LIQUIDITY MANAGEMENT SIMULATION MODEL

APPROVED BY:

Prof. Dr. Özer Ertuna

Doç. Dr. Belkıs Seval

Prof. Dr. Nuri Uman

DATE OF APPROVAL : June 8, 1988

LIQUIDITY MANAGEMENT SIMULATION MODEL

Abstract of the dissertation

The objective of the dissertation was to build a simulation model for liquidity management in multi-branch financial institutions in Turkey. TURBO-BASIC language was used. The model was tested with real data to determine its validity. Sensitivity of the model to various parameters was also tested. It was found that the output of the model was close to real numbers thus establishing its validity . Interest rates, level of liquid assets, and standard deviations of various flows turn out to be the most important parameters. Transaction costs, although they are very important in theoretical studies, turn out to be unimportant in applications in Turkey. This is due to the very high interest rates compared to transaction costs.

LİKİDİTE YÖNETİMİ SİMULASYON MODELİ

Tez Özeti:

Tezin amacı, Türkiye şartlarında kullanılabilecek, çok şubeli mali müesseseler için bir likidite yönetimi simulasyon modeli geliştirmekti. Simulasyon programı TURBO-BASIC diliyle yazılmıştır. Modelin geçerliliği hakiki verilerle test edilmiştir. Ayrıca modelin değişik parametrelere duyarlılığı da hakiki verilerle ölçülmüştür. Elde edilen sonuçlar reel sonuçlara hayli yakın çıkmış ve modelin geçerliliği tespit edilmiştir. Faiz oranları, likit aktiflerin miktarı ve çeşitli fon akımlarının standard sapmalarının önemli parametreler olduğu saptanmıştır. Teorik çalışmalarda çok önemli olan işlem maliyetinin ,Türkiye'de faiz oranlarının işlem maliyetlerine göre çok yüksek olması nedeniyle, önemsiz olduğu ortaya çıkmıştır.

CONTENTS

ACKNOWLEDGEMENTS

It took a long time for me to complete this study. I promise to make up for the attention that I did not pay to my daughter Yasemin Pınar and my wife Ferran during all that time. I thank my wife for all the years she gave support to me while I was studying in the U.S.A. This dissertation is dedicated to her.

I thank Professor Dr. Özer Ertuna for giving me the idea for this dissertation and showing all the care he could to bring this study to a successful end. I also thank the other members of my dissertation jury Professor Dr. Nuri Uman and Doçent Dr. Belkıs Seval for their advice and suggestions for further research.

I also thank Professor Dr. Ahmet Koç and Professor Dr. Mustafa Dilber for all their encouragement and support.

I can not thank enough my friend Dr. Tamer Sıkoğlu who spent so much time with me writing the computer program and giving me advice to make the whole study better.

I thank Mrs. Evin Şaylan and Mrs. Rezzan Gürkan for their skillful typing.

Mustafa Akan

CHAPTER I -- OBJECTIVE OF THE STUDY AND BACKGROUND

A. OBJECTIVE OF THE STUDY:

The general objective of banks is to transfer the savings to investments efficiently. They have to try to achieve this objective taking into consideration other objectives as profitability, growth, and liquidity. In the dynamic world of banking, both the liabilities and asset side of the balance sheet elements change continously in terms of amount, term, cost, and yield. Thus the bank managers are faced with increasing uncertainty, about the size of bank's deposits (sources), the market value of non-matured securities, amount of default loans, and loan demand in the future . Thus, a bank must continually adjust its portfolio to meet the demands of its depositors and borrowers in the most effective way. Inability to meet the depositors demand will surely result in default.

In pre-1980 period when the banking sector in Turkey was tightly regulated, deposit and credit rates were fixed, the banking sector was highly static. The sector simply transferred the savings to investments in a reel negatif interest rate environment.

Due to economic liberalization policies of 1980 period, the banking sector became one of the most dynamic sector facing similar set of uncertainties as in more developed countries. Liquidity management became more important than in these countries because of the lack of as many liquidity instruments. The banking sector went through a very tight period in 1982-86 in terms of liquidity management. The Interbank System where the banks can borrow from each other through the Central Bank was introduced in 1986. The Open Market Operations through which the Central Bank buys and sells Government paper to regulate liquidity in the market was introduced in 1986 also. The swapping 1/ of currencies with the Central Bank became possible in 1987.

