then "sells" the note to the FICB. This transaction allows the local bank to provide more funds to the local community. The commercial bank is limited in the amount of loans it can rediscount with the FICB to a maximum of two times its capital and surplus. The regulations on length of loan, amount of interest rate

above the FICB rate, type of loan and collateral needed for rediscounting by the direct line method are the same as discussed earlier for the Agricultural Credit Corporation.

The Correspondent Arrangement

There are no written regulations governing the correspondent relationship. A country bank and its correspondent bank work out the type of agreement they feel is convenient to both parties. In most correspondent arrangements the country bank receives a predetermined portion of the interest charge to service the note. The correspondent also provides other services such as check clearing and handling the country bank's bond portfolio.

Generally, a country bank is required to maintain compensating balances at its correspondent bank. The overlines the correspondent participates in are usually limited to some proportion of the correspondent balances kept by the rural bank at the city bank. State chartered banks are allowed to use these compensating balances to meet reserve requirements. Nationally chartered banks must either keep their required reserves in their bank or in a Federal Reserve Bank. Thus, nationally chartered banks are forced to have additional cash deposited at their correspondent bank. Although, the correspondent system has been successfully used by aggressive rural banks, it has been suggested that the net flow of funds through the correspondent system is frequently from rural communities to urban centers.[20]

FOOTNOTES

[1]Richard H. Leftwich, The Price System and Resource Allocation, 4th Ed. (Hinsdale, 1970), pp. 26-27.

[2]For a discussion of "monopolistic" or "imperfect" competition the reader may find this description in any current text in economics. Leftwich, Ibid., Chapters 10, 11, and 12.

[3]Leftwich, pp. 271-272.

[4]James Tobin, "Commercial Banks as Creators of 'Money'", D. Carson, Ed., Banking and Monetary Studies (Homewood, 1963), pp. 408-419.

[5]Kalman J. Cohen and Frederick S. Hammer, Ed., Analytical Methods in Banking (Homewood, 1966).

[6]Kalman J. Cohen, Frederick S. Hammer and Howard M. Scheider, "Harnessing Computers for Bank Asset Management", The Bankers Magazine, Vol. 150, No. 3 (1967), pp. 72-80.

[7]Ibid., p. 73.

[8]Ibid.

[9]Fred G. DeLong, "Liquidity Requirements and Employment of Funds", Kalman J. Cohen and Frederick S. Hammer, Ed., Analytical Methods in Banking (Homewood, 1966), pp. 38-53.

[10]Ibid., p. 38.

[11]Ibid., pp. 38-53.

[12]Ibid., PP. 45-53.

[13]Robert H. Waterman, Jr. and Robert E. Gee, "A New Tool for Bank Management: A Mathematical Model in Banking", Innovations in Bank Management: Selected Readings (1969), pp. 293-300.

[14]Mandatory Provisions for Articles of Incorporation and By-Laws of Agricultural Credit Corporations, Budget Bureau No. 108-R-0034, FICB, Wichita, Kansas.

[15]Ibid., p. 4.

[16]Oklahoma Statutes, 1970 Supplement, Title 6, Chapter 1, Article VIII, Section 806 (St. Paul, 1970).

[17]Federal Register, Farm Credit Administration, Title 12, Chapter 6, Part 614, Subpart Q, Vol. 37, Number 110, Part II, Wednesday (June 7, 1972).

[18]The requirements are summarized from: Mandatory Provisions for Articles of Incorporation and By-Laws of Agricultural Credit Corporations, Budget Bureau No. 108-R-0034, FICB, Wichita, Kansas; Requirements and Procedures for Financing Institutions Rediscounting with the Federal Intermediate Credit Bank of Wichita, Revised Edition (October, 1969).

[19]Federal Register, Farm Credit Administration, Title 12, Chapter 6, Part 614, Subpart C, Vol. 37, Number 110, Part II, Wednesday (June 7, 1972).

[20]Robert E. Hamilton, "Banking Sources of Funds", Preliminary Report of the ABA Task Force on Bank Sources of Funds, Proceedings of the 20th National Agricultural and Rural Affairs Conference, Kansas City, Missouri (November, 1971), p. 4; Gene L. Swackhamer and Raymond J. Doll, Financing Modern Agriculture: Banking's Problems and Challenges, Federal Reserve Bank of Kansas City (1969), pp. 55-56.

CHAPTER III

THE EMPIRICAL MODEL

To analyze the optimal acquisition and utilization of funds for commercial banks, a multi-period linear programming model of a bank firm is utilized. The purpose of this chapter is to first specify the general linear programming model and to summarize the assumptions required to use this model. This discussion will be followed by a description of the specific model used in the empirical analysis.

The Multi-Period Analytical Model

A three year linear programming model of a rural bank is used in the empirical analysis, with each year divided into two six month periods. The model is not designed to provide day to day management information for bankers, but rather to determine the optimum acquisition and allocation of funds. Two major assumptions underlie this study. First, it is assumed that the bank is striving to maximize discounted net returns over the planning horizon. Second, the bank is assumed to be a nationally chartered bank. However, the results and implications are also applicable to state chartered banks.

The basic structure of a multi-period linear programming model has been summarized by Heady.[1] The simultaneous solution, multi-period model can be mathematically formulated as:

Maximize:

$$\pi = \frac{\sum_{j=1}^{n} \sum_{k=1}^{t} C_{jk} X_{jk}}{(1 + r)^{k}} \tag{3-1}$$

Subject to:

$$\sum_{j=1}^{n} a_{ijk} X_{jk} \leq B_{ik} \tag{3-2}$$

and

$$X_{jk} \geq 0 \tag{3-3}$$

Where:

π = the total net returns discounted over the planning horizon,

C_{jk} = the net return of one unit of activity in period k,

X_{jk} = the level of the jth activity in period k,

r = the discount rate,

a_{ijk} = the amount of resource i used in activity j in period k, and

B_{ik} = the amount of resource i available in period k.

The objective function maximizes discounted net returns over the planning horizon. A discount rate of seven percent was used in this study.

A set of specific assumptions are also required to use the linear programming analysis method. The specific assumptions are linearity, additivity, divisibility, and finiteness.[2] Additivity implies that when two or more activities are used, their total product must be equal to the sum of their individual products. Linearity implies constant

input-output ratios or constant returns over the relevant range. Finiteness assumes that the number of alternative activities and resource restrictions considered are limited. Divisibility suggests that inputs can be employed and products can be produced in fractional units.

Relevant Data Used in the Model

To obtain empirical results the linear programming model was applied to a case bank. The bank had $6.37 million deposits and $500,000 of capital and surplus in 1971. It is located in a town of 1,200 people in a progressive rural Oklahoma community. The majority of the loans are agricultural in nature and consist of mainly short term notes. The bank's initial balance sheet is presented in Table III.

The loan activities included in the model are a six month (type 1), one year (type 2), two year (type 3), three year (type 4), and ten year (type 5) agricultural loans. A two year installment loan, a two year commercial loan and an eight year municipal bond activity are also included in the model. In addition, six month (type 1), one year (type 2) and three year (type 3) government security activities are included.

In an attempt to keep the model of manageable size, it is assumed that all loans, government securities, and municipal bonds are held until maturity. A constant interest rate for all types of loans, government securities, and municipal bonds is also assumed. All loans, government securities and municipals mature on the first day of the appropriate period, and the money received from the maturing issues can be invested in other assets the same day. The model assumes that

TABLE III

BANK BALANCE SHEET AS OF DECEMBER 28, 1971

ASSETS		CLAIMS	
Loans and Discounts	$5,037,678	Savings	$ 959,987
U.S. Government Bonds	517,000	Certificates of Deposits	2,843,152
Municipal Bonds	900,276	Demand Deposits	2,567,236
Fixed Assets	42,200	Capital and Surplus	500,000
Cash Reserve and Correspondent Balances[a]	713,252	Undivided Profit	75,074
		Federal Funds Purchased	200,000
Total Assets	$7,210,406	Reserve for Losses on Loans	64,959
		Total Liabilities and Net Worth	$7,210,406

[a]Since the model was developed for a nationally chartered bank, the correspondent balances are assumed to not be available to meet reserve requirements, but are compensative balances required by the correspondent.

all assets in the beginning inventory mature in equal amounts over the specified remaining life of the asset. For example, if the beginning balance sheet contained $100,000 of one year agricultural loans, $50,000 would mature the first day of the first period of year one and $50,000 would mature the first day of the second period of year one.

Table IV summarizes the annual cost and return data for the major activities in the model. Much of the cost data came from a cost study that was recently completed for the case bank. The data for returns on government securities and municipal bonds was taken from the Federal Reserve Bulletin for April, 1972. The rates on the various loans made by the bank were determined through conversations with the banker.

Restraints and Activities of the Model

The restrictions included in the model are summarized in Table V. Also, the mathematical type of relation is indicated. The right-hand-side values for each restriction are shown in Table VI. The model contains 281 rows for the three year planning horizon with 5 additional accounting rows which summarize values one day beyond the planning horizon.

The activities included in the model are identified in Table VII. The model contains 310 activities for the planning horizon. The following discussion will describe the specific relationship between rows and activities.

A generalized linear programming matrix for the bank management problem is presented in Table VIII. To eliminate needless repetition,

TABLE IV

GROSS RETURNS, COST AND NET RETURNS PER DOLLAR PER YEAR FOR MODEL ACTIVITIES[a]

ACTIVITY	GROSS RETURN	COST	NET RETURNS
6 month agricultural loan (Type 1)	.041	.00178	.03992
1 year agricultural loan (Type 2)	.082	.002156	.079844
2 year agricultural loan (Type 3)	.082	.001078	.080922
3 year agricultural loan (Type 4)	.082	.001078	.080922
10 year agricultural loan (Type 5)	.082	.001078	.080922
2 year installment loan	.094	.00336	.09044
2 year commercial loan	.0839	.00472	.08054
6 month government security	.02177	.00137	.0204
1 year government security	.0467	.00137	.04533
3 year government security	.0592	.00137	.05783
8 year municipal bond	.0505	.00137	.04913
Demand deposits		.0019	
Time deposits		.04745	

[a]All gross and net returns are for one year (except for 6 month agricultural loans) and are non-discounted values.

TABLE V

MODEL RESTRICTIONS

ROW CODE[a]	ROW DESCRIPTION	RIGHT-HAND-SIDE RELATION[b]	RIGHT-HAND-SIDE ELEMENT[c]
OBJ	Objective function.	N	0
tAF-m	Allocable funds available in year t, period m.	E	b_i[d]
tCR-m	Reserve requirement for year t, period m.	E	0
tLDD-m	Demand deposits for year t, period m.	E[e]	b_i[f]
tLTD-m	Time deposits for year t, period m.	E[e]	b_i[f]
tCS-m	Capital and surplus for year t, period m.	E	b_i[g]
tTLL-m	Total loan limit for the bank and external mechanisms for year t, period m.	L	b_i
tLLn-m	Internal loan limit for year t, loan type n and period m.	L	b_i
tTLLI-m	Total loan limit on installment loans for year t, period m.	L	b_i
tTLLO-m	Total loan limit on commercial loans for year t, period m.	L	b_i
tTLLn-m	Total external and internal loan limit for year t, agricultural loan type n and period m.	L	b_i
tTLLA-m	Total loan limit for the Agricultural Credit Corporation for year t, period m.	L	b_i
tTLLB-m	Total loan limit for the participation agreement in year t, period m.	L	b_i
tTLLC-m	Total loan limit for the correspondent arrangement in year t, period m.	L	b_i
tTLLD-m	Total loan limit for Direct Line discounting in year t, period m.	L	b_i

TABLE V (CONTINUED)

ROW CODE[a]	ROW DESCRIPTION	RIGHT-HAND-SIDE RELATION[b]	RIGHT-HAND-SIDE ELEMENT[c]
tDC2-m[h]	Direct capital requirement for year t, period m.	G	b_i
tLR-m[h]	Liquidity requirement in year t, period m.	E	0
tLR1-m[h]	Liquidity provided by minimum risk, intermediate term and portfolio assets for year t, period m.	G	0
tLR2-m[h]	Liquidity provided by intermediate term and portfolio assets in year t, period m.	G	0
tLR3-m[h]	Liquidity provided by portfolio assets in year t, period m.	G	0
tTC-m[h]	Total capital requirement for year t, period m.	E	0
tAC-m	Actual capital availability in year t, period m (Requires actual capital to be greater than capital requirement).	G	0
tAD-m	Summation row for all deposits in year t, period m.	E	0
tLN-m	Summation row for all internal loans for year t, period m.	E	0
tGS-m	Summation row for government securities in year t, period m.	E	0
tTE-m	Summation row for tax exempts in year t, period m.	E	0
tSTDD-m	Summation row for deposits in year t, period m (Initiates ratio requirements).	E	0
tLND-m	Minimum ratio requirement of internal loans to deposits in year t, period m.	L	0
tLND1-m	Maximum ratio requirement of internal loans to deposits in year t, period m.	G	0

TABLE V (CONTINUED)

ROW CODE[a]	ROW DESCRIPTION	RIGHT-HAND-SIDE RELATION[b]	RIGHT-HAND-SIDE ELEMENT[c]
tTED-m	Maximum ratio requirement of tax exempts to deposits in year t, period m.	G	0
OtGSn-m	Beginning balances of government securities maturing in year t, type n, period m.	E	b_i
OtTE-m	Beginning balance of tax exempts maturing in year t, period m.	E	b_i
OtALn-m	Beginning balance of agricultural loans maturing in year t, type n, and period m.	E	b_i
OtCL-m	Beginning balance of commercial loans maturing in year t, period m.	E	b_i
OtIL-m	Beginning balance of installment loans maturing in year t, period m.	E	b_i
tTP	Taxable profits in year t.	E	0
tNP	Non-taxable profits in year t.	E	0
tTB	Tax bracket for first $25,000 of profits in year t.	L	b_i
tAP	After tax profit in year t.	E	0
1CACC-1	Capital for formation of the ACC in year 1, period 1.	E	b_i
tLFACC-m	Loanable funds of the ACC in year t, period m.	E	0
tTBACC	Tax bracket for the ACC in year t (first $25,000).	L	b_i
tAPACC	After tax profit of the ACC in year t.	E	0
tTPACC	Taxable profits of the ACC in period t.	E	0
4AF-1	Allocable funds available one day beyond the planning horizon.	N	0

TABLE V (CONTINUED)

ROW CODE[a]	ROW DESCRIPTION	RIGHT-HAND-SIDE RELATION[b]	RIGHT-HAND-SIDE ELEMENT[c]
4AD-1	Sum of deposits one day beyond the planning horizon.	N	0
4CR-1	Reserve requirements one day beyond the planning horizon.	N	0
4CS-1	Capital and surplus one day beyond the planning horizon.		
4LFACC-1	Loanable funds available for the ACC one day beyond the planning horizon.	N	0
tFER	Fixed expense for year t.	E	b_i

[a] t = number of the year, t = 1, 2, 3
m = number of the period, m = 1, 2
n = type of agricultural loan and government security by maturity length, n = 1, 2, 3, 4, 5 for agricultural loans, n = 1, 2, 3 for government securities

[b] N = unconstrained G = greater than
L = less than E = equality

[c] 0 = indicates a zero right-hand-side.
b_i = indicates a non-zero right-hand-side which is shown in Table VI.

[d] The allocable funds row only has a positive right-hand-side value for the first period. The remaining periods have a zero right-hand-side.

[e] The first period has an equality (E) to indicate the beginning inventory of demand deposits and time deposits. The remaining periods have L's for the right-hand-side relationship.

[f] The first period indicates the beginning inventory and the remaining values indicate the potential growth rate in demand deposits and time deposits.

[g] The first period indicates the beginning balance of capital and surplus.

[h] The information for these rows was taken from the capital adequacy form used by the Federal Reserve System.