1/ A bank lends foreign currency to Central Bank in exchange for TL deposit and vice-versa.

Due to increase in activity in the Capital Market activities beginning in 1986 the liquidity of securities that the banks hold increased. In 1988, the Central Bank entered into the Interbank system as a major player quating on a two-way basis 2/ thus increasing the depth of this market also. Before 1985 none of these liquidity instruments were available. The banks had to, to a large extent, regulate their liquidity by borrowing from other banks on a one-to-one basis.

However, as the number of liquidity instruments increased after especially 1986, due to economic policies of the government, increase in the number of foreign banks in Turkey, relaxation in foreign exchange policies, the banking sector began to face the similar uncertainities as in other countries making liquidity management a very difficult task. The purpose of this study is to develop a simulation model for liquidity planning with the given set of instruments within the Turkish banking sector constraints.

A background to the liquidity management problem is presented in the next section of this chapter. The Miller and Orr Model which forms the basis of this study is overviewed in the next section also.

The problem which will be described in the next chapter, to the author's knowledge, is the first attempt to solve the cash management problem in a multi-firm (multi-branch bank) financial environment using simulation technique. In the second chapter, the practical approaches to cash management problems in the U.S.A., U.K. and Turkey will also be presented. In the third chapter a simulation model will be presented. In the fourth chapter cash flow data of a selected financial institution will be analyzed to determine if data conforms with the requirements of Miller and Orr paper. In the fifth chapter simulation model will be applied to the same financial institution and the conclusions will be presented. The general conclusions and the suggestions for further research is presented in the sixth chapter.

2/ Quating on a two-way basis means to announce the interest rates for both borrowing (bid) and lending (offer).

B. BACKGROUND:

A major modification that John M.Keynes made in classical analysis was his aggregate-demand approach to the determination of national product and his invention of the consumption function as the explanation for the largest component of national product. Another major modification was his concept of Liquidity Preference a demand for money that depends on the interest rate. He argued that the demand for money depended inversely on the interest rate: the higher the interest rate the less the demand for money. He accepted the classical theory which says that money is demanded for use as a medium of exchange and that the amount of "transactions demand for money" depends on the money value of output or income. However, this was only one element of his liquidity preference. He differed with the quantity theory of money by arguing that there were at least two other components of the demand for money: a "precautionary demand" and a "speculative demand" each of which is a demand for money as an asset not as a medium of exchange.

"Precautionary Demand" for money, on the part of the individual or a business, consists of sum of money set aside for use in some potential emergency that unexpectedly might deprive him of income, delay its receipt, or impose sudden requirements or favorable opportunities for extra purchases. Such a demand for money as an asset could not be satisfied by holding of securities for two reasons: first, because, in an emergency, securities might loose some value; and, second, it would take time to dispose of the securities for money.

"Speculative Demand" for money involves holding cash in order to secure profit from knowing better than the market what the future will bring forth. Keynes believed that the transactions demand and the precautionary demand for money to be essentially functions of the level of income and the speculative demand for money to be a function of interest rate. In this dissertation, we concern ourselves with the transactions demand for cash, in particular the management of multi-branch, multi currency bank cash balances.

In spite of their importance, cash balance problems received little attention in economics and management science. W.J. Baumol [2] was first to investigate a rational firm's transactions demand for cash by formulating its transactions demand as a deterministic inventory control problem. He assumed a firm with or constant, continuous drain of cash reserves which periodically converted some of its assets to cash to ensure a positive cash balance. He formulated two costs: the opportunity cost of keeping cash assets greater than zero (a function of interest rate) and the "brokerage" cost of converting assets to cash. The second cost had been ignored by theorists prior to Baumol. He then computed the cash demand for a rational firm that tried to minimize total costs expressed as the sum of holding and brokerage costs per unit of time. Whitin [23] was first to bring the anology between cash balance and inventory control problems to the attention of economics. Tobin [20] used this anology for determining the transactions demand for money at micro level.

William Beranek [3] studied the problem of determining the optimal allocation of available funds between the cash balance and marketable securities. He includes a probability distribution for expected cash flows and a cost function for the loss of cash discounts and deterioration of credit rating when the firm is caught short of cash. The decision variable in Beranek's model is the allocation of funds between cash and investments at the beginning of the period. Withdrawals from investment are possible only at the end of each planning period.

According to Beranek, it is more helpful for the analysis of cash management problems to regard cash disbursements as being directly controllable by management and relatively lumpy, and to regard receipts as being uncontrollable and continuous.

In Beranek's model, the financial manager is regarded as having total resources of k dollars available at the beginning of a planning period. He expects his net cash drain (receipts less disbursements) at the end of the period to be y dollars (either positive or negative) with a probability distribution g (y). His objective of maximizing returns by investment in securities is constrained by transactions costs and the risk of being short of cash when funds are needed for expenditures. "Short costs" are regarded by Beranek as consisting of cash discounts foregone and the deterioration of the firm's credit rating when it is unable to meet payments in time. It might be more realistic, however, to think of "short costs" as the cost of borrowing on a line of credit, since the company would undoubtedly prefer short-term borrowing to foregoing cash discounts or allowing its credit rating to deteriorate.

Given the probability distribution of net cash flows, the costs of running short of cash, and the opportunity cost of holding cash balances, Beranek develops a cost function and differentiates it to find the optimal initial cash balance, or the amount of cash that should be on hand at the start of the period.

White and Norman [22] developed a model for an English insurance company similar in spirit to the Beranek model. Investment decisions are assumed to be considered periodically, and cash flows from premiums and outflows for claims and expenses are assumed to fluctuate randomly according to some known distribution. In addition, another cash outflow for "call-offs" by the stockbrokers is assumed to have an independent distribution function. A penalty rate on overdrafts (borrowings), analogous to Beranek's short-cost function, is also included in the model, while transactions costs are ignored (or implicity considered in the net rate of return on investments). The opening cash balance that maximizes expected wealth at the end of the period is the relevant decision variable.

Archer [1] includes the precautionary demand for cash in his study which was ignored by Baumol and Beranek. By empirical analysis of cash needs day by day over a period of years, he determines an individual firm's expected variability in net cash flow for transaction purposes. Added to the daily amount needed for transaction balances is the precautionary balance which is found by selecting the risk that management is willing to assume of shortage of cash. Archer's model is an improvement over the earlier models but needs more work in the area of the dynamic and rapidly growing firm. It is based upon computations of the past net cash flow data. It, therefore, fails to provide a meaningful cash balance formula for new or rapidly growing firms.

The Miller-Orr [11] model incorporates several basic assumptions concerning the nature of a firm's cash management problem.

First, it assumes only two assets the firm's cash balances, and a portfolio of earning assets which yield i dollars per dollar per day. The earning assets are assumed to be relatively short-term money-market instruments such as certificates of deposit (CD) or treasury bills (TB).

Transfers between the two assets take place at a marginal cost of b dollar per transfer regardless of the size or direction of transfer. Transfers may take place at any time and are assumed to be instantaneous.

The firm is assumed to have an exogenous constraint which prohibits cash balances from falling below some specified amount. Specifically, the model requires that the firm's cash balance never be allowed to fall below zero.

The cash flows are assumed to be stochastic, generating a stationary random walk in cash balances. In the simplest form, the distribution of cash flows has a zero mean. Cash inflows and outflows behave as a sequence of independent Bernoulli trials, such that in a small fraction of the working day 1/t (that is an hour), cash balances will increase by +m with a probability p = 1/2 and will decrease by -m with a probability q=(1-p)=1/2. Hence, over a number of days n, the distribution of changes in the cash balance is binomial with mean μ = nmt (p-q) = 0 and variance σ^2 = tnm^2. As n increase, this binomial distribution approaches a normal distribution.

The firm's objective is to minimize the steady-state cost of managing the cash balance under a naive control policy. The naive policy employed is a two-parameter control limit model. Such a policy allows the cash balance to fluctuate freely until the upper or lower limit (h and o respectively) is violated. The decision rule calls for a transfer of h - z dollars into earning assets when the cash balance reaches h and a transfer of z dollars out of earning assets when the cash balance reaches zero. The aim of the policy is to minimize the expected cost per day of managing the cash balance with respect to the upper limit h and the return point z. This expected daily cost E (C) comprise two parts: the expected transactions cost (probability of transfer multiplied by the cost per transfer b), and the expected opportunity cost of holding cash (the expected cash balance multiplied by "i" the earning rate on securities).