TABLE VI

RIGHT-HAND-SIDE VALUES FOR THE MODEL

ROW	RHS ELEMENT	ROW	RHS ELEMENT
1AF-1	$ 85,702.00	01IL-1	$ 44,021.00
1LDD-1	2,567,235.00	01GS1-1	50,000.00
1LTD-1	2,803,137.00	01GS2-1	37,212.00
1CS-1	586,702.00	01GS3-1	63,666.00
1TLL-1	7,000,000.00	01TE-1	51,500.00
1LL1-1	2,500,000.00	1CACC1	50,000.00
1LL2-1	2,500,000.00	1LDD-2	55,000.00
1LL3-1	700,000.00	1LTD-2	225,000.00
1LL4-1	700,000.00	1TLL-2	7,125,000.00
1LL5-1	400,000.00	1LL1-2	2,500,000.00
1TLL1-1	3,000,000.00	1LL2-2	2,500,000.00
1TLL2-1	3,000,000.00	1LL3-2	700,000.00
1TLL3-1	1,000,000.00	1LL4-2	700,000.00
1TLL4-1	1,000,000.00	1LL5-2	400,000.00
1TLLI-1	100,000.00	1TLL1-2	3,000,000.00
1TLLO-1	50,000.00	1TLL2-2	3,000,000.00
1TLLA-1	332,500.00	1TLL3-2	1,000,000.00
1TLLB-1	200,000.00	1TLL4-2	1,000,000.00
1TLLC-1	800,000.00	1TLLI-2	100,000.00
1TLLD-1	900,000.00	1TLLO-2	50,000.00
1DC2-1	85,000.00	1TLLA-2	332,500.00
01AL1-1	1,232,598.50	1TLLB-2	200,000.00
01AL2-1	616,294.75	1TLLC-2	800,000.00
01AL3-1	195,432.00	1TLLD-2	900,000.00
01AL4-1	34,923.50	1DC2-2	85,000.00
01CL-1	70,433.50	01AL2-2	616,294.75
01AL3-2	195,432.00	1FER	80,000.00
01AL4-2	34,923.50	2DC2-1	85,000.00
01CL-2	70,433.50	02AL3-1	195,432.00
01IL-2	44,021.00	02AL4-1	34,923.50
01GS2-2	37,212.00	02CL-1	70,433.50
01GS3-2	63,666.00	02IL-1	44,021.00
01TE-2	51,500.00	02GS3-1	63,666.00
1TB	25,000.00	02TE-1	51,500.00
1TBACC	25,000.00	2LDD-2	55,000.00
2LDD-1	55,000.00	2LTD-2	225,000.00
2LTD-1	225,000.00	2TLL-2	7,375,000.00
2TLL-1	7,250,000.00	2LL1-2	2,750,000.00
2LL1-1	2,500,000.00	2LL2-2	2,750,000.00
2LL2-1	2,500,000.00	2LL3-2	1,000,000.00
2LL3-1	700,000.00	2LL4-2	1,000,000.00
2LL4-1	700,000.00	2LL5-2	500,000.00
2LL5-1	400,000.00	2TLL1-2	3,500,000.00
2TLL1-1	3,000,000.00	2TLL2-2	3,500,000.00
2TLL1-1	3,000,000.00	2TLL3-2	1,500,000.00

TABLE VI (CONTINUED)

ROW	RHS ELEMENT	ROW	RHS ELEMENT
2TLL3-1	$1,000,000.00	2TLL4-2	$1,500,000.00
2TLL4-1	1,000,000.00	2TLLI-2	200,000.00
2TLLI-1	100,000.00	2TLLO-2	100,000.00
2TLLO-1	50,000.00	2TLLA-2	332,500.00
2TLLA-1	332,500.00	2TLLB-2	200,000.00
2TLLB-1	200,000.00	2TLLC-2	800,000.00
2TLLC-1	800,000.00	2TLLD-2	900,000.00
2TLLD-1	900,000.00	2DC2-2	85,000.00
2FER	80,000.00	3FER	80,000.00
02AL3-2	195,432.00	03AL4-1	34,923.50
02AL4-2	34,923.50	02GS3-1	63,666.00
02IL-2	44,021.00	03TE-1	51,500.00
02CL-2	70,433.50	3LDD-2	55,000.00
02GS3-2	63,666.00	3LTD-2	225,000.00
02TE-2	51,500.00	3TLL-2	7,625,000.00
2TB	25,000.00	3LL1-2	2,750,000.00
2TBACC	25,000.00	3LL2-2	2,750,000.00
3LDD-1	55,000.00	3LL3-2	1,000,000.00
3LTD-1	225,000.00	3LL4-2	1,000,000.00
3TLL-1	7,500,000.00	3LL5-2	500,000.00
3LL1-1	2,750,000.00	3TLL1-2	3,500,000.00
3LL2-1	2,750,000.00	3TLL2-2	3,500,000.00
3LL3-1	1,000,000.00	3TLL3-2	1,500,000.00
3LL4-1	1,000,000.00	3TLL4-2	1,500,000.00
3LL5-1	500,000.00	3TLLI-2	200,000.00
3TLL1-1	3,500,000.00	3TLLO-2	100,000.00
3TLL2-1	3,500,000.00	3TLLA-2	332,500.00
3TLL3-1	1,500,000.00	3TLLB-2	200,000.00
3TLL4-1	1,500,000.00	3TLLC-2	800,000.00
3TLLI-1	200,000.00	3TLLD-2	900,000.00
3TLLO-1	100,000.00	3DC2-2	85,000.00
3TLLA-1	332,500.00	03AL4-2	34,923.50
3TLLB-1	200,000.00	03GS3-2	63,600.00
3TLLC-1	800,000.00	03TE-2	51,500.00
3TLLD-1	900,000.00	3TB	25,000.00
3DC2-1	85,000.00	3TBACC	25,000.00

TABLE VII

MODEL ACTIVITIES

ACTIVITY CODE[a]	ACTIVITY DESCRIPTION
tDD-m	Demand deposits for year t, period m.
tTD-m	Time deposits for year t, period m.
tACR-m	Reserve requirements for year t, period m. (Transfers reserves from period to period.)
tTAF-m	Transfer allocable funds from year t, period m, to the following period.
tTCS-m	Transfer capital and surplus from year t, period m, to the following period.
tBGSn-m	Buy government securities of maturity class n in year t, period m.
tBTE-m	Buy tax exempts in year t, period m.
OtSTE-m	Sell tax exempts from beginning inventory in year t, period m.
OtCALn-m	Collect agricultural loan of maturity class n from beginning inventory in year t, period m.
OtCIL-m	Collect installment loan from beginning inventory in year t, period m.
OtCOL-m	Collect commercial loan from beginning inventory in year t, period m.
tMALn-m	Make agricultural loan of maturity class n in year t, period m.
tMIL-m	Make installment loan in year t, period m.
tMCL-m	Make commercial loan in year t, period m.
tSDC-m[b]	Sum of direct capital requirement in year t, period m.
tSLR-m[b]	Sum of liquidity required in year t, period m.
tSLR1-m[b]	Sum of liquidity requirements provided by minimum risk, intermediate term and portfolio assets in year t, period m.
tSLR2-m[b]	Sum of liquidity requirements provided by intermediate term and portfolio assets in year t, period m.
tSLR3-m[b]	Sum of liquidity requirements provided by portfolio assets in year t, period m.

TABLE VII (CONTINUED)

ACTIVITY CODE[a]	ACTIVITY DESCRIPTION
tSTC-m[b]	Sum of total capital requirements in year t, period m.
tSLN-m	Sum of all internal loans in year t, period m.
tSGS-m	Sum of all government securities in year t, period m.
tSTE-m	Sum of all tax exempts in year t, period m.
tSAD-m	Sum of all deposits in year t, period m.
tTDD-m	Transfer deposits from year t, period m to the following period.
tPTX-1	Pay tax in year t in bracket one (22 percent rate).
tPTX-2	Pay tax in year t in bracket two (48 percent rate).
tPDI	Distribute after tax profit from year t.
1FACC1	Form Agricultural Credit Corporation in period 1 of year 1.
tALAn-m	Make agricultural loan of type n in year t, period m through the ACC.
tALBn-m	Make agricultural loan of type n in year t, period m through the participation agreement.
tALCn-m	Make agricultural loan of type n in year t, period m with the correspondent arrangement.
tALDn-m	Make agricultural loan of type n in year t, period m through the direct line discounting method.
tFACC-m	Transfer loanable funds of the ACC from year t, period m to the following period.
tPTXAC1	Pay tax in year t in bracket one (22 percent rate) for the ACC.
tPTXAC2	Pay tax in year t in bracket two (48 percent rate) for the ACC.
tPDIACC	Distribute after tax profit of the ACC in year t.
tFEA	Fixed expense account for year t.

TABLE VII (CONTINUED)

[a]t = number of the year,	t = 1, 2, 3
m = number of the period,	m = 1, 2
n = type of agriculture loan and government security by maturity length,	n = 1, 2, 3, 4, 5 for agricultural loans, n = 1, 2, 3 for government securities.

[b]The information for these fectors was taken from the capital adequacy form used by the Federal Reserve System.

TABLE VIII

SIX MONTH MATRIX WITH FLOWS TO THE FOLLOWING PERIOD

	LDD-1	1TD-1	1ACR-1	1TAF-1	1TCS-1	1EGSn-1	1ETE-1	01CALn-1	01SGSn-1	01STE-1	1MALn-1	1MCL-1	1MIL-1	1SDC-1	1SLR-1	1SLR1-1	1SLR2-1
OBJ	- .00498	- .12491				+ .0275	+ .12893	+ .0385	+ .023	+ .03	+ .07462	+ .1439	+ .16216				
1AF-1			+1.0	+1.0		+1.0	+1.0	-1.0	-1.0	-1.0	+1.0	+1.0	+1.0				
1CR-1	- .13	- .05	+1.0														
1LDD-1	+1.0																
1LTD-1		+1.0															
1CS-1					+ 1.0												
1TLL-1											+1.0	+1.0	+1.0				
1LLn-1											+1.0						
1TLLn-1											+1.0	+1.0	+1.0				
1TLLA-1																	
1TLLB-1																	
1TLLC-1																	
1TLLD-1																	
1DC2-1						- .005	- .06				- .10	- .10	- .10	+1.0			
1LR-1	- .47	- .36													+1.0		
1LR1-1			+1.0			+ .995									-1.0	+1.0	
1LR2-1							+ .85									-1.0	+1.0
1LR3-1																	-1.0
1TC-1														-1.0		- .065	- .04
1AC-1					+ 1.0												
1AD-1	-1.0	-1.0															
1LN-1											-1.0	-1.0	-1.0				
1GS-1						+1.0											
1TE-1							-1.0										
1LND-1																	
1LND1-1																	
1TED-1																	
1STDD-1	-1.0	-1.0															
01GSn-1									+1.0								
01ALn-1								+1.0									
01TE-1										+1.0							
1TF	+ .00177	+ .04434				- .0275		- .0385	- .023		- .07462	- .07438	- .08382				
1WP							- .04592			- .03							
1AP																	
1TB																	
1TPACC																	
1APACC																	
1TBACC																	
1LPACC-1																	
1CACC-1																	
1TLL-2										+1.0	+1.0	+1.0					
1LLn-2										+1.0							
1TLLn-2										+1.0	+1.0	+1.0					
1AF-2			-1.0	-1.0		-1.0											
1CR-2			-1.0														
1CS-2					-1.0												
1LDD-2																	
1AD-2																	
1STDD-2																	
1LPACC-2																	
1DC2-2											- .10						
2AF-1											-1.0						
2CS-1																	
2LDD-1											- .04						

TABLE VIII (CONTINUED)

	1SLR3-1	1STC-1	1SLN-1	1SGS-1	1STE-1	1SAD-1	1TDD-1	1ALAn-1	1ALBn-1	1ALCn-1	1ALDn-1	1FACC1	1TFACC-1	1PTX-1	1PTX-2	1TNF	1PDI	1PTXAC1	1PTXAC2	1PDIACC	RHS
OBJ								+ .0062		+ .00137	+ .0062	- .04		- .22	- .48			- .78	- .48		N
1AF-1																					E
1CR-1																					E
1LDD-1																					E
1LTD-1																					E
1CS-1												+1.0									E
1TLL-1								+1.0	+1.0	+1.0	+1.0										L
1LLn-1																					L
1TLLn-1								+1.0	+1.0	+1.0	+1.0										L
1TLLA-1								+1.0													L
1TLLB-1									+1.0												L
1TLLC-1										+1.0											L
1TLLD-1											+1.0										L
1DC2-1																					G
1LR-1																					E
1LR1-1																					G
1LR2-1																					G
1LR3-1	+1.0																				G
1TC-1	- .095	+1.0																			E
1AC-1		- .75																			G
1AD-1								+1.0													E
1LN-1			+1.0																		E
1GS-1				+1.0																	E
1TE-1					+1.0																E
1LMD-1			-1.538			+1.0															L
1LMD1-1			-1.333			+1.0															G
1TED-1					-10.0	+1.0															G
1STDD-1						+1.0															E
01GSn-1																					E
01ALn-1																					E
01TE-1																					E
1TP										- .00137	- .0062			+1.0	+1.0						E
1MP																+1.0					E
1AP														- .78	- .52	-1.0	+1.0				E
1TB														+1.0							L
1TPACC								- .0062										+1.0	+1.0		E
1APACC																		- .78	- .52	+1.0	E
1TBACC																		+1.0			L
1LFACC-1								+1.0				-6.65	+1.0								N
1CACC-1												+1.0									E
1TLL-2																					E
1LLn-2																					E
1TLLn-2																					E
1AF-2											- .02									-1.0	L
1CR-2																					E
1CS-2																					E
1LDD-2								- .02	- .02	- .02											L
1AD-2							-1.0														E
1STDD-2							-1.0														E
1LFACC-2								-1.0					-1.0								E
1DC2-2																					G
2AF-1																	- .50			-1.0	E
2CS-1																	- .50				E
2LDD-1																					

only selected activities (referred to as column or activity in the discussion) are presented. In the case of agricultural loans, the 6 month maturity loan is presented for the external sources of funds, while the 1 year loan is presented for the internal structure. All other agricultural loans are handled in the same manner as those included in the generalized matrix (Table VIII). Also, only the 6 month government security is included in the matrix. The 1 year and 3 year government security activities are again handled in a similar fashion as the 6 month security.

Demand and Time Deposits

The 1DD-1 column in Table VIII represent the acquisition of demand deposits by the bank. The remaining tDD-m columns can be interpreted in the same manner as this column. The right-hand-side value for the 1LDD-1 row ($2,567,235) represents the beginning balance of demand deposits for the bank. The right-hand-sides ($55,000) for the remaining tLDD-m rows represent the potential future growth of demand deposits. The beginning balance of deposits is transferred internally to the next period. The growth increment can be brought into solution if it is profitable. This potential growth rate was estimated from the actual rate of growth in demand deposits for the case bank during the last five years.

The objective function value in the 1DD-1 activity represents the discounted variable cost per dollar of demand deposits for the entire planning horizon. The objective function value in the remaining tDD-m activities is the discounted variable cost per dollar for the remainder of the planning horizon. For example, the objective function value

in the 1DD-2 column is the cost of demand deposits for the last 2½ years of the planning horizon. This cost is assessed only against the amount of the growth increment which the model finds profitable to use in each period. The entry in the 1CR-1 row (-.13) represents a 13 percent reserve requirement for demand deposits as specified by federal banking laws.[3] The entry in the 1LR-1 row (-.47) represents the liquidity requirement specified by the capital adequacy form used by the Federal Reserve System. The procedure used by Federal Reserve examiners to analyze the liquidity and capital adequacy of banks will be discussed in greater detail later. The coefficients in the 1AD-1 and 1STDD-1 rows are for summation purposes to activate transfers to future periods and to maintain specified loan to deposit and municipal to deposit ratios. The entry in the 1TP row (+.00177) indicates a reduction in the taxable profit of the bank. This number represents the discounted variable cost of a dollar of demand deposits for the first year of the planning horizon.[4]

The 1TD-1 activity performs the same function for time deposits as the 1DD-1 activity performs for demand deposits. Time deposits have different reserve requirements (-.05) and liquidity requirements (-.36) than demand deposits. These coefficients are again taken from the federal bank regulations and the Federal Reserve System capital adequacy form. The +.04434 coefficient in the 1TP row is the discounted variable cost per dollar of time deposits for the first year of the planning horizon.