The solution for optimal h and z involves first finding the steady-state occupancy probability distribution of cash balance and then carrying out the following minimization.

$$\min_{h,\ z} E(C) = \frac{h\sigma^2}{z(h-z)} + \frac{i(h+z)}{3}$$

where σ^2 is the daily variance of changes in the cash balance (m^2t). The solution yields

$$z_{opt} = \left(\frac{3b\sigma^2}{4i}\right)^{1/3}$$

$$h_{opt} = 3z_{opt}$$

$$\bar{m} = \text{average cash balance} = (4/3)z_{opt}$$

The solution yields the curious result that despite the symmetry of cash flows and transfer costs the return point is not (1/2)h as one might suspect: rather it is (1/3)h regardless of the values of i and b. The result follows the nature of the cost function.

Miller and Orr [1] applied their control limit model to a real life problem. In a later paper, Miller and Orr showed that their assumptions concerning the demand for cash in the corporate sector are extremely robost. Specifically, they showed that the extreme changes in the assumptions of their earlier paper turn out to have trivial impact upon its predictions of certain crucial relationships. It is for this reason that their model and its extentions will form the basis of this study.

Eppen and Fama [6] considers the case where transaction costs are strictly proportional to the amount of funds transferred. In addition, the model allows the stochastic changes in the cash balance problem to come from any probability distribution. Eppen and Fama deals with a more general stochastic model in which transaction costs contain both fixed and variable components in a later paper [7].

Girkis [9] deals with the optimal policies for keeping cash in anticipation of future net expenses. It is an inventory problem in which the inventory level can either decrease or increase, and the decision maker is allowed to change the inventory level in any direction at the beginning of each period. In addition to usual holding and shortage cots, the problem involved fixed and proportional costs for deciding to change the inventory level. He shows the form of optimal policy if the expected holding and shortage costs is convex and if deciding to change the inventory level does not involve a fixed cost. Neave [13] discusses the problem as a stochastic and multi-period cash balance problem.

Sethi and Thompson [17] applied Pontryagin's Maximum Principle 1/ to a simple dynamic cash balance problem. Application of the Maximum Principle to more realistic problems will be extremely difficult, and is left for a further research. John Philippe Vial [21] studied the cash balance problem with the purpose of establishing the thesis that an optimal policy is a simple one on a specific model : namely a continuous-time and state model in which the random process is a diffusion process and where the costs are evaluated by means of a discount factor. Studies such as [6, 7, 9, 17, 21] were dynamic and stochastic models. Robinchek, A.A; et. a [16] is another example of cash balance problems studied in a deterministic context using Linear Programming in addition to Calman [4] and Orglar [14]. Kaufman and Lee [10] attempted, in a realistic manner, to view the problem as a liquidity planning problem. Their approach, however, purely heuristic. Constantinides and Richard [5] formulated a continuous, infinite horizon, discounted cash management model with both fixed and proportional transaction costs, and with linear holding and penalty costs, and used the Optimal Control techniques of impulse control to find sufficient conditions under which and optimal policy exists. They showed that these conditions are always met. Therefore, they showed that there always exists an optimal policy for cash management problem and that this policy is of a simple form 2/.

The models mentioned above are the ones which received the most attention in the literature. There are, of course, many others. They are however, in way or another, variants of these models. The fact that most concern us is that none of these models deal with more than one firm. In addition, all of them except Kaufman and Lee [10] attempted to solve the problem in the context of a financial institution.

1/ In an Optimal Central Problem if there is one trajectory which satisfies the necessary conditions for optimality, then it is optimal.

2/ Simple form implies that optimal policy can be calculated by using a simple formula which expresses the optimal value as a function of system parameters.

CHAPTER II

LIQUIDITY MANAGEMENT AND ITS INSTRUMENTS IN VARIOUS COUNTRIES

The effective control of cash is one of the most important requirements of successful financial management. Cash is lifeblood of business enterprise, and its steady and healthy circulation throughout the entire business operation has been shown repeatedly to be the basis of business solvency. The importance of cash control is self evident for financial institutions such as banks.