Reserve Requirements

The 1ACR-1 activity insures that the reserve requirements are met each period. This is accomplished by summing the reserve requirement row (1CR-1) with a +1.0 and removing or using the same amount of money from allocable funds as indicated by the +1.0 in the 1AF-1 row. Thus, the required cash reserves are taken from allocable funds and cannot be invested. However, these reserves can be used to meet a portion of the bank's liquidity requirements which is shown by the coefficient (+1.0) in the 1LR1-1 row.

To properly maintain the correct amount of cash reserves based on the composition and level of demand and time deposits, the reserves required to support the initial level of time and demand deposits are transferred to period two by placing a -1.0 in the 1CR-2 row. Also since allocable funds can be transferred between periods, -1.0 is placed in the 1AF-2 row to indicate the freeing of cash reserves. In the following period, a -1.0 is placed in both the 1AF-2 and 1CR-2 rows for activity 1ACR-2 to indicate the reduction of allocable funds in the second period by the cash reserves required to support the initial level of deposits plus the deposit growth.

Funds and Capital Transfers

The 1TAF-1 column functions as a transfer activity. If the model chooses not to invest all of the available allocable funds in any period, the tTAF-m activities allow for these funds to be transferred to allocable funds (tAF-m) in the following period. Also, since the initial capital and surplus is reflected in the b_i values for the first

period only, the 1TCS-1 activity is used to transfer capital and surplus from the current period to the following period (row 1CS-2) so that an accurate capital structure account is maintained.

Government Securities and Municipal Bonds

The 1BGSn-1 activity is a buy and/or transfer government security activity, depending on the maturity length of the government security involved. The coefficient in the OBJ row (+.0275) indicates the discounted net returns for a six month government security. The +1.0 in the 1AF-1 row indicates the use of $1 of allocable funds. The entry in the 1DC2-1 row (-.005) is the direct capital requirement for each dollar of government securities of this maturity type. The +.995 coefficient in the 1LR1-1 row is the amount of liquidity provided by this government security. The 1TP coefficient is merely the amount of taxable profit earned from the government security over the entire year. The -1.0 coefficient in the 1AF-2 row indicates an increase in allocable funds for investment in the following period by the amount of the original investment in the security. If the data concerning the one year government security instead of the six month security had been used in Table VIII, appropriate coefficients would also appear in the 1DC2-1, 1LR1-1 and 1GS-1 rows for the second period. In this way, the activity serves as a transfer as well as a buy activity.

The objective function values for government securities indicate the discounted net return from the investment over its life as long as the security matures within the planning horizon. If a three-year security was bought in the second period of year two, the objective function value would indicate the discounted returns for the remainder

of the model's planning horizon, not the full three year maturity of the security. The returns on loans and municipal bonds are also handled in this same manner.

The 1BTE-1 column is a buy and transfer activity for municipal bonds. This activity performs the same functions for bonds as the government security activity performs for securities. The municipals have a different direct capital requirement and provide different amounts of liquidity due to the difference in maturity length. The entry in the 1NP row (-.04592) is the non-taxable profit on a discounted basis for one year.

Beginning Balance Sheet Items

The activities which have a zero (0) as the first symbol of the vector identification denote beginning balance sheet assets. These activities result in an increase in allocable funds in the period in which these investments mature and a decrease in the amount of inventory of the particular asset. For example, in the 01CALn-1 vector, there appears a -1.0 coefficient in the 1AF-1 row and a +1.0 in the 01ALn-1 row. These coefficients reflect the maturing of six month agricultural loans from beginning inventory, and thus result in an increase in allocable funds for the period (-1.0) and a decrease in the beginning balance of loans (+1.0). The entries in the OBJ, and, 1TP and 1NP rows indicate the earnings attributable to these beginning inventory items. All classes of loans, government securities and municipal bonds are handled in this same manner.

Loans

The agricultural loan activities (tMALn-m), commercial loan activities (tMCL-m) and installment loan activities (tMIL-m) are all structured in a similar manner. Although Table VIII includes activities for all three of these loan types, only the one year agricultural loan activity (1MALn-1) will be discussed.

When a loan is made, it requires one dollar (+1.0) of allocable funds (1AF-1) for each dollar of the loan. The model contains a total loan limit which limits the total of the internally and externally financed loans of all types. The right-hand-side value for the total loan limit was determined through discussions with the banker. He indicated that if funds were available he could loan a total of $7 million initially with an increase of at least $250,000 per year. For all loans, whether made with internal or external funds a +1.0 is placed in the loan limit row (tTLL-m).

Due to the present composition of the bank's existing loan portfolio and the economic characteristics of the local community, a limit is also specified on the amount of any maturity length or type that can be loaned. These restraints are identified as the tLLn-m rows for agricultural loans and the tTLLI-m and tTLLO-m rows for installment loans and commercial loans respectively. The right-hand-side values for these restrictions were determined from discussions with the banker and by evaluating the bank's past loan history. Since the banker indicated that demand for any maturity of agricultural loan was greater than the amount he could supply from internal funds, a total loan limit for each maturity of agricultural loan (irrespective of source of

funds) was also included (tTLLn-m). These restrictions thus allow competition between both internal and external sources of funds in making type 1, 2, 3 and 4 agricultural loans. Consequently, a +1.0 is placed in the 1LLn-m (type loan limit) row and 1TLLn-m (total loan limit) row for each type of agricultural loan made internally to reflect the satisfaction of one dollar of loan demand for each dollar of loans. Since we are discussing a one year (type 2) maturity loan, these same coefficients appear in the appropriate rows in period two of year one. Since installment loans, commercial loans and type 5 (ten year) agricultural loans can only be made internally, there is only a total loan limit for commercial loans (1TLLO-m), a total loan limit for installment loans (1TLLI-m) and a total loan limit for ten year agricultural loans (1LLs-m) and not both an individual loan limit row and total loan limit row for these types of loans.

Consistent with Federal Reserve requirements, all internal loans have a direct capital requirement of one tenth of the loan amount. This requirement is reflected by the -.10 coefficient in the 1DC2-1 row and the 1DC2-2 row since the loan being discussed is of one year in maturity. The 1LN-1 row is a loan summation row for internal loans that is used to activate the loan to deposit ratio restrictions. Therefore, for any loan made internally a -1.0 coefficient is included in the row.

The 1TP entries reflect the taxable profit from the loan for the year or the length of the loan in the case of a six month loan. For the one year loan being discussed here, the loan was made on the first day of the first period of the first year and matures on the first day of the first period of the second year. This fact is shown by placing

a negative coefficient (-1.0) in the 2AF-1 row. This coefficient indicates that the original amount loaned is repaid in the first period of the second year. A feedback coefficient is also included in the demand deposit row (2LDD-1) in the period of maturity for all loans made. The feedback relationship will be discussed in detail later.

Capital and Liquidity Requirement

As was indicated earlier, the Federal Reserve capital and liquidity requirements are important constraints on portfolio composition. The columns which deal with the capital and liquidity requirements are the following: 1SDC-1, 1SLR-1, 1SLR1-1, 1SLR2-1, 1SLR3-1 and 1STC-1. The rows involved are: 1DC2-1, 1LR-1, 1LR1-1, 1LR2-1, 1LR3-1, 1TC-1 and 1AC-1. Before the functions of the numerous rows and columns can be meaningfully understood, the source of the capital and liquidity requirements for the model must be discussed.

The form used by the Federal Reserve examiners to analyze bank's capital structure was used in specifying the liquidity and capital constraints for the model (Table IX). As indicated by Table IX, there are two types of capital requirements: direct capital and additional capital. Direct capital requirements are imposed against the five classes of assets as shown on the left side of Table IX. Different direct capital requirements are required depending on the type and maturity of the asset in each class. For example, U.S. government securities with a maturity of over ten years have a direct capital requirement of six percent (see Item 3 in Table IX) whereas U.S. government securities with a maturity of five to ten years (Item 2 in Table IX) have a capital requirement of four percent. Item 6 of the capital

TABLE IX

FORM FOR ANALYZING BANK CAPITAL

	Amount Outstanding	Capital Requirement Per Cent	Capital Requirement Amount
(1) PRIMARY AND SECONDARY RESERVE			
Cash Assets	$	0%	
Guar. Portion of CCC or V-loans			
Comm. Paper, Bnk Accept. & Bnks' Lns			
U.S. Govt. Secs:		0.5%	$
Bills			
Certificates, etc. (to 1 yr.)			
Other (1-5 yrs.) (Incl. Treas Inv. Series A & B)			
Other Secs. Inv. Rtngs 1 & 2 or Equiv. (to 3 yrs.)		4.0%	
TOTAL	$		
(2) MINIMUM RISK ASSETS			
U.S. Govt. Secs. (5-10 yrs.)			
Ins. Portion FHA Rep. & Modr'n Loans			
Loans on Passb'ks, U.S. Secs. or CSV Life ins.			
Short-term Municipal Loans			
TOTAL	$	4%	
(3) INTERMEDIATE ASSETS			
U.S. Govt. Secs. (Over 10 yrs.)			
FHA and VA Loans			
TOTAL	$	6%	
(4) PORTFOLIO ASSETS (Gross of Res.)			
Investments (not listed elsewhere)			
Loans (not listed elsewhere)			
TOTAL	$	10%	

*Plus 15% of 1st $100,000 of portfolio, 10% of next $100,000 and 5% of next $300,000.

LIQUIDITY CALCULATION

42% of Demand Deposits l.p.c.	$
36% of Time Deposits l.p.c.	
100% of Deposits of Banks	
100% of Other Deposits	
100% of Borrowings	
Allow. for spec. factors, if info. available (+ or -)	
A. Total Provision for Liquidity	
B. Liquidity available from Prim. and Secondary Res. ("amt. outstanding" less cap. required thereon)	
C. Liquidity to be provided from assets in Groups 2, 3 or 4 (zero if B equals or exceeds A, otherwise A less B)	
D. Liquidity available from Min. Risk Assets (90% of "amt. outstanding" in line 2)	
E. Liquidity to be provided from assets in Groups 3 or 4 (zero if D equals or exceeds C, otherwise C less D)	
F. Liquidity available from Intermediate Assets (85% of "amt. outstanding" in line 3)	
G. Liquidity to be provided from Portfolio Assets (zero if F equals or exceeds E, otherwise E less F)	

* * * * * * * * * * * * * * * * *

TABLE IX (CONTINUED)

	AMOUNT OUTSTANDING	CAPITAL REQUIREMENT Per Cent	CAPITAL REQUIREMENT Amount
(5) FIXED, CLASSIFIED & OTHER ASSETS			
Bk Prem.. Furn. & Fixt., Other Real Est.			
Stocks & Defaulted Secs.		100%	
Assets Classified as "Loss"			
Assets Classified as "Doubtful"		50%	
Assets Classified as "Substandard"		20%	
Accruals, Fed. Res. Bk. Stock, Prep. Expen.		0%	
TOTAL ASSETS	$		
(6) ALLOWANCE FOR TRUST DEPT. (Amt. equal to 300% of annual gross earnings of Department)			
(7) EXTRA CAP. RECD. IF ANY ASSETS IN GROUPS 2-4 USED FOR LIQUIDITY (zero if line C in Liquidity Calculation is zero, otherwise Total in line H)			
(8) ALLOW. FOR SPEC. OR ADDIT. FACTORS, IF INFOR. AVAILABLE (+ or -) (see notes on reverse side)			
(9) TOTAL CAPITAL REQUIREMENT (1 thru 8)			$

Extra Capital Required on Any Assets in Groups 2-4 Used for Liquidity

6.5% of line C	
4.0% of line E	
9.5% of line G	
◄ H. Total Extra Cap. Req.	$

(10) ACTUAL CAP., ETC. (Sum of Cap. Stock, Surplus, Undiv. Profits, Res. for Conting., Loan Valuation Res., Net unapplied Sec. Valuation Res., Unallocated Charge-offs, and any comparable items) (Exclude Depreciation and Amortization Reserves) $

analysis form (Table IX) indicates an allowance for a trust department. Since the majority of the banks similar in size to the one used in this study do not have trust departments, this item was not included. By multiplying the "amount outstanding" of the various assets times the indicated capital requirement in the "Per Cent" column and then summing items 1 through 6 in Table IX, the direct capital requirement can be calculated.

The additional capital requirement is based on the bank's liquidity structure. The underlying assumption of the liquidity analysis is that as the liquidity of the assets decreases, the bank faces increasing risk. Using the capital analysis form (Table IX), a bank's liquidity requirements can be calculated as 47 percent of demand deposits and 36 percent of time deposits plus 100 percent of deposits of other banks and 100 percent of other deposits and borrowing. The summation of these items determines the bank's total provision or requirement for liquidity (Item A).

After determining the total requirement for liquidity, it must be determined how much liquidity is provided by the various asset categories. Primary and secondary assets provide 99.5 percent and 96.0 percent liquidity respectively. The 99.5 percent is found by subtracting .5 percent from 100 percent. The .5 percent is shown under the "Capital Requirement" heading in the "Per Cent" column. The 96.0 percent liquidity for secondary reserves is arrived at in the same manner.

By subtracting the liquidity provided by primary and secondary assets from the total liquidity needed in Item A, the liquidity which must be met by minimum risk, intermediate term and portfolio assets

can be determined. Depending on the amount of liquidity provided by these asset groups, there is an "additional capital" requirement assessed in addition to the direct capital required. First, additional capital is required equal to 6.5 percent of the liquidity left to be met by minimum risk, intermediate and portfolio assets. Since minimum risk assets provide 90.0 percent liquidity as shown by Item D in Table IX, the amount is subtracted from Item C. The remaining liquidity must be provided by intermediate and portfolio assets (Item E). An additional capital requirement of 4.0 percent is assessed against this remaining liquidity. Finally, the liquidity available from intermediate assets is then subtracted from Item E, leaving liquidity to be provided by portfolio assets. The additional capital requirements against portfolio assets is 9.5 percent. The total additional capital requirement can then be totaled in Item H and added to the direct capital requirement to arrive at a total capital requirement for the bank.

Table VIII shows the appropriate coefficients which incorporate the capital and liquidity requirements in the model. The direct capital row (1DC2-1) includes the appropriate coefficient as specified in Table IX for each dollar of various loans made (-.10 for all agricultural loans) and government security or municipal bond purchased. A +1.0 in the 1DC2-1 row for a summing activity (1SDC-1) and a greater than or equal to constraint with a right-hand-side value of $85,000 on the 1DC2-1 row insures that the direct capital requirement will be met. The $85,000 right-hand-side value is determined by adding the bank's fixed assets and a $40,000 constant capital requirement for a portfolio

of over $500,000. This $85,000 is a capital requirement which must be met each period of each year.

The liquidity requirements are dealt with in a similar manner. The total liquidity requirements are summed by the 1SLR-1 activity and transferred into the 1LR1-1 row. The liquidity provided by primary and secondary assets as indicated by the coefficients in the 1LR1-1 row for activities such as 1BGSn-1 are subtracted from the required amount. Because the sign of the 1LR1-1 row is an equality set equal to zero, the remaining liquidity to be satisfied is transferred by activity 1SLR1-1 to the second liquidity class (1LR2-1) where intermediate term assets provide liquidity. Also, the additional capital charge that is required if liquidity must be satisfied from this second liquidity class (minimum risk, intermediate and portfolio assets) is shown in the 1TC-1 row. This coefficient is -.065 for the 1SLR1-1 column. The remainder of the total liquidity requirement is transferred with a transfer activity (1SLR2-1) to the 1LR3-1 row where intermediate term assets provide liquidity. If intermediate term assets are required to satisfy part of the liquidity requirements, additional capital is again required as indicated by the -.04 coefficient in the 1TC-1 row. The remaining liquidity is satisfied by the portfolio assets which require .095 of additional capital per dollar of liquidity provided. The 1LR1-1, 1LR2-1 and 1LR3-1 rows have greater than or equal to zero constraints to allow all of the liquidity requirement to be met if possible by the first asset class. Additional liquidity is obtained from the second and third classes if it is needed.

The final row for the set of capital restrictions is the 1AC-1 row which has a greater than or equal to zero constraint. Actual

capital and surplus has been transferred to this row by the 1TCS-1 activity discussed earlier. The direct and additional capital requirements are transferred into this row by placing a +1.0 in the 1AC-1 row and a -.75 in the 1TC-1 row for the 1STC-1 column.[6] This constraint guarantees that the sum of the direct and additional capital requirements are less than or equal to the capital and surplus account of the bank.

Portfolio Composition Ratios

The 1SLN-1, 1SGS-1, 1STE-1 and 1SAD-1 columns are all summation activities for the internally financed investments and the deposits. The banker indicated that he was not willing to have less than a 65 percent loan to deposit ratio. Therefore, a minimum loan to deposit ratio of 65 percent was imposed. The 65 percent minimum loan to deposit ratio is incorporated by placing a -1.538 coefficient in the 1SLN-1 column for the 1LND-1 row and a +1.0 in the 1STDD-1 row (sum of deposit row) for this same activity. Combined with the less than or equal to constraint on the 1LND-1 row, the model is forced to maintain a minimum 65 percent loan to deposit ratio. The maximum loan to deposit ratio of 85 percent and a maximum municipal bond to deposit ratio are incorporated in the model in a similar manner as the minimum loan to deposit ratio. There are no restrictions placed on government securities.

Deposit Transfers

The 1TDD-1 column is a transfer activity for demand and time deposits. A +1.0 is placed in the 1AD-1 and 1STDD-1 rows which have

previously accumulated the bank's time and demand deposits. The transfer is accomplished by inserting a -1.0 in the 1AD-2 and 1STDD-2 rows. The total deposits are transferred from period to period in this manner.

External Funds Sources

Four external sources of funds are incorporated into the model. Activities to incorporate the Agricultural Credit Corporation, participation agreement, correspondent arrangement and direct line discounting with the FICB are added to the internal bank model. The assumption is made that the ACC can only be formed in the initial period and the bank will use only $50,000 to form it. By using only $50,000 of capital, it is necessary for the case bank to jointly form the ACC with three other banks to reach the minimum capital requirement for an ACC. Although the bank had the $200,000 of capital that is necessary to form the ACC independently, individual formation of the ACC would drastically decrease the bank's individual loan limit. The banker was not willing to make this sacrifice, since one of the problems he faces is making large loans to individual borrowers.

As indicated earlier the formation of an ACC requires the purchase of FICB participation certificates in the amount of 5 percent of the approved discount line. Thus, instead of the bank being able to discount $7 for each dollar of capital and surplus in the ACC, the ACC is allowed to discount only $6.65 for each dollar of capital and surplus. This decrease in the amount that can be discounted reflects the amount of funds used for FICB participation certificates.

The formation activity for the ACC (1FACC1) results in a decrease in the objective function to cover the formation cost. A formation cost of $2,000 dollars or 4 cents per dollar of capital put into the ACC by the case bank is assumed as indicated by the -.04 in the OBJ row. When the ACC is formed the bank's capital and surplus is decreased 1 dollar for every dollar that goes into the ACC. The +1.0 in the 1CACC-1 row and a right-hand-side of less than or equal to $50,000 restricts the formation capital to $50,000. This restriction gives the ACC $332,500 of loanable funds since it can loan $6.65 for each dollar of capital and surplus as indicated by the -6.65 in the 1LFACC-1 row. These funds can be used to make type 1 (6 month), type 2 (1 year), type 3 (2 year) and type 4 (3 year) agricultural loans. Only type 1 (1ALAn-1) is represented in Table VIII.

The total loan limit for the ACC of $332,500 is reflected in the 1TLLA-1 row. When a loan is made through the ACC as indicated by the 1ALAn-1 activity, the +1.0 in the total loan limit row (1TLL-m) the type of loan limit (1TLLn-m) and the ACC loan limit row (1TLLA-1) indicate that a dollar of each limit has been used. The objective function values for the loans made through the ACC are discounted net returns. Although the ACC is allowed to charge 4 percent above the cost of the FICB funds, it is assumed that it would use a 1.5 percent gross margin per year on loans. This assumption is necessary for the ACC to remain competitive with other sources of loanable funds.

The second external funds source included in the model is the participation arrangement with the Production Credit Associations. It is assumed that the bank would not receive any revenue from participating with a PCA on a loan, but that the bank would be able to satisfy

additional loan demand in the community. The participation mechanism can be used to make type 1, 2, 3 and 4 agricultural loans. The total loan limit (1TLLB-1) for the participation agreement is set at $200,000 outstanding at any time. When a loan is made through this mechanism, as indicated by activity 1ALBn-1, the +1.0 in the 1TLL-1, 1TLLn-1 and 1TLLB-1 rows indicate a satisfaction of one dollar of total loan demand, type of loan demand, and the mechanism's total loan limit respectively.

The correspondent arrangement (1ALCn-1) is used to make only type 1 (6 month) and type 2 (1 year) agricultural loans. Although the country bank receives only a small fee to service the loan, the bank does make a profit from the correspondent arrangement because only the variable cost of arranging for overlines are included in the analysis. This profit is indicated by the +.00137 coefficient in the OBJ and 1TP rows. The correspondent arrangement is restricted to a total loan limit (1TLLC-1) of $800,000 outstanding at any time. This restriction is included because the banker indicated that the correspondent bank would take overlines in an amount up to twice the compensating balance of the country bank. For loans made through the correspondent, the +1.0 in the 1TLL-1, 1TLLn-1 and 1TLLC-1 rows indicate the satisfaction of a particular loan demand constraint.

The direct line discount with the FICB which is designated as 1ALDn-1 in Table VIII, is used to make types 1, 2, 3 and 4 agricultural loans. It is assumed that the case bank would use a 1.5 percent margin on the notes discounted with the FICB. As in the case of the other mechanisms, there is a limit on the funds available with a direct line. The limit expressed in the 1TLLD-1 row is $900,000 outstanding at any

time. The case bank is limited to this amount because of the FICB restriction which allows a bank to discount an amount up to twice the bank's capital and surplus. For loans made by the direct line mechanism, a +1.0 in the 1TLL-1, 1TLLn-1, and 1TLLD-1 rows reflects the satisfaction of appropriate loan demand constraints. The profit from making the loan is expressed in the taxable profit row (1TP) and the objective function (OBJ) and represents the discounted net returns for the year.

Loan Feedback

The loan feedback relationship reflects the fact that making a loan, irrespective of the source of funds, will have a positive influence on bank deposits. Frey has identified at least three causes for this feedback effect: (1) loan funds are usually deposited by the borrower in an account held by the lending bank, and are often withdrawn slowly overtime; (2) loan funds may be used to make payments on purchases within the community, thus generating growth and increased deposits in which the bank shares; (3) making loans helps attract and retain the customer, thus generating a stream of profit and deposits for the bank.[7] In contrast, investments outside the community, in such items as government securities, would have no impact on bank deposits.

Little empirical work is available to provide numerical estimates of the feedback relationship. Thus, in the following analysis it is assumed that for each dollar of loans the bank makes, demand deposits would increase 4 percent per year. The 4 percent per year feedback assumption is based on the fact that if the investment made with the

loan earned a conservative rate of 8 percent, the bank could realize a 4 percent increase in deposits after accounting for the consumption needs of the borrowers. The feedback relationship is used for all loans irrespective of whether internal deposits or external sources of funds are used.

If the bank makes a six month loan, demand deposits increase from the feedback effect by 2 percent of the loan the following period. The increase in demand deposits from making longer term loans occurs one year after the loan is made. The loan continues to increase demand deposits 4 percent per year until it matures. An example of the feedback relationship is shown in Table VIII by the -.02 coefficient for the 1ALAn-1 activity. Since this activity denotes a six month loan, the feedback of -.02 appears in the 1LDD-2 row. If the loan activity denoted a one year or longer loan, a -.04 would be placed in the 2LDD-1 row.

Taxes and Profit Distribution

Profits are computed annually in the model. Therefore, the model includes one taxable profit row (tTP) for each year. All activities which generate income are represented in these rows with a negative coefficient indicating an increase in taxable profits. For example, the taxable profit from the 1MCL-1 activity is -.07438. Also included in the model is a non-taxable profit row (tNP) for each year which facilitates the handling of the income received from municipal bonds.

For each year, the model contains two pay tax activities (tPTX-1 and tPTX-2). The first tax activity (tPTX-1) allows for the first $25,000 of taxable profit (after fixed expenses) to be taxed at 22

percent, while the remainder of the income is taxed at 48 percent by the second activity (1PTX-2).

A +1.0 coefficient in the taxable profit row (1TP) and a +1.0 in the tax bracket row (1TB) for the 1PTX-1 activity allows for the first $25,000 of net income to be taxed at 22 percent as indicated by the -.22 in the objective function. The after tax profit for the first $25,000 of taxable income is transferred to the after tax profit row (1AP) by the -.78 in this column. The second pay tax activity (1PTX-2) also has a +1.0 in the taxable profit row. The objective function for this tax activity is decreased by the use of a -.48 coefficient in the OBJ row, and the after tax profit is shown in the 1AP row by a -.52.

The fixed expenses were estimated from the bank's records to be approximately $80,000 per year. These expenses are incorporated in the model by using a fixed expense row (tFER) with an equal to restraint and a fixed expense activity (tFEA), for each year. The 1FER row has a right-hand-side value of $80,000, while the 1FEA activity has a -1.0 coefficient in the OBJ row, a +1.0 in the 1TP row and a +1.0 in the 1FER row. These rows and activities make the model treat the first $80,000 of income above variable cost as a fixed expense.

The non-taxable profit column (1TNP) transfers all non-taxable profit to the after tax profit row (1AP). This transfer is accomplished by placing a +1.0 in the 1NP row and a -1.0 in the 1AP row. The model then sums all the after tax profit with a +1.0 in the 1AP row for the profit distribution activity (1PDI). This profit distribution activity distributes the after tax profit equally to the allocable funds row and capital and surplus row for the first period of the second year. This distribution is accomplished by placing a -.50 in each of these rows.

The taxes for the ACC are handled in the same manner as the taxes paid by the bank. The tax payment activities for the ACC are 1PTACC1 and 1PTACC2. All of the after tax profit from the ACC is transferred by the 1PD1ACC activity to the allocable funds (2AF-1) of the bank in the second period, and is not retained in the ACC.

Model Modification

The previous discussion has described what will be referred to as the base model. In order to thoroughly evaluate the usefulness and profitability of the external sources of funds, it is necessary to obtain additional empirical results under different assumptions than those contained in the base model. The purpose of these different assumptions is to determine the specific effect of alternative values for loan demand and deposit growth on the use of internal and external sources of funds.

First, the utilization of internal and external sources of funds if the $250,000 annual growth in demand and time deposits is eliminated will be analyzed. This analysis will be accomplished by changing the right-hand-side values for the tLTD-m and tLDD-m rows to zero during every period of the planning horizon except the first period of the first year. The positive right-hand-side values will remain on the first period rows, because they are used to force into solution the beginning balances of demand and time deposits.

The implications of different loan demand will be analyzed by changing the demand for type 1 (6 month) and type 2 (1 year) agricultural loans. Only these two loan classes are varied because the majority of the case bank's loans are of these two types. The

alternative levels of loan demand for type 1 and 2 agricultural loans that will be analyzed are: (1) a 25 percent increase in loan demand, (2) a 10 percent increase in demand, (3) a 10 percent decrease in demand, (4) a 25 percent decrease in demand and (5) a 50 percent decrease in demand. These changes are incorporated in the model by varying the right-hand-sides on the tTLL1-m and tTLL2-m rows. Also, to reflect the loan demand changes internally, the internal loan limits (tLL1-m and tLL2-m) are changed in the same relative amount. Table X summarizes the changed right-hand-side values for these alternative loan demand assumptions.

TABLE X

RHS VALUES FOR MODEL MODIFICATIONS

ROW	25 PERCENT INCREASE IN TYPE 1 AND 2 LOANS	10 PERCENT DECREASE IN TYPE 1 AND 2 LOANS	25 PERCENT DECREASE IN TYPE 1 AND 2 LOANS	50 PERCENT DECREASE IN TYPE 1 AND 2 LOANS
1LL1-1	$3,125,000.00	$2,250,000.00	$1,875,000.00	$1,250,000.00
1LL2-1	3,125,000.00	2,250,000.00	1,875,000.00	1,250,000.00
1TLL1-1	3,750,000.00	2,700,000.00	2,250,000.00	1,500,000.00
1TLL2-1	3,750,000.00	2,700,000.00	2,250,000.00	1,500,000.00
1LL1-2	3,125,000.00	2,250,000.00	1,875,000.00	1,250,000.00
1LL2-2	3,125,000.00	2,250,000.00	1,875,000.00	1,250,000.00
1TLL1-2	3,750,000.00	2,700,000.00	2,250,000.00	1,500,000.00
1TLL2-2	3,750,000.00	2,700,000.00	2,250,000.00	1,500,000.00
2LL1-1	3,125,000.00	2,250,000.00	1,875,000.00	1,250,000.00
2LL2-1	3,125,000.00	2,250,000.00	1,875,000.00	1,250,000.00
2TLL1-1	3,750,000.00	2,700,000.00	2,250,000.00	1,500,000.00
2TLL2-1	3,750,000.00	2,700,000.00	2,250,000.00	1,500,000.00
2LL1-2	3,187,500.00	2,475,000.00	2,062,500.00	1,375,000.00
2LL2-2	3,187,500.00	2,475,000.00	2,062,500.00	1,375,000.00
2TLL1-2	4,375,000.00	3,150,000.00	2,725,000.00	1,750,000.00
2TLL2-2	4,375,000.00	3,150,000.00	2,725,000.00	1,750,000.00
3LL1-1	3,187,500.00	2,475,000.00	2,062,500.00	1,375,000.00
3LL2-1	3,187,500.00	2,475,000.00	2,062,500.00	1,375,000.00
3TLL1-1	4,375,000.00	3,150,000.00	2,725,000.00	1,750,000.00
3TLL2-1	4,375,000.00	3,150,000.00	2,725,000.00	1,750,000.00
3LL1-2	3,187,500.00	2,475,000.00	2,062,500.00	1,375,000.00
3LL2-2	3,187,500.00	2,475,000.00	2,062,500.00	1,375,000.00
3TLL1-2	4,375,000.00	3,150,000.00	2,725,000.00	1,750,000.00
3TLL2-2	4,375,000.00	3,150,000.00	2,725,000.00	1,750,000.00

FOOTNOTES

[1]Heady, Earl O. and Wilfred Candler. Linear Programming Methods, Iowa State University Press, Ames, Iowa; 1958, Ch. 1-3.

[2]Loftsgard, L. D. and Earl O. Heady, "Application of Dynamic Programming Models for Optimum Farm and Home Plans," Journal of Farm Economics, Vol. 41, No. 1, February, 1954, pp. 51-62.

[3]"Reserve Requirements on Deposits of Member Banks," Federal Reserve Bulletin, Board of Governors, The Federal Reserve System, Washington, D. C., Vol. 58, No. 12, December, 1972, p. A10.

[4]This is reversed from conventional procedure. When using the conventional L.P. framework a positive coefficient indicates a use or reduction of a resource while a negative coefficient indicates an increase in a resource.