The need for cash control arises from the lack of synchronization between cash inflows and outflows and the difficulty of accurately predicting these flows. Thus, uncertainty is a major element in cash control problem. Fortunately, uncertainty is less important in making cash management decisions than it is in deriving long-range plans such as capital budgets. The reason for the relatively unimportant role of uncertainty is the short run nature of its planning horizon. A cash flow prediction for several weeks or months in the future is more reliable than similar forecast for 5-10 years ahead.

For banks, cash control problem can also be described as the liquidity problem. Liquidity can be defined as a bank's ability to meet deposit withdrawals and to provide for credit needs of its customers. It represents a defence against the extreme pressures on a bank that would represent a loss of confidence by depositors and could lead to a "run" on the bank, that is, when depositors collectively attempt to withdraw deposits. However, in temporary situations like this, the Central Banks (Federal Reserve in the U.S.A.) acts as lenders of last resort, since they can buy the assets of banks for cash. There are three types of circumstances when commitment of Central Banks could be called in to defend a bank's liquidity.

The first would be when a single bank had run into difficulty when depositors and short-term lenders withdraw their funds even though the banking system in general would be in good condition. The second instance would be when depositors and short-term lenders would be worried about the banking system in general. This situation represents an extreme duress in the economy such as in the U.S.A. and other Western Nations during 1929-1933. The third instance would be when depositors and investors would flee from paper currency to nonmonetory assets such as gold, silver, and land. This occurred in Germany in 1923 when there was super inflation in that country. The U.S.A. was nearly in the same situation during the Revolutionary War and the Civil War. The first type of instance is the problem we are concerned with in this study. However factors which contribute to changes in aggregate banking system's liquidity will be briefly mentioned.

During some periods, due to exegenous or endegenous political and economic factors, rate of loan expansion may exceed the growth rate of GNP. At such time the banks will generally lower their holdings of government securities to increase their loans thus lowering liquidity. Due to same factors, there may be some periods when the rate of loan repayment is reduced. This reduces liquidity given total assets and liabilities do not change.

Frequent changes in interest rates paid by the banks to depositors affect the deposit velocity. If in the face of increasing demand for funds interest rates increased, the value of money also increases and if the banks can not offer higher interest rates to depositors the funds will leak out of the commercial banking system. Dynamic existence of profitable investment opportunities outside banking system, which will occur in an imperfect financial environment, coupled with frequent changes in the rules and regulations which regulate the functioning of the commercial banking system will increase the deposit velocity. With increased velocity the level of deposits in each individual bank tends to fluctuate more rapidly and widely adversly affecting liquidity of the bank.

In countries like the U.S.A., commercial banks have increasingly turned to liability sources of liquidity both to make loans and to meet deposit withdrawals. Banks have been able to issue large denominations of negotiable certificates and borrow Eurodollars or Federal Funds to obtain funds in periods of easy money. In periods of tight money, they relied on holding company commercial paper, Eurodollars, Federal Funds, sale of loans, note issue, discount window and security repurchase agreements (Repos). However, the risk to banks in obtaining funds by these non-deposit liabilities is that the supplies of such sources of funds are likely to be inelastic or unstable and may disappear when liquidity needs are most acute.

The discussion above has been concerned with liquidity in general. For an individual bank, there are four major sources to provide liquidity. They are: Self-Liquidating Assets, Asset Saleability, New Funds, Federal Reserve Discount Window. Banks can manage liquidity through one or a combination of these instruments.

The Self-Liquidating Asset Source for liquidity looks to the repayment of funds to the bank as a source of liquidity. This approach to liquidity is referred to as the "real bills doctrine" or "commercial loan theory" of banking in the 19th century. A particular loan is self-liquiding only if the borrower is successful at his business. Moreover, the commercial loan would have to be renewed by the bank to keep the businessmen going.

Asset Saleability Source for liquidity refers to the ability of a bank to sell its assets (loans and securities) to other banks and to the open market with or without an agreement to repurchase them. Short-term government securities which have a range of maturities suitable for any liquidity need, are the most widely used money-market instruments. For short-term liquidity Treasury Bills (T-Bills) is the most widely used instrument. They are available in weekly auctions on discounted basis for 91-day, 182-day and one year maturities. T-Bills have, in most countries, a rather active secondary market which makes them a highly liquid asset.