[5]Form for Analyzing Bank Capital, Federal Reserve Bank.

[6]In the past, capital has been required on a one to one basis. In recent years this restriction has been relaxed according to Bank Examiners. Therefore this study used a $.75 ratio of actual capital to $1 of required capital for the bank.

[7]Frey, p. 18.

CHAPTER IV

OPTIMUM USE OF INTERNAL AND EXTERNAL SOURCES OF FUNDS

In this chapter the optimal organization of the case bank as generated by the analytical model is described and analyzed. This discussion emphasizes the following characteristics: (1) internal sources and uses of funds, (2) annual net worth, (3) external sources and uses of funds, (4) annual profit and loss, and (5) the value of the objective function. The effects of the model modifications discussed in the previous chapter are then presented and analyzed.

The Case Bank

Internal Sources and Uses of Funds

The sources and uses of internal uncommitted funds are summarized in Table XI. In general the empirical results indicate that internal funds (time and demand deposits) are utilized completely during all time periods. There are no transfers of unused allocable funds at any time during the planning horizon. The availability of time and demand deposits increases during the planning horizon because of both market growth and the "feedback effect" from loans. The internal uses of uncommitted funds include: six month, one year, two year, three year and ten year agricultural loans, two year installment loans, two year commercial loans and eight year municipal bonds.

TABLE XI

INTERNAL SOURCES AND USES OF FUNDS AS DETERMINED BY THE BASE MODEL[a]

	YEAR 1		YEAR 2		YEAR 3	
	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2
Demand Deposits	$2,567,235	$115,000	$ 153,166	$ 177,155	$ 175,479	$ 194,914
Time Deposits	3,803,137	225,000	225,000	225,000	225,000	225,000
Agricultural Loans						
Six Month	1,071,315	973,700	1,683,336	2,277,325	2,267,500	1,467,500
One Year						1,295,858
Two Year	700,000				824,923	
Three Year	252,142	447,858			300,000	
Ten Year		400,000			100,000	
Government Security						
Six Month						
One Year						
Three Year						
Municipal Bond	92,143	578,894	37,817	40,215	40,048	41,991
Commercial Loan						
Installment Loan	100,000			100,000	100,000	

[a]For demand and time deposits the data for period 1, year 1 indicates the initial volume of deposits, and the data for the following periods indicates the increments in deposits for each period. For investments, the data represents the amount of loans made and government securities purchased in each period.

In period one of year one the bank holds $2,567,235 and $3,803,137 of demand and time deposits, respectively. These funds are used to make $1,071,315 of six month, $700,000 of two year and $252,142 of three year agricultural loans. The bank also makes $100,000 of installment loans and purchases $92,143 of municipal bonds. In period two of year one, demand deposits increase by $115,000 and time deposits by $225,000. The bank utilizes these additional deposits and the funds from other maturing investments to make $973,700 of six month agricultural loans, $447,858 of three year agricultural loans and $400,000 of ten year agricultural loans. Also, $578,894 of municipal bonds are purchased.

In period one of year two demand deposits increase by $153,166 and time deposits increase by $225,000. The demand deposits increase more in this period than in the previous period due to the "feedback" from loans. The bank makes $1,683,336 of six month agricultural loans and purchases $37,817 of municipal bonds during the period. In the second period of year two the bank makes $2,277,325 of six month agricultural loans, $100,000 of installment loans, and purchases $40,215 of municipal bonds. Demand deposits increase by $177,155 and time deposits increase by $225,000. Time deposits increase by the maximum amount in all periods. Although interest rates on time deposits are high, the bank still found it profitable to increase time deposits by the maximum amount in each period.

In period one of year three demand deposits increase by $175,479. A total of $2,267,500 of six month, $825,923 of two year and $300,000 of three year agricultural loans and $100,000 of installment loans are

made in this period. Also the bank purchases $40,048 of municipal bonds. In period two of year three the bank makes $1,467,500 of six month and $1,295,858 of one year agricultural loans. Also the bank purchases $41,991 of municipal bonds. Demand deposits increase by $194,914 during this last period.

Annual Net Worth

Table XII shows the total of the various loans, government securities and municipal bonds that the bank held in inventory at the beginning of the planning horizon. The amount of these inventory assets that mature in each period is also shown in this table. This information along with the annual decisions is used to construct annual net worth statements for the bank as summarized in Tables XIII, XIV, and XV.

At the end of year one demand deposits have increased to $2,682,235 and time deposits increase to $4,028,137 (Table XIII). The availability of these deposits allows the bank to have $973,700 of six month agricultural loans, $1,140,865 of two year agricultural loans, $839,694 of three year agricultural loans and $400,000 of ten year agricultural loans outstanding at the end of the first year. Also the bank has $254,664 of three year government securities, $1,351,394 of municipal bonds, $140,867 of commercial loans and $288,042 of installment loans in its portfolio in year one. These totals represented in the annual net worth statements include the amount of the initial inventory (Table XII) plus the loans made and securities purchased by the bank (Table XI). The bank also has a $50,000 investment in an Agricultural Credit Corporation and $1,765,648 in cash reserves. These cash reserves

TABLE XII

INITIAL INVENTORY LEVELS OF LOANS, GOVERNMENT SECURITIES AND MUNICIPAL BONDS WHEN THE INVENTORY MATURES

	TOTAL IN INVENTORY	AMOUNT MATURING IN EACH PERIOD					
		YEAR 1		YEAR 2		YEAR 3	
		PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2
Agricultural Loan							
Six Month	$1,232,589	$1,232,589					
One Year	1,232,598	616,300	$616,300				
Two Year	881,728	220,432	220,432	$220,432	$220,432		
Three Year	209,541	34,923	34,923	34,923	34,923	$34,923	$34,923
Ten Year							
Government Security							
Six Month	50,000	50,000					
One Year	74,424	37,231	37,213				
Three Year	381,996	63,666	63,666	63,666	63,666	63,666	63,666
Municipal Bond	875,500	51,500	51,500	51,500	51,500	51,500	51,500
Commercial Loan	281,734	70,433	70,433	70,433	70,433	70,433	70,433
Installment Loan	376,084	94,021	94,021	94,021	94,021		

TABLE XIII

ANNUAL NET WORTH STATEMENT--YEAR ONE

ASSETS		LIABILITIES	
Agricultural Loans		Demand Deposits	$2,682,235
Six Month	$ 973,700	Time Deposits	4,028,137
One Year		Capital and Surplus	536,702
Two Year	1,140,864		
Three Year	839,694		
Ten Year	400,000		
Government Securities			
Six Month			
One Year			
Three Year	254,664		
Municipal Bonds	1,351,394		
Commercial Loans	140,867		
Installment Loans	288,042		
Fixed Assets	42,200		
ACC Investment	50,000		
Cash, Liquid Assets and Correspondent Balances[a]	1,765,648		
TOTAL	$7,247,074	TOTAL	$7,247,074

[a]Since the model was developed for a nationally chartered bank, the correspondent balances are assumed to not be available to meet reserve requirements, but are compensative balances required by the correspondent.

TABLE XIV

ANNUAL NET WORTH STATEMENT--YEAR TWO

ASSETS		LIABILITIES	
Agricultural Loans		Demand Deposits	$3,012,556
Six Month	$2,277,352	Time Deposits	4,478,137
One Year		Capital and Surplus	567,655
Two Year	700,000		
Three Year	769,847		
Ten Year	400,000		
Government Securities			
Six Month			
One Year			
Three Year	127,332		
Municipal Bond	1,418,569		
Commercial Loans			
Installment Loans	200,000		
Fixed Assets	42,200		
ACC Investment	50,000		
Cash, Liquid Assets and Correspondent Balances[a]	2,073,047		
TOTAL	$8,058,347	TOTAL	$8,058,347

[a]Since the model was developed for a nationally chartered bank, the correspondent balances are assumed to not be available to meet reserve requirements, but are compensative balances required by the correspondent.

TABLE XV

ANNUAL NET WORTH STATEMENT--YEAR THREE

ASSETS		LIABILITIES	
Agricultural Loans		Demand Deposits	$3,382,949
Six Month	$1,467,500	Time Deposits	4,928,137
One Year	1,295,588	Capital and Surplus	598,838
Two Year	824,923		
Three Year	1,000,000		
Ten Year	500,000		
Government Securities			
Six Month			
One Year			
Three Year			
Municipal Bonds	1,397,609		
Commercial Loans			
Installment Loans	200,000		
Fixed Assets	42,200		
ACC Investments	50,000		
Cash, Liquid Assets and Correspondent Balances[a]	2,132,105		
TOTAL	$8,909,924	TOTAL	$8,909,924

[a]Since the model was developed for a nationally chartered bank, the correspondent balances are assumed to not be available to meet reserve requirements, but are compensative balances required by the correspondent.

include the corresponding balances at the correspondent bank and the reserves required by the Federal Reserve System.

At the end of year two (Table XIV) the bank has $2,277,352 of six month, $700,000 of two year, $769,847 of three year and $400,000 of ten year agricultural loans outstanding. The bank's demand deposits have increased to $3,012,556 and time deposits to $4,478,137 by the end of year two. The bank also has $1,418,569 of municipal bonds and $200,000 of installment loans in its portfolio.

At the end of the planning horizon, demand deposits reach a $3,382,949 total and time deposits have increased to $4,928,137. The bank has invested these funds in six month ($1,467,500), one year ($1,295,588), two year ($824,923), three year ($1,000,000) and ten year ($500,000) agricultural loans. Also, the bank has increased its holding of municipal bonds to $1,397,609 and has $200,000 of installment loans. Cash reserves have increased to $2,132,105 due to the increased deposits and expanded use of the correspondent system.

External Sources and Uses of Funds

The utilization of the four external sources of funds identified earlier by the case bank are summarized in Table XVI. The Agricultural Credit Corporation could be utilized to make six month, one year, two year and three year agricultural loans. As can be determined from Table XVI, the bank utilizes the ACC to its fullest extent in all periods to make six month agricultural loans. By forming the ACC, the bank is able to satisfy a total of $1,995,000 of loan demand which would not have been satisfied otherwise. In addition the bank receives a total contribution to profit of $12,810 from these loans during the

TABLE XVI

EXTERNAL SOURCES AND USES OF FUNDS

	YEAR 1		YEAR 2		YEAR 3	
	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2
Agricultural Credit Corporation						
Six Month Loan						
Volume[a]	$332,500	$332,500	$332,500	$332,500	$332,500	$332,500
Profit Contribution[b]	2,135	2,135	2,135	2,135	2,135	2,135
Correspondent						
Six Month Loan						
Volume[a]	706,010		93,990			800,000
Profit Contribution[b]	1,003		133			1,136
One Year Loan						
Volume[a]	93,990	800,000		800,000		
Profit Contribution[b]	256	2,176		2,176		
FICB Direct Line						
Six Month Loan						
Volume[a]	89,175	890,175	890,175	890,175	900,000	900,000
Profit Contribution[b]	575	5,735	5,735	5,735	5,978	5,978
Two Year Loan						
Volume[a]	9,825					
Profit Contribution[b]	120					
PCA Participation						
Three Year Loan						
Volume[a]	200,000					

[a]The volume data indicates the total amount of loans made during each period.

[b]This is the total contribution to net profit above direct variable costs of using each external source of funds to make the various maturity types of agricultural loans.

three year planning horizon.

The correspondent arrangement could be used to make both six month and one year agricultural loans. The correspondent arrangement is used to make $1,600,000 of six month agricultural loans and $1,600,000 of one year agricultural loans during the planning horizon (Table XVI). The total profit contribution from these loans amounts to $6,860.

Direct line discounting with the district FICB was included in the model to supply external funds for making six month, one year, two year and three year agricultural loans. The FICB direct line discount is utilized to make $9,825 of three year agricultural loans and $5,360,699 of six month agricultural loans (Table XVI). It should be noted that the profit margin for direct line discounts is identical to the margin on ACC loans. Thus, this external source of funds generates an additional $29,856 of profit for the bank during the planning horizon.

Even though the PCA participation arrangement does not generate a direct profit for the bank, an economic benefit results from this source of funds through the increase in loanable deposits from the "feedback effect".

Annual Profit and Loss Summary

Table XVII shows the profit and loss summary for the bank for the three year planning horizon. The figures represent the income from taxable sources, the amount of non-taxable income, and the amount of taxes paid for each of the three years.

In year one, the net income from taxable sources is $72,177 and the taxable income from the ACC is $4,270. The non-taxable income

TABLE XVII

PROFIT AND LOSS SUMMARY[a]

	YEAR 1	YEAR 2	YEAR 3
Net Profit from Taxable Sources[b]	$72,177	$51,025	$ 94,241
Net Profit from the ACC	4,270	4,270	4,270
Net Profit from Non-taxable Sources	21,752	37,428	41,376
Total Net Profit	$98,219	$92,723	$139,887
Less Taxes Paid[c]	28,645	17,994	38,089
Total after Tax Profit[d]	$69,574	$74,729	$101,798

[a]This profit and loss summary presents only aggregate income figures. The model was not designed to keep detailed accounting records.

[b]The net profit from taxable sources figure represents the net profit after all variable and fixed expenses have been deducted.

[c]Includes taxes paid by the Agricultural Credit Corporation.

[d]Includes the after tax profit of the Agricultural Credit Corporation.

amounts to $21,752 for a total of $98,219 of net income before taxes. Taxes paid for the first year total $28,645 which is determined by taxing the first $25,000 of taxable profit at a 22 percent rate and the balance at a 48 percent rate. The income of the ACC is taxed at the same rates. After deducting the taxes paid, the bank has a $69,574 after tax profit. This total includes a $21,752 income from non-taxable sources.

In year two, the net income from taxable sources decreases to $51,025 because of a decline in the volume of loans and government securities that earn taxable income. In contrast, non-taxable income increases to $37,428 in the second year. The liability decreases to $17,994 for a net after tax profit of $74,729 in year two. In year three, the bank experiences an increase in both loan volume and municipal bond investments, thus resulting in an increase in taxable income to $94,241 and an increase in non-taxable income to $41,376. The taxes paid in the third year total $38,089 for a net after tax profit of $101,798.

The objective function value for the base model is $213,435. This figure is a discounted net profit figure for the three year planning horizon. As mentioned previously a seven percent discount rate was used in the analysis.

Alternative Optimal Solutions

When using the linear programming procedure the possibility always exists that an alternative solution will yield the same objective function value. An alternative optimal solution which included minor

changes in the loan portfolio was indicated for the case bank and will be briefly reviewed.

In period one of year one, the base solution indicates that $252,142 of three year agricultural loans are made. By making the same volume of ten year agricultural loans, the bank would have realized the same profit over the planning horizon. Also in period two of year one, differences in the volume of three year and ten year agricultural loans occur between the base and alternative solutions. In the base solution $447,858 of three year and $400,000 of ten year agricultural loans are made, while the alternative optimal solution includes $700,000 of three year and $147,858 of ten year agricultural loans in this period. Similar substitutions between the three year and ten year agricultural loans occur during the remaining periods in the alternative compared to the base optimal solution.

Since the PCA participation arrangement does not yield a direct profit, (only an indirect increase in the bank's deposits through the feedback effect), there is no distinction in profitability between the types of agricultural loans handled by this arrangement. Thus, the alternative optimal solution uses the PCA participation for two year rather than three year agricultural loans.

Analysis of the Base Solution

The following discussion will indicate the sensitivity of the optimal base solution to changes in the net return for selected activities (C_{jk}) and the amount of resources available and market demand in each period (B_{ik}).

Sensitivity to Changes in Net Returns

Banks operate in a highly competitive industry where the banker must be able to quickly reallocate resources to the most profitable alternative. A bank's return on various investments is highly variable depending on the loan demand and interest rates of competitors. Thus, the optimal solution would be expected to be sensitive to slight changes in net returns on investments. An analysis of cost and return ranges confirms this expectation. Table XVIII contains the cost ranges for the base solution. Only selected ranges will be discussed.

Deposits. In the second period of year one demand deposits increase by $115,000. The demand deposits cost the bank $.00409. Even if the cost would increase to $.04197, demand deposits would still have increased by $106,449. In this same period time deposits increase by $225,000 even though they cost $.10234 per dollar. If the cost would increase to $.13895, time deposits would still increase by $213,838. The insensitivity of time and demand deposit growth to relatively large changes in cost, as suggested by the cost ranges in all periods, indicates the importance of internal sources of loanable funds even though they are relatively expensive to the bank.

Investments. In period one of year one the bank buys $92,143 of municipal bonds with a discounted net return of $.12893. The amount of municipal bonds purchased would not vary as long as the net returns did not fall below $.12678. If the returns on municipals should decrease below $.12678, the bank would not buy municipal bonds. Because of other constraints, an increase in the net return for municipal bonds would not have increased the quantity purchased. The cost ranges on municipal bonds in the following periods are quite similar in magnitude.

TABLE XVIII

COST RANGES FOR ACTIVITIES WHICH ARE IN SOLUTION AT LESS THAN LIMIT LEVEL

ACTIVITY[a]	CURRENT ACTIVITY LEVEL	CURRENT YIELD OR COST	COST RANGE		CHANGE IN ACTIVITY LEVEL IF COSTS CHANGE BEYOND COST RANGES	
			LOWER	UPPER	LOWER	UPPER
1BTE-1	$ 92,143	$ .12893	$ .12678	Infinity	0	$ 92,143
1MAL1-1	1,171,314	.03857	.03840	$ .03858	$1,061,186	1,323,456
1MAL3-1	700,000	.14632	.14609	Infinity	252,144	700,000
1MAL4-1	252,142	.21237	.21237	.21254	0	262,270
1MIL-1	100,000	.16216	.16159	Infinity	100,000	100,000
1DD-2	115,000	-.00409	-.04197	Infinity	106,449	115,000
1TD-2	225,000	-.10234	-.13895	Infinity	213,838	225,000
1BTE-2	578,894	.10597	.10353	.10812	0	671,037
1MAL1-2	973,700	.03731	.03702	.03757	732,828	1,373,700
1MAL4-2	447,857	.17455	.17438	.7455	437,730	700,000
1MAL5-2	400,000	.17455	.17455	Infinity	147,857	400,000
1ALA1-1	332,500	.0062	.00576	Infinity	322,679	332,500
1ALC1-1	706,010	.00137	.00135	.00167	578,987	800,000
1ALC2-1	93,989	.00254	.00224	.00256	0	221,013
1ALD1-1	890,174	.0062	.00618	.00637	765,056	900,000
1ALD3-1	9,826	.02207	.0219	.02209	0	134,944
1ALA1-2	332,500	.006	.0056	Infinity	322,679	332,500
1ALC2-2	706,010	.00245	.00243	.00284	578,987	715,985
1ALD1-2	890,175	.006	.00598	.00617	765,056	900,000
2DD-1	153,166	-.00321	-.00379	-.00548	153,166	153,362
2TD-1	225,000	.08017	-.10965	Infinity	213,880	225,000
2BTE-1	37,817	.08301	.08043	.08544	0	617,852
2MAL1-1	1,683,325	.03601	.03583	.03634	1,673,812	1,683,335

TABLE XVIII (CONTINUED)

ACTIVITY[a]	CURRENT ACTIVITY LEVEL	CURRENT YIELD OR COST	COST RANGE		CHANGE IN ACTIVITY LEVEL IF COSTS CHANGE BEYOND COST RANGES	
			LOWER	UPPER	LOWER	UPPER
2ALA1-1	332,500	.00579	.00535	Infinity	332,679	332,500
2ALC1-1	93,990	.00128	.00104	.0013	93,990	221,013
2ALD1-1	890,175	.00579	.00577	.00596	765,056	900,000
2DD-2	177,155	-.00243	-.60677	-.00214	176,762	177,155
2TD-2	225,000	-.05945	-.08096	Infinity	213,882	225,000
2BTE-2	40,215	.06155	.05873	.06413	0	78,032
2MAL1-2	2,277,325	.03487	.0347	.03492	2,267,500	2,277,325
2MIL-2	100,000	.11238	.11008	.11445	0	100,000
2ALA1-2	332,500	.0056	.00517	Infinity	322,679	332,500
2ALC2-2	800,000	.00229	.00227	Infinity	676,830	800,000
2ALD1-2	890,175	.00561	.00559	.00578	765,056	900,000
3DD-1	175,479	-.00155	-.00183	.00273	175,479	175,879
3TD-1	225,000	-.03873	-.05249	Infinity	11,904	225,000
3BTE-1	40,048	.0401	.03745	.04292	0	80,261
3MAL1-1	2,267,500	.03361	.03359	.0339	2,144,330	2,277,325
3MAL3-1	824,923	.06606	.06583	.06606	377,066	1,000,000
3MAL4-1	300,000	.06606	.06606	.06664	124,923	552,179
3MAL5-1	100,000	.06606	.06606	.06638	0	100,000
3MIL-1	100,000	.07321	.07158	.07551	0	200,000
3ALA1-1	332,500	.00541	.00494	Infinity	0	332,500
3ALD1-1	900,000	.00541	.00512	Infinity	890,175	900,000
3DD-2	194,914	-.00077	-.00498	-.00049	194,509	194,914
3TD-2	225,000	-.01936	.02604	Infinity	0	225,000
3BTE-2	41,991	.02005	.01695	.0227	0	82,039
3MAL1-2	1,467,500	.03259	.03259	.03261	13,359	1,590,670

TABLE XVIII (CONTINUED)

ACTIVITY[a]	CURRENT ACTIVITY LEVEL	CURRENT YIELD OR COST	COST RANGE		CHANGE IN ACTIVITY LEVEL IF COSTS CHANGE BEYOND COST RANGES	
			LOWER	UPPER	LOWER	UPPER
3MAL2-2	1,295,857	.03259	.03257	.03259	1,176,659	2,749,998
3ALA1-2	332,500	.00525	.00505	Infinity	0	332,500
3ALC1-2	800,000	.00116	.00114	Infinity	676,830	800,000
3ALD1-2	900,000	.00525	.00511	Infinity	224,923	900,000

[a]See Table VII for the definitions of these activities.

About $1,071,000 of six month agricultural loans with a discounted net return of $.03857 are made in the first period. The bank would continue to make this amount of six month agricultural loans as long as the net returns remain between $.03840 and $.03858. If the net return should decrease below $.03840, then the bank would make only $1,061,200 of six month loans. But if the returns increase above $.03858, $1,323,450 of six month agricultural loans would be made. Thus, only a slight increase in net returns would cause the bank to make $252,000 more of type one loans, while a relatively large reduction in net returns could be experienced before a decrease in the amount of loans would occur.

The bank also makes $700,000 of two year agricultural loans in the first period at a net return of $.14632. This total would not change unless the net return decreased to $.14609 or increased to infinity. The infinity value indicates that regardless of the net return, the bank could not make any more two year agricultural loans since it is at the upper limit of the market demand for this type of loan. If the net return did decline below $.14609, only $252,144 of two year agricultural loans would be made. The unused allocable funds generated by this decrease in two year loans would be invested in two year agricultural loans in period two of year one.

Approximately $252,100 of three year (type 4) agricultural loans are also made in the first period, with a net return of $.21237. As long as the net return did not drop below $.21237 or increase above $.21254, the bank would not alter the amount of three year loans made. If the net return increased to $.21254 the bank would make $262,300 of these loans. If the net return decreased below the current $.21237

level, no three year agricultural loans would be made, but ten year agricultural loans would be made instead.

In the second period of year one the bank makes $973,700 of six month agricultural loans, which have a net return of $.03731. If the net return on these loans would decrease to $.03702, the bank would have loaned only $732,800 of six month loans and utilized the other loanable funds to make one year agricultural loans. If the returns would increase to $.03757, the bank would have made $1,373,700 of six month agricultural loans. Within this narrow range in net returns ($.03702 to $.03757), the amount of six month agricultural loans that would be made varies widely.

Approximately $447,900 of three year agricultural loans which return $.17455 over the planning horizon are also made in the second period of year one. Only $437,800 of loans would be made if the return decreased to $.17438. The additional funds would be used to make one year agricultural loans in period one of year two. If the return would increase slightly above $.17455, $700,000 of three year agricultural loans would be made. Also in period two of year one, $400,000 of ten year agricultural loans are made which have a discounted net return of $.17455. If the return would decrease to slightly less than $.17455, only $147,857 of ten year loans would be made in year one period two and the remainder of the funds would be used to make ten year agricultural loans.

These cost ranges and those in the remaining periods indicate that agricultural loans, particularly the six month maturity loans, are very sensitive to cost or yield changes. The bank tends to make relatively

the same amount of six month agricultural loans within only a narrow range in net returns (Table XIX). During only period two, of year one and year three is there a large difference in the amount of these loans the bank would make if the returns varied. This difference occurs in period three because the bank substitutes one year agricultural loans for six month agricultural loans in this period. The reason for this substitution is that both loans have a return of $ .03254 in this period. In all previous periods the returns were not the same since the loans were not of the same maturity length. Due to the termination of the planning horizon for the bank, all returns for the last period are based on a six month discounted net return.

A comparison of the net return ranges for agricultural loans and municipal bonds indicates that the ranges are much narrower for the agricultural loans. Thus, agricultural loans are much more sensitive to yield changes than municipal bonds. Also as indicated by the ranges of Table XVIII, agricultural loans are also much more sensitive to changes in returns than installment loans.

External Funds Sources. The ranges on the loans made by the Agricultural Credit Corporation in all periods lead to the same basic conclusion. The bank utilizes the ACC to make $332,500 of six month agricultural loans in each period of each year. Even if the return should increase in any of the periods for the six month loan, no more loans could be made since the ACC only has sufficient assets to make $332,500 of loans. The bank would have utilized the ACC in all periods to make six month loans as long as the return did not decrease significantly. For example, in period one of year one the six month loans through the ACC have a return of $ .0062. If the return decreased to $ .00576 the

TABLE XIX

AMOUNTS OF SIX-MONTH AGRICULTURAL LOANS MADE AND THE AMOUNT THAT WOULD BE MADE WITH VARYING RETURNS

PERIOD OF LOAN	CURRENT ACTIVITY LEVEL	CURRENT YIELD OR COST	COST RANGE		CHANGE IN ACTIVITY LEVEL IF COSTS CHANGE BEYOND COST RANGES	
			LOWER	UPPER	LOWER	UPPER
Period 1, Year 1	$1,071,315	$ .03857	$ .0384	$ .03858	$1,061,186	$1,323,456
Period 2, Year 1	973,700	.03731	.03702	.03757	732,829	1,373,700
Period 1, Year 2	1,683,336	.03601	.03583	.03634	1,673,812	1,683,335
Period 2, Year 2	2,277,325	.03487	.0347	.03492	2,267,500	2,277,325
Period 1, Year 3	2,267,500	.03361	.03359	.0339	2,144,330	2,277,325
Period 2, Year 3	1,467,500	.03259	.03258	.03261	13,359	1,590,670

bank would still have utilized the ACC to make $322,700 of six month agricultural loans and would have made two year agricultural loans with the balance of the ACC's loanable funds.

The correspondent is utilized to make only six month and one year agricultural loans (Table XVI). In period one of year one the correspondent arrangement is utilized to make $706,000 of six month agricultural loans which yield $ .00137. If the yield would have decreased to $ .00135 the bank would have made only $579,000 of six month loans through the correspondent. If the yield increased to $ .00167 the bank would utilize the correspondent to make $800,000 of six month loans. Also in period one of year one, the correspondent arrangement is utilized to make $94,000 of one year agricultural loans which have a yield of $ .00254. If the yield had been $ .00256, the bank would have made $221,000 of one year agricultural loans. When this $221,000 of one year loans is added to the $579,000 of six month loans that would be made if the return decreased on these loans, it totals to $800,000 which is the limit placed on the correspondent arrangement. Thus, the relative amount of six month and one year agricultural loans made with the correspondent arrangement may be changed by changes in relative returns, but the bank would fully utilize the correspondent arrangement in all periods.

The direct line discounting mechanism is also utilized fully in all periods. As in the case of the correspondent arrangement, if the return varied on the loans made by the direct line, the loan portfolio would change but the bank would still fully utilize the direct line mechanism. For example in period one of year one the direct line mechanism is used to make approximately $890,200 of six month

agricultural loans which have a return of $ .0062. If the return decreased to $ .00618 the bank would make only $765,056 of six month loans. Also in period one of year one, the direct line mechanism is used to make $9,825 of two year agricultural loans at a return of $ .02207. If the return should decrease to $ .0219 the bank would not have made any two year loans with the direct line mechanism. But if the return would increase to $ .02209, the bank would have made $134,944 of two year agricultural loans.[1]

In general, the net return ranges indicates that all the external sources of funds are highly sensitive to changes in net returns. Thus, changes occur in the volume of various types of loans made through the external mechanisms when only a slight change in return occurs. However, even with these changes in returns, the mechanisms are still fully utilized.

Government Securities. The previous discussion has dealt with the sensitivity of the activities which are in the base solution at a positive level. Surprisingly, the purchase of government securities is not included in the base solution. Municipal bonds are purchased instead of government securities to meet liquidity requirements. However, the question arises as to what return would be required on government securities before they would be included in the solution.

In period one of year one, six month government securities have a return of $ .02037. Before any six month government securities would be purchased, the bank would have to receive a return of $ .02395 on these investments. One year government securities have a return of $ .04236 in period one of year one, but would have to receive a return of $ .04632 before they would be purchased. In the first period of

year two, six month government securities return $ .01841, but would not be purchased by the bank unless the return increased to $ .02768. One year government securities have a return of $ .03725 in the same period, but would not be purchased until the return increased to $ .04897. The return on three year government securities was $ .07246 but they would not be purchased unless the return increased to $ .07811. In general, a bank has basically two reasons to purchase government securities: (1) profitability and (2) liquidity. Considering the tax differences, other investments such as municipal bonds are more profitable for the case bank. In addition the bank is able to meet liquidity requirements through the purchase of municipal bonds.

Sensitivity to Changes in Resource Availability and Market Conditions

The sensitivity of the optimal solution to changes in the right-hand-side values for various constraints will be briefly reviewed. The discussion will emphasize the market demand constraints on loans, the limits on external funds utilization and the demand and time deposit constraints. Table XX shows selected rows which are used at their limit level and the range in right-hand-sides within which the set of activities in solution would not change. The table also gives the increase and decrease in the objective function value associated with a dollar change in the resource or market demand level.

A change in the quantity of uncommitted allocable funds in the first period of the first year (1AF-1), which is currently at a level of $86,700 would not alter the optimal set of activities as long as the constraint value was between $77,400 and $250,200. With each dollar

TABLE XX

RANGES IN LIMITING RESOURCES OR MARKET AVAILABILITY[a]

ROW[b]	RANGE IN RESOURCE OR MARKET AVAILABILITY WITHIN WHICH ACTIVITIES WILL NOT VARY		INCREASE OR DECREASE IN THE OBJECTIVE FUNCTION WITH A UNIT CHANGE IN RESOURCE OR MARKET AVAILABILITY
	LOWER VALUE	UPPER VALUE	
1AF-1	$ 77,369	$ 250,215	$ .11775
1TLL1-1	2,572,475	3,240,696	.00076
1TLLB-1	0	200,000	.00125
1TLLC-1	555,353	1,234,544	.0016
1TLLD-1	655,041	1,335,099	.0042
1LDD-2	42,758	269,034	.08094
1LTD-2	213,838	422,462	.03661
1TLLB-2	200,000	1,016,394	.00125
1TLLC-2	708,905	1,037,071	.00227
1TLLD-2	329,602	1,717,710	.00449
2LDD-1	42,436	274,657	.06259
2LTD-1	213,881	421,717	.02948
2LL3-1	227,257	700,000	.00058
2LL4-1	447,821	700,000	.00058
2TLL1-1	2,907,480	3,244,292	.00072
2TLLC-1	547,905	893,984	.00088
2TLLD-1	647,905	993,989	.00326
2LDD-2	42,439	214,961	.046
2LTD-2	213,883	366,575	.02151
2TLL1-2	3,376,880	3,509,672	.00003
2TLLC-2	800,000	923,170	.00122
2TLLD-2	890,328	1,023,170	.00353
3LDD-1	120,479	287,373	.02965
3LTD-1	11,904	426,238	.01376
3TLL1-1	3,324,923	3,982,500	.00037
3TLLC-1	676,830	800,000	.00057
3TLLD-1	417,500	1,075,077	.00274
3LDD-2	139,914	1,512,589	.01465
3LTD-2	0	1,726,758	.00668
3TLLC-2	0	2,254,142	.0006
3TLLD-2	0	2,354,142	.00273

[a] See Table VI for the current limit or right-hand-side value for each of these rows.