Calculations involving T-Bills include the following variables 1/:

D: Discount from face value
F: Face Value
d: Rate of discount
t: Days to maturity
P: Price

Then;

$$D = F\left(\frac{d \times t}{360}\right) \text{ and}$$

$$P = F - D = F\left(1 - \frac{d \times t}{360}\right)$$

Given the rate of discount d, equivalent simple interest rate is calculated as:

$$db = \frac{F - P}{P} \times \frac{365}{t} = \frac{365 \times d}{360 - d \times t}$$

The yield on T-Bills sold before maturity is calculated as:

$$i = \frac{\text{Sales Price} - \text{Purchase Price}}{\text{Purchase Price}} \times \frac{365}{t}$$

where now t denotes the number of days held.

Equivalent bond yield for T-Bills with less than 6-month to maturity is equal to db above. For T-Bills with more than 6-month to maturity

$$db = \frac{-\frac{2 \times t}{365} + 2\sqrt{\left(\frac{t}{365}\right)^2 - \left(\frac{2t}{365} - 1\right)\left(1 - \frac{1}{P}\right)}}{\frac{2t}{365} - 1}$$

1/ Marcia Stigum, Money Market Calculations, Dow Jone-Irwin, Homewood, ILL, 1981

Repurchase agreements (repos) in which a bank sells a purchased government security with an agreement to repurchase it at a specified price at a specified date is also an important instrument of liquidity. Most repos are overnight (longer term repos are called term repos) with payment in immediately available funds. With repos, the borrower achieves a flexible source of funds that is not subject to reserve requirements, and that is relatively low cost because of its security.

Repo market is a market where major buyers and sellers deal in large denomination transactions. Most repos are for amounts of at least 1 million dollars. The interest rate is negotiated between the seller and the buyer without any relation to the interest rate of the paper underlying the transaction. Short-term government agency securities (such as that of Federal Intermediate Credit Bank, the Federal National Mortgage Association "Fannie Mae", the Federal Land Bank, the Federal Home Loan Bank, the Export-Import Bank in the U.S.A.) are also important instruments of liquidity. Sale of purchased Commercial papers and Banker's acceptances are important sources of liquidity. Commercial paper is a discount note issue of large good quality business firms. Maturity is always less than 270 days (in the USA) to avoid registration with the Securities and Exchange commission. The cost of commercial paper is usually below the cost of short-term borrowing from the banks. However, when calculating the cost of commercial paper, issuing costs and indirect costs such as maintaining a back up line of credit at a commercial bank must be included.

The market for commercial paper is essentially a primary market mostly due to the short-term nature of this instrument. Standard and Poor's and Moody's are primary rating agencies for commercial papers. Interest rate on commercial papers are significantly higher than that of T-Bills reflecting credit risk (T-Bills are riskless), marketability (T-Bills have a very large secondary market) and tax considerations (T-Bills are only taxable at the Federal level).

A bankers acceptance is a time draft drawn on a commercial bank ordering the bank to pay a specified sum to the holder of the draft at time of its maturity in relation to a commercial transaction. This draft becomes an acceptance when the bank accepts the responsibility for payment and stamps "accepted" on the face of the draft. Most acceptances have maturities of 90 days or 182 days.

Acceptances are money market instruments that have very low risk for a private instrument because they are guaranteed both by a bank and the drawer. They are also secured by the goods that are being financed. They are short-term, non-interest bearing notes sold at a discount. Therefore calculations regarding acceptances are very similar to T-Bills.

Excess reserves loaned as "Fed-funds" to other banks is perhaps the most important liquidity instrument. "Fed-funds" is almost immediately available for liquidity purposes. Funds on deposit in a bank's reserve account with the Federal Reserve are referred to as Federal Funds or Fed Funds. Excess funds in this account can be sold to other banks, while a deficit can be covered by buying Fed Funds from other banks.

New funds approach to liquidity rests upon the reputation of a bank. Reputations, on the other hand, are largely determined by the way in which the banks fullfill the expectations of financial community. The problem with that approach is that new funds are hardest to obtain when liquidity is most needed. Issuance of Certifates of Deposit of various types, discounting bank's own notes with the Central Bank or with another bank, borrowing from other banks (Fed funds), issuance of Eurodollar certificates of deposits through foreign branches (London, Bahamas), issuance of commercial paper through subsidiaries and affiliates are instruments of new funds for liquidity. Certificate of deposits (CD) may be divided into domestic and Eurodollar types.