[b] See Table V for the definitions of these rows.

increase or decrease in the allocable funds, the objective function would increase or decrease respectively by $ .11775. If the bank would have had $250,000 rather than $86,702 of uncommitted allocable funds available in period one of year one, net return would increased by approximately $19,000.

The market demand for six month agricultural loans in period one, year one, (1TLL1-1 of Table XX) is exhausted at its upper limit of $3,000,000. The set of activities in the optimal solution would not change unless this market demand would decrease below $2,512,500 or increase above $3,240,700. If the market demand should vary in this range, the objective function would increase or decrease, respectively, by $ .00076. For example, if the market demand had been $3,240,000, the bank could have increased net profit by approximately $180 by making additional six month agricultural loans.

The total loan limit for the participation agreement, correspondent arrangement, and direct line discounting are also exhausted in the first period of the first year. For the direct line mechanism (1TLDD-1), the set of activities in the optimal solution would not change unless the market constraint value decreased below $655,000 or increased above $1,335,100. Any change within this range would decrease or increase, respectively, the objective function by $ .0042. If the bank had been able to make $1,335,000 of loans through the direct line, its profit would have increased by $1,800. A change in the loan limit for the correspondent arrangement in period one (1TLCC-1) would not alter the activities in the optimal solution unless the constraint was less than $555,300 or greater than $1,234,500. Any change within this range would cause a $ .0016 decrease or increase, respectively.

in the objective function value. If the bank had been able to utilize the correspondent arrangement to make $1,200,000 of loans, the bank's profit would have increased by $640. As in the first period, these three external sources of funds are fully utilized during all of the remaining periods of the planning horizon. In general, the constraint ranges in these later periods indicate that additional external funds could have been used profitably.

The data of Table XX indicates that additional internal sources of funds would have a significant effect on the bank's profitability. For example, if the bank would have been able to attract up to $269,000 of demand deposits in period two of year one (1LDD-2), profit would have increased by $ .08094 for every dollar above the $55,000 upper limit imposed on demand deposits. Also in this period, the bank could have increased profits $ .03661 for each dollar increase in time deposits (1LTD-2) up to a total of $422,500. These additional time deposits would increase bank profits by approximately $7,230. If demand deposits had increased up to $287,400 in period one of year three (3LDD-1) profit would have increased by $ .02965 for each dollar increase over $175,000. An increase in time deposits in this period (3LTD-1) of up to $426,200 would increase the bank's profit by $ .01376 for each dollar increase over $225,000.

In general, these shadow prices indicate that substantial profit increases would occur if more deposits or internal sources of funds were available. Comparing the profitability of external and internal sources of funds, it is apparent that internal sources (time and demand deposits) would increase the bank's profit by a substantially greater amount. However, as has been pointed out earlier, the potential for

attracting an increased volume of deposits that will keep up with the increasing loan demand in rural communities is severely limited. Thus, although increases in internal sources of funds create more profit for the bank relative to external sources of funds, it is profitable to use external sources when deposit expansion is not adequate to serve loan demand.

Changes in the internal loan limits could have an effect on the bank's profitability without changing the activities in solution. For example, a change in the internal loan limit on three year agricultural loans (2LL4-1 of Table XX) in period one of year two, which is currently at a level of $700,000, would not alter the optimal set of activities as long as the RHS value was between $447,820 and $700,000. With each dollar decrease in the loan limit, the objective function would decrease by $ .00058.

Resource and market constraints which are not utilized in the solution at their limit level are shown in Table XXI. The lower limit value in Table XXI indicates the level at which the activities in the optimal solution will not vary as long as the market demand or resource availability does not decrease below this level. The lower limit unit cost indicates what return will be sacrificed if the market demand or resource use is lowered below its current level. For example, if total market demand for 1TLL-1 loans was forced below the present level of $4,355,958, the bank would have a decrease in profit of $ .00125 for each dollar of decreased demand. The $ .00125 decrease in profit only holds true to the point where the market demand reaches its lower limit of $4,155,958. The effect of a total loan demand below this level cannot be determined since the solution will contain new activities.

TABLE XXI

RANGES FOR NON-LIMITING RESOURCE OR MARKET CONSTRAINTS

ROW[a]	SOLUTION LEVEL	LOWER LIMIT	LOWER LIMIT UNIT COST	UPPER LIMIT	UPPER LIMIT UNIT COST
1TLL-1	$4,355,958	$4,155,958	$ .00125	$4,448,101	$ .00215
1LL1-1	1,071,315	1,061,187	.00017	1,323,457	.00001
1TLL2-1	93,990	0	.00030	293,990	--
1TLL3-1	709,825	700,000	.00017	709,825	--
1TLL4-1	200,000	0	--	209,825	.00029
1TLL-2	5,106,201	5,106,201	.00125	5,685,095	.00244
1LL1-2	973,701	732,829	.00029	1,373,701	.00026
1TLL1-2	2,196,375	2,196,375	.00001	2,206,200	.00017
1TLL2-2	800,001	708,863	.0003	1,000,001	--
2TLL-1	5,815,836	5,571,153	.00031	5,853,646	.00258
2LL1-1	1,683,336	1,673,813	.00018	1,683,336	.00033
2TLL2-1	706,011	578,987	.00002	706,011	--
2TLL3-1	709,825	709,825	--	909,825	--
2TLL-2	6,509,825	6,509,825	.00054	6,509,825	.00005
2LL1-2	2,277,325	2,267,500	.00017	2,277,325	.00005
2LL3-2	700,000	227,257	.00058	709,672	.0004
2LL4-2	700,000	447,821	.00058	709,672	.0004
3TLL-1	3,532,500	3,532,500	--	3,532,500	--
3LL1-1	2,267,500	2,144,330	.00002	2,217,325	.00029
3TLLI-1	200,000	100,000	.00163	300,000	.00057
3TLL-2	3,532,500	3,532,500	--	3,632,500	.00006
3LL1-2	1,467,501	13,359	--	1,590,671	.00002

[a]See Table V for the definitions of these rows.

The upper limit value is the upper limit to which the market demand or resource availability can be forced without bringing a new activity into the solution. Thus, the market demand could be forced from its present level of $4,355,958 to the level of $4,448,100 at a cost of $ .00215 per dollar. The $ .00215 cost, which is shown in the upper limit unit cost column indicates the decrease in the objective function value associated with each dollar of loan demand the model is forced to utilize.

The data of Table XXI indicates that all of the rows which designate the internal market potential for six month agricultural loans (1LL1-1, 1LL1-2, 2LL1-1, 2LL1-2, 3LL1-1 and 3LL1-2) have basically the same interpretation. The solution level for each of these rows is close to the lower limit level. Thus, only a slight decrease in the market demand for six month loans would result in a change in the optimal acquisition and utilization of funds.

Model Modifications

Zero Growth in Deposits

The base model allowed the case bank to have a growth of $55,000 and $225,000 per period in demand and time deposits respectively. To determine the impact of deposit availability on sources and uses of funds, zero growth in demand and time deposits was assumed.

Table XXII summarizes the internal sources and uses of funds for the bank when zero deposit growth is assumed. As with the base solution, (Table XI), no government securities are purchased in any period when deposit growth is limited. The bank makes as large a volume of

TABLE XXII

INTERNAL SOURCES AND USES OF FUNDS ASSUMING ZERO DEPOSIT GROWTH[a]

	YEAR 1		YEAR 2		YEAR 3	
	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2
Demand Deposits	$2,567,235	$ 60,000	$ 97,606	$ 121,762	$ 110,145	$ 130,472
Time Deposits	3,803,137					
Agricultural Loans						
Six Month	1,319,827	935,888	1,415,173	1,782,936	2,267,500	1,952,064
One Year						393,723
Two Year	700,000				388,593	
Three Year		700,000				
Ten Year	3,631	396,369			100,000	
Government Security						
Six Month						
One Year						
Three Year						
Municipal Bond	94,143	355,107				185,248
Commercial Loan						
Installment Loan	100,000			100,000	100,000	

[a]For demand and time deposits the data for period one, year one indicates the initial volume of deposits, and the data for the following periods indicates the increments in deposits for each period. For investments, the data represents the amount of loans made and government securities purchased in each period.

loans as possible and only maintains enough municipals in its portfolio to provide needed liquidity. Demand deposits continue to grow due to the feedback relationship.

Relative to the base model, the bank has a higher loan-to-deposit ratio and a lower municipal bond-to-deposit ratio when deposit growth is limited. For example, in period two of year one, the loan-to-deposit ratio is 68 percent for the base model and the municipal bond-to-deposit ratio is 10 percent. When zero deposit growth is assumed, the loan-to-deposit ratio is 69 percent and the municipal bond-to-deposit ratio is 6.9 percent in this same period. The increased importance of loans is also indicated by the fact that the bank does not invest in as large an absolute amount of municipal bonds when deposit growth is limited.

The real effect of the decreased amount of deposits can be seen by comparing the profit and loss statements for the base (Table XVII) and zero deposit growth solutions (Table XXIII). The income from taxable sources tends to be higher for the bank when deposits are not allowed to grow. This forces the bank to pay a higher percentage of its income in taxes. For example, in year two the income for the base solution is $92,723 and it pays $17,994 in taxes for an after tax profit of $74,829. In this same year when the bank has zero deposit growth, it makes $75,120 and pays $16,199 in taxes for an after tax profit of $58,921. The bank pays only 19.4 percent of its income in taxes for the base solution compared to 21.5 percent when zero deposit growth is assumed. More loans and fewer municipal bonds are included in the portfolio when deposit growth is limited, even though the bank is forced to pay a larger percent of its income in taxes.

TABLE XXIII

PROFIT AND LOSS SUMMARY WHEN ZERO DEPOSIT GROWTH IS ASSUMED[a]

	YEAR 1	YEAR 2	YEAR 3
Net Profit from Taxable Sources[b]	$76,249	$47,262	$66,473
Net Profit from the ACC	4,270	4,270	4,270
Net Profit fron Non-taxable Sources	16,255	23,588	28,101
Total Net Profit	96,774	75,120	98,844
Less Taxes Paid[c]	31,680	16,199	24,900
Total after Tax Profit[d]	$65,094	$58,921	$73,944

[a]This profit and loss summary presents only aggregate income figures. The model was not designed to keep detailed accounting records.

[b]The net profit from taxable sources figure represents the net profit after all variable and fixed expenses have been deducted.

[c]Includes taxes paid by the Agricultural Credit Corporation.

[d]Includes the after tax profit of the Agricultural Credit Corporation.

All of the external sources of funds are fully utilized when deposit growth is limited. Relative to the base model, more short-term agricultural loans are made with the external funds sources. This occurs because short term loans are the most profitable and the limited internal sources of funds are not able to satisfy as much of the short-term loan demand.

As with the base model, the shadow prices are much higher for time and demand deposits compared to the external sources of funds. In fact, when zero deposit growth is assumed, internal sources of funds are even more profitable to the bank than external sources of funds. However, in contrast to the base solution, the short-term loans are as sensitive to changes in net returns (C_{jk}) values as the longer term agricultural loans when zero deposit growth is assumed.

Not surprisingly, the objective function value is lower when a zero growth in deposits is assumed. Under limited deposit growth the objective function value is $173,853 compared to $213,435 for the base model. This decreased objective function value can be attributed to the decreased amount of funds which can be invested and the lower amount of municipals in the portfolio which causes the bank to pay a greater portion of its income in taxes.

Changes in Loan Demand

To analyze the impact of changes in market conditions, several different levels of loan demand were incorporated in the model. These levels included a 25 percent increase, a 10 percent increase, a 10 percent decrease, a 25 percent decrease and a 50 percent decrease in the loan limits or loan demand for six month and one year agricultural

loans. Only those different levels of loan demand which caused a significant change in the optimum solution will be discussed.

As would be expected, the 50 percent decrease in six month and one year agricultural loans has the greatest effect on the bank's asset portfolio. However, this market modification did not affect the objective function value drastically. With the 50 percent decrease demand for type one and two loans, the bank has a $209,510 objective function value as compared to $213,435 for the base model. This small change in the objective function value between the base and limited loan demand models indicates that, under the assumptions of this study, the bank is able to adjust to changing loan demand without greatly affecting profitability.

The major change in loan composition when demand is restricted occurs in six month (type one) and one year (type two) agricultural loans. The base model only made $1,295,857 of one year agricultural loans during the three year planning horizon, while $4,498,600 of one year loans are made when the demand for six month and one year agricultural loans is altered (Table XXIV). In constrast, $9,740,675 of six month agricultural loans were made in the base situation compared to only $5,577,995 of these loans when the decreased demand is faced. When the bank faces the decreased demand in six month and one year agricultural loans, more commercial loans and two year agricultural loans are also made.

Short-term agricultural loans prove to be more sensitive to changes in net returns (C_{jk}) values as compared to longer term agricultural loans when loan demand is restricted. For example, in period one, year one, $190,357 of six month agricultural loans are made. The bank

TABLE XXIV

INTERNAL SOURCES AND USES OF FUNDS ASSUMING A 50-PERCENT DECREASE IN LOAN DEMAND FOR SIX-MONTH AND ONE-YEAR AGRICULTURAL LOANS[a]

	YEAR 1		YEAR 2		YEAR 3	
	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2	PERIOD 1	PERIOD 2
Demand Deposits	$2,567,235	$ 85,000	$199,238	$ 114,086	$ 222,914	$ 146,009
Time Deposits	3,803,137	225,000	225,000	225,000	225,000	225,000
Agricultural Loans						
Six Month	190,357	867,500	822,303	1,248,086	1,375,000	1,074,750
One Year	33,100		822,857	69,643	546,907	828,093
Two Year	700,000				1,000,000	
Three Year	700,000				300,000	
Ten Year	400,000				100,000	
Government Security						
Six Month						
One Year						
Three Year						
Municipal Bond	92,143	575,894	42,424	33,909	44,791	37,101
Commercial Loan		50,000		50,000		50,000
Installment Loan	100,000			100,000	100,000	

[a]For demand and time deposits the data for period one, year one indicates the initial volume of deposits, and the data for the following periods indicates the increments in deposits for each period. For investments, the data represents the amount of loans made and government securities purchased in each period.

would continue to make this amount of loans as long as the net return did not deviate outside the range of $ .03857 and $ .0386. The bank also made $700,000 of two year agricultural loans in the same period with a net return of $ .14632. This amount of two year loans would have been made even if the return increased to $ .14643. If the return decreased to $ .1458 the bank would still make $630,357 of two year agricultural loans. Thus, when the demand for short-term agricultural loans is decreased, the returns can fluctuate on long-term loans to a greater degree and the bank would continue to make a large amount of long-term loans.