A domestic certificate of deposit is a receipt indicating that a depositor has placed a certain amount of funds at a bank at a specified interest rate for a specific period. A domestic CD is issued by a U.S. bank in the USA. They are issued in large denominations ($100,000 or more) and traded in secondary market.

CD's are issued for periods of less than one year usually between two and four months. Interest is calculated on the basis of 360 day basis. Interest rate on CD's are higher than T-Bill rates reflecting the differences in credit risk (T-Bills are riskless), marketability (CD's have thinner secondary markets compared to T-Bills) and taxability (T-Bills are taxed only on federal level).

Eurodollar CD is issued by a bank outside the U.S.A. by a foreign branch of a US bank or a foreign bank. Their maturity range between two months to one year. Interest rate on a Eurodollary CD is higher than a domestic CD because of higher credit risk and lower marketability.

A new type of CD is variable rate CD's. The two most common types are 6-month CD's with a 30-day roll where interest is paid and a new coupon set every month and a one-year CD's with practices in the past but have proven to be unsuccesful. CD's issued by foreign banks in the USA are called Yankee CD's.

Calculations concerning CD's are presented below 2/:

tis = days issue to settlement
tim = days from issue to maturity
C = Coupon rate
F = Face value
tsm = days from settlement to maturity
y = yield on the CD
P = Purchase price with accrued interest

$$y = \frac{(1 + C.\frac{tim}{360}) - P}{P} \times \frac{360}{tsm}$$

or

$$P = \frac{1 + C.\frac{tim}{360}}{1 + y.\frac{tsm}{360}} = F + C.\frac{tis}{360}$$

2/ See Marcia Stigum, Money Market Calculations.

Discounting and advances, are forms of borrowing from the Federal Reserve. A discount is actually a rediscount of a customer loan meeting specific conditions. However, it is not a source of short-term borrowing for liquidity needs. An advance is a loan based on bank's own note secured by eligible paper or government securities. Loans in the form of advances have maturities of up to 90 days. However, most are very short-term. They are made only as last resort sources to banks to help them get through liquidity crisis due to some unexpected developments. However, the banks which often use this source of funds are not looked upon favorably by the Fed. These funds should be viewed as only an escape valve to ease pressure on banks and the economy while they adjust to a different set of constraints and conditions.

Discount window approach is the least preferred since it raises questions about the proper liquidity management of the banks. However, Central Banks have been given authority to lend on the assets of a bank to provide the bank a way of monetizing its assets thus providing liquidity.

The liquidity requirements for a bank will vary over time as funds flow in and out an the actual and potential demand for funds change from day to day.

The instrument or combination of instruments employed by bank management will also change accordingly. In the dynamic world of finance new instruments come into being frequently as some become obsolete. The liquidity instruments available to banks differ significantly from country to country. The United States, England, Switzerland, and Japan have perhaps the most advanced financial markets and instruments. Due to many economic and political factors less developed nations have less sophisticated markets and instruments. The instruments discussed above are all available and used by banks in the U.S.A. Funds flow in the form of cash in the U.S.A is very limited. Any flow above $10,000 has to be reported to the Treasury. Bank branches have cash limits determined by experience. Cash is supplied by Head Office by armored trucks. Excess cash at Head Office is deposited at the Federal Reserve. In the following paragraphs liquidity instruments employed by banks in England, and Turkey will be discussed.

The banks in the U.K. operate in the Sterling Money Markets and the Eurocurrency Markets. The Sterling Money Markets consists of the discount market and the parellel markets.

The discount market consists of the ten members of the London Discount Market Association (LDMA), a number of money broking firms and the money trading departments of a number of banks. A major function of discount market is the provision of a facility for banks to place surplus funds in a very liquid form (call money). This gives the banks a means of holding near-liquid assets which can be drawn on when their operational deposits at the Bank of England is too low. The market is used by the Bank of England to smooth out cash fluctuations in transactions between government and banks. In addition the market functions as a market maker in bills (Treasury, municipalities, commercial), It helps finance the Government's short-term debt by agreeing to purchase all the Treasury Bills and helps finance short-term trade debts by purchasing commercial bills at a discount.