The external sources of funds are again fully utilized when the bank faces decreased demand for short-term loans. However, the types of loans made with the external sources of funds changes significantly. For example, the direct line mechanism is utilized to make $1,121,914 of six month, $657,500 of two year and $542,500 of three year agricultural loans when market demand is restricted. In the base model, the direct line was utilized to make $5,360,700 of six month and $9,825 of two year agricultural loans. In general, as the market demand for short-term loans decreases, all of the external sources of funds except the ACC are used to a larger volume of long term loans. However, the ACC continues to be fully utilized to make six month agricultural loans as short term loan demand decreases. Although increased availability of both internal (time and demand deposits) and external sources of loanable funds remain profitable, internal sources of loanable funds are still more profitable than increased funds from external sources with limited loan demand.

TABLE XXV

PROFIT AND LOSS SUMMARY ASSUMING A 50-PERCENT DECREASE IN LOAN DEMAND FOR SIX-MONTH AND ONE-YEAR AGRICULTURAL LOANS[a]

	YEAR 1	YEAR 2	YEAR 3
Net Profit from Taxable Sources[b]	$65,464	$42,158	$ 74,255
Net Profit from the ACC	4,270	4,270	4,270
Net Profit from Non-taxable Sources	20,260	32,625	33,680
Total Net Profit	89,994	79,053	112,205
Less Taxes Paid[c]	25,815	14,570	29,917
Total after Tax Profit[d]	$64,179	$64,483	$ 81,188

[a]This profit and loss summary presents only aggregate income figures. The model was not designed to keep detailed accounting records.

[b]The net profit from taxable sources figure represents the net profit after all variable and fixed expenses have been deducted.

[c]Includes taxes paid by the Agricultural Credit Corporation.

[d]Includes the after tax profit of the Agricultural Credit Corporation.

The 25 percent decrease in six month and one year agricultural loan demand has a similar effect on the bank's portfolio as did the 50 percent decrease in demand. However, the changes are not as pronounced. The external sources of funds are again utilized to make more long-term agricultural loans with a 25 percent decrease in demand compared to the base model. The volume of short-term loans is not as sensitive to changes in net returns (C_{jk}) values compared to the 50 percent demand reduction, but it is still more sensitive than in the base model. For example, $920,245 of six month agricultural loans, with a return of $ .03857 are made in period one of year one when demand is reduced 25 percent. If the return should decrease to $ .03851 the bank would make $719,330 of six month loans, and if the return increased to $ .03862 the bank would make $923,457 of six month loans. In general, it appears that as demand decreases for type one and type two agricultural loans, they become more sensitive to changes in net return (C_{jk}) values relative to the longer term agricultural loans.

When the loan demand for six month and one year agricultural loans is increased by 25 percent, the bank makes more short-term loans with both internal and external sources of funds. In comparison with the base solution, the volume of longer term agricultural loans is reduced. Although the shift from long-term to short-term loans is not a major change, it is readily noticeable. Also the shorter-term loans are less sensitive to changes in net return (C_{jk}) values than the longer term loans when loan demand is increased. The 10 percent increase and 10 percent decrease in loan demand for six month and one year agricultural loans did not alter the asset portfolio, the annual profit and loss or the value of the objective function in any significant way.

Thus, the model solution appears to be relatively stable with respect to small changes in loan demand.

It should be noted in general that although the objective function values vary only slightly for the loan demand modifications discussed, there are significant differences in types of loans made both internally and externally except for the 10 percent increase and 10 percent decrease in market demand. Also, the sensitivity of the net returns (C_{jk}) values varies substantially for the various loan demand modifications except for the 10 percent changes.

FOOTNOTES

[1]An analysis of the C_{jk} values of the participation agreement is impossible since the bank does not receive any direct return from the loans made with the participation agreement.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Commercial banks in rural communities face two major problems in adequately servicing their farm customers: (1) a growth in loanable funds which has not kept pace with the growth in loan demand and (2) a set of legal constraints imposed by state and federal regulatory bodies which limit the size of loans that can be made to one individual. This study was concerned with the description and evaluation of alternative methods of providing additional loanable funds to rural banks. The specific objectives were: (1) to identify the alternative methods for commercial bank-Farm Credit System coordination as a means of increasing loanable funds for agriculture, (2) to describe the various legal requirements concerning the use of the PCA participation agreement, the Agricultural Credit Corporation, direct line discounting with the Federal Intermediate Credit Bank and the correspondent arrangement, and (3) to determine under what conditions these external sources could be profitably used by a commercial bank.

Conceptual and Analytical Model

The Agricultural Credit Corporation may be used by commercial banks to make short and intermediate term loans to farmers and

ranchers. A rediscount agreement must be entered into by the ACC with the district Federal Intermediate Credit Bank and the requirements for formation of the ACC as enumerated by the FICB must be met before an ACC can become operational. An ACC is not subject to state or federal regulations on the size of loan that can be made to any one individual. A commercial bank can also use a direct line to obtain funds from the Farm Credit System by entering into a rediscounting agreement with the District FICB. Notes discounted are on a recourse basis, which makes the bank liable for the note if the individual does not pay. The PCA participation agreement allows commercial banks to lend funds to farmers jointly with Production Credit Associations. Any borrower whose loan involves PCA participation must subscribe to the stock of the local PCA and negotiate a note payable to the PCA.

To analyze the use of these alternative external sources of funds a linear programming model was developed and applied to a case bank. The model included a three year planning horizon, with each year subdivided into two periods. The loan and investment activities included in the model were: (1) make six month, one year, two year, three year and ten year agricultural loans; (2) purchase six month, one year and three year government securities; (3) purchase eight year municipal bonds; (4) make two year commercial loans; (5) make two year installment loans; (6) make six month, one year, two year and three year agricultural loans through the ACC; (7) make six month, one year, two year and three year agricultural loans through direct line discounting with the FICB; (8) make six month and one year agricultural loans through the correspondent arrangement; (9) and make six month, one year, two year and three year agricultural loans through the participation

agreement with the local PCA. All loans, government securities and municipal bonds were required to be held to maturity. The only internal sources of funds included in the model were demand and time deposits. Demand and time deposits were allowed to increase each period, if it proved profitable to the bank.

Constraints incorporated in the model included liquidity and capital restrictions as specified by the Federal Reserve examiners. Market limitations were expressed in the form of loan limits for each period. Use of the external mechanisms was limited by constraints as specified by appropriate Farm Credit System and state banking regulations. Internal policy constraints included a minimum and maximum ratio of agricultural loans to deposits and a maximum ratio of municipal bonds to deposits.

Costs for the model were obtained from a recent cost study for the case bank. Returns for agricultural loans were determined through conversations with the banker. Yields for government securities and municipal bonds were obtained from recent Federal Reserve publications. The net return for external sources of funds was determined by considering the cost associated with making the loans and the legal rate which can be charged on loans made through the respective external sources. The model was structured so that only changes in the cost and return estimates and initial resource and market conditions as reflected by the C_{jk} and B_{ik} coefficients are needed to apply it to other banks in different markets or communities.

Empirical Results

Results from the base solution indicate that the case bank could utilize external sources of funds to increase profit and satisfy local loan demand. A total of $10,058,505 of loans were made with funds from the external sources, resulting in a $49,546 contribution to bank profits during the three year planning horizon. Before tax profit was increased by approximately 17.6 percent through the use of the external funds sources.

With respect to loan portfolio, the bank used deposit funds to make a larger volume of short-term loans compared to long-term loans. The short-term loans were more profitable as well as more liquid, and thus allowed the bank more flexibility. No government securities were purchased since liquidity requirements could be met by the liquidity derived from municipal bonds, capital and surplus and government securities contained in the beginning inventory.

External sources of funds, particularly the ACC, the correspondent arrangement and the FICB direct line discount, were also utilized to make primarily short-term loans. The ACC was always utilized to make six month agricultural loans. However, a limited volume of longer-term agricultural loans were made from external sources, particularly through the PCA participation agreement and the FICB direct line. External funds were utilized to the fullest extent possible in all periods, and the shadow prices incidate that additional external funds could have been utilized in a profitable manner by the bank.

The bank's assets increased from an initial level of $7,210,406 to a balance of $8,909,924 at the end of the planning horizon. The bank had a discounted net return of $213,435 for the three year period.

Capital and surplus increased from $500,000 at the beginning of the planning horizon to $598,838 at the end. The growth in assets and discounted net profit appear to be reasonably close to what a bank of this size could accomplish in a three year period.

When zero deposit growth was assumed, the bank continued to invest in short-term loans, but only purchased enough municipal bonds to meet liquidity requirements. In the base model $831,108 of municipal bonds were purchased during the three year planning horizon, while only $632,497 of municipal bonds were purchased when deposit growth was eliminated. External sources of funds were again fully utilized by the bank. The objective function decreased to $173,853 for the zero deposit growth model compared to $213,435 for the base model. This decrease was a result in part of the bank having fewer internal funds available for investment. In addition the investment portfolio included a smaller proportion of municipal bonds, which caused the bank to pay a larger proportion of its income in taxes.

Loan demand variations did not affect annual income or the objective function value to a great extent. With a 50 percent decrease in loan demand, the objective function value decreased to $209,510 compared to $213,435 for the base model. However, variations in loan demand did significantly alter the bank's investment portfolio and the type of loans made with the external sources of funds. When a 50 percent decrease in loan demand for six month and one year loans was assumed, the bank made more commercial loans and one year agricultural loans and fewer six month agricultural loans than in the base model. The external sources of funds, with the exception of the ACC also were utilized to satisfy more long-term loan demand when the market demand

for six month and one year loans was severely limited. The ACC continued to be used to make only six month agricultural loans regardless of the constraints imposed on the market demand for loans.

When the loan demand for six month and one year agricultural loans was increased by 25 percent, both internal and external sources of funds were utilized to make more short-term loans and fewer long-term loans. To provide the liquidity to support this larger loan volume the amount of municipal bonds purchased increased from $831,108 for the base model to $833,337 when increased loan demand was available. No significant changes in portfolio or income occurred when loan demand was increased or decreased by 10 percent.

Conclusions and Implication

In all of the situations analyzed, the external sources of funds were utilized to their fullest extent. Although these external sources of funds were not highly profitable compared to the internal funds (time and demand deposits) they did allow the bank to provide more loans to the community than it would have been able to provide otherwise. In reality, a bank may not attempt to utilize all four external sources at once, but would choose the source which was best suited to its current operation. The source chosen should be the one which provides the greatest amount of loanable funds and the most profit. However depending on the magnitude of the "feedback" relationship, the direct profit from the external sources of funds should not be the only consideration. Preliminary analysis indicates that a typical rural bank can economically benefit by using external funds sources, even if these sources do not contribute directly to bank profits. By making

economically sound loans, irrespective of the source of funds, increased economic activity will occur in the community resulting in increased bank deposits and loanable funds in the future. If these internal funds are as highly profitable as the results of the study indicate, this increase in deposits which is propagated through the availability of additional loanable funds may be the primary benefit of the external funds sources. Recognition of the "feedback" concept by commercial banks will not only increase bank profits in the future, but will also provide evidence of the broader responsibility of rural banks to invest in the future of their community.

Although the external sources of funds were fully utilized under all conditions, the type of loan made with each source except the Agricultural Credit Corporation and the PCA participation agreement proved to be very sensitive to changes in net return (C_{jk}). Irrespective of significant changes in relative returns, the ACC was utilized to make only six month agricultural loans and the participation agreement was utilized to make only longer-term agricultural loans. However, for the direct line and correspondent arrangement, the various types of loans were substituted for each other as returns changed to keep the mechanism fully utilized. Thus, the external sources of funds can be profitably used for various maturity length loans as fluctuations occur in relative yields.

Although the bank utilized the external mechanisms to the fullest extent, internal sources of loanable funds (time and demand deposits) appear to be significantly more profitable than external sources of funds. Generally, increased demand deposits were approximately ten times more profitable and increased time deposits were approximately

five times more profitable than the external funds sources. If the bank has unlimited access to internal loanable funds, external sources of funds would be relatively unimportant. However, very few rural banks have access to sufficient internal loanable funds to satisfy loan demand, and consequently they should seriously consider the use of external sources to satisfy that demand.

Government securities were not purchased in any of the situations analyzed. The bank was able to derive needed liquidity from municipal bonds, government securities in beginning inventory and capital and surplus. Commercial banks should carefully consider the after tax return on government securities compared to municipal bonds before making investment decisions. Although the government securities may possess important liquidity and flexibility characteristics, municipals may have a higher after tax return. However, if the analysis procedure used in this study had considered the differences in flexibility and risk between government securities and municipal bonds, the bank may have purchased more government securities.

Short-term agricultural loans proved to be more sensitive to net return changes as loan demand for short-term agricultural loans decreased. This fact was caused in part by the bank's reliance on short-term loans to maintain flexibility and liquidity of its resources. Thus, banks should be quick to analyze the impact of changing demand on profitability and be able to channel resources in the most profitable direction.

Relative to municipal bonds and installment loans, agricultural loans of all types proved to be quite sensitive to changes in net returns. In fact municipal bonds and installment loans were quite

insensitive to changes in net returns. It appears that assets which provide liquidity (municipal bonds) or have a relative high return (installment loans) are not as sensitive to changes in net returns compared to agricultural loans. Thus, changes in the returns for bonds and commercial and installment loans may not require significant reevaluation and changes in the loan portfolio.

Under the various loan demand modifications, the bank's profitability was not significantly affected because of the substitutability between the various classes of loans. Even under the assumption of a 50 percent decrease in loan demand for six month and one year agricultural loans, the bank was able to substitute longer-term agricultural loans in its portfolio without greatly affecting profit. This may indicate that wide variations in loan portfolio composition may result in only small differences in net return. Thus, the major determinant of bank profitability may be the sources of funds and liability management rather than the uses of funds or asset management. In addition, the substitution of long for short-term loans did not significantly reduce bank profits. Thus, rural bankers may need to reevaluate their attitudes and philosophy with respect to long term agricultural loans.

The relatively high level of cash, correspondent balances and liquid assets projected by the model appear to be excessive at first glance. However, when considering that the bank is assumed to be nationally chartered, the cash levels are not too excessive. A state chartered bank would not need this large amount of cash. However, the major conclusions of the study are felt to be relevant to state chartered banks as well.

Areas for Further Research

One serious problem encountered in this study was the inability to secure up-to-date cost and return data for a small rural bank. Data on the costs and returns associated with various types of loans and investments is necessary to accurately analyze the relative profitability of different investments. This information would also allow commercial banks to compare the net return received from each function they perform.

The specification of loan demand for the bank was also troublesome. The actual determinants of farm demand should be empirically estimated so that the demand for a given area could be determined. Some of these determinants of loan demand might be the interest rate, agricultural technology, personal income, retail sales index, index of farm prices and possibly weather conditions. Knowledge of the specific empirical relationship between these factors and loan demand would also enable commercial banks to project the need for loanable funds.

The model did not deal with the competition problem between commercial banks and the various Farm Credit System lending institutions. It was assumed that the bank would be willing to work with the Farm Credit System agencies to provide funds for the community. However, concern has been expressed that by participating with or obtaining funds from these agencies, the bank may lose a portion of its business. This problem should be investigated and a program developed to minimize the potential of customers moving from the bank to the Farm Credit System agencies.

In general the method used in this study appears to be an adequate way to investigate bank management problems. However, one must be

careful to include all the essential information and at the same time not include so many details that the results cannot be interpreted.

One very important area which merits further study is the empirical estimation of the feedback effect. Most bankers agree with the theoreticians that feedback or a deposit multiplier exists, but the actual value of the multiplier and its impact in various communities has not been measured. By knowing the value of the feedback relationship for different types of loans, commercial banks could evaluate the indirect as well as the direction returns from various loans and use this information to improve their loan portfolio decisions.

The impact that the legal loan limit has on a bank's ability to meet loan demand should also be analyzed. If the legal loan limit does have an effect on the bank's ability to meet loan demand, these limits should possibly be altered or changes in structure encouraged which would allow banks to continue supplying a substantial portion of the credit in agriculture.

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