The parallel markets are money markets which have developed since 1950's as a result of the demand for short-term funds by the banks and other financial intermediaries. The role of these markets is to provide financial institutions, local authorities and companies with mainly short-term deposits and to give investors a method of investing funds in a liquid and interest-bearing form. One of these parellel markets is the Interbank market. Like the discount market, the Interbank market provides a mechanism whereby banks can adjust their liquidity. The market developed to facilitate the taking and placing of sterling deposits between banks in London. All lending is unsecured and transactions are arranged by telephone through specialist money brokers. The amounts involved vary considerably ranging up to several billion pounds and, although funds can be placed from overnight to a period of years, the market is predominantly short-term. The main participants are merchant banks, overseas and foreign banks in London, saving banks, and the clearing banks. Pension funds, and companies are other participants in this market.

The Certificates of deposit market started when the first CD's were issued in 1968. They were intended as a means of attracting funds from commercial and industrial depositors which would otherwise have been diverted to non-bank sources. They are now mainly a means of interbank financing. Periods of issue vary between three months and five years. The main attraction of CD's is that they can be sold before maturity in a security market in which the discount houses are the main operators. They are repayable to bearer. They may be issued by banks as an alternative to borrowing from interbank market. They may also be purchased by the banks as an alternative to other investments.

The Euro currency markets are the international markets in which the currencies of the major industrial and financial countries, in the form of balances with banks in those countries, are lent or borrowed. These markets have become the largest international financial markets in the world and the major single center of operations is London.

The major participants in these markets are commercial enterprises seeking liquidity and security, foreigners for hoardings of currency, avoiding the need to convert into local currency, official institutions including central banks, governments and international monetary institutions holding foreign currency reserves in these markets, and commercial banks investing surplus resources in the markets. The instruments used in this market is summarized in Table II-A below.

TABLE II-A SHORT-TERM INVESTMENTS IN EURODOLLAR MARKET 3/

Euro Deposits	-	US Dollar deposits with banks outside USA
		Non negotiable - no secondary markets.
		Interest bearing.
		Interest paid at maturity free of withholding tax.
		Not liquid - early repayment generally involves penalty fee.
		Typical amounts: $1 to $10 million - odd amounts acceptable.
		Typical maturities: one day to five years; odd maturities common; interest on deposits maturing past one year is payable annually.
		Settlement Basis: same day, next day and spot (2 days later) dates. Same day settlement (payment) implies that deal and settlement are both completed on the same day. If settlement is one day after the deal, it is called next day settlement. If settlement is two days after deal date it is then called spot.

3/ Readers should refer to:
- Euromoney, International Finance Yearbook, 1987 Edition
- Marcia Stigum, Money Market Dow-Jones Irwing 1983
- Marcia Stigum, Managing banks assets and liabilities Don Jones, Irwing, 1982

Euro NCD - US Dollar Negotiable Certificates of Deposit

Generally issued by the London branch of international banks.

Interest bearing - paid at maturity free of withholding tax.

Bearer instruments - freely tradeable in substantial secondary market.

Highly liquid: typical amount $5 million - bid/offer spread ranges from 2 to 5 basis points.

Maturities from two weeks to one year.

Settlement: Spot (two day) basis.

Delivery: physical or through CD clearing systems.

Euronotes - Dollar obligations of sovereign, governmental agencies, banks and corporations

Issued under partial or wholly committed underwriting facilities.

Freely negotiable bearer instruments.

Interest bearing and discount paper available. Interest payments are free of withholding tax.

Secondary market - limited but growing.

Liquid - typical amounts $1 to $5 million - bid/offer differential 5 basis points.

Higher yields then bank deposits, CD's, T-Bills, and US commercial paper.

Maturity range of one week to one year: typical maturities one month to six months.

Settlement generally on a spot basis but one day settlement is available for secondary market purposes.

Delivery: physical or through CD clearing and bond clearing systems.

Issued through sole placing agencies in US dollars and ECU's with swap potential into other currencies.

Calculations for interest bearing and discount notes are similar to Certificate of Deposit and T-Bill calculations respectively as shown in previous pages.

Euro Commercial Paper - Issued by sovereign, governmental agencies, banks and corporations

Mostly issued in discounted form.

Negotiable bearer instruments.

Secondary market - limited, tends to be placed to end investors in primary market.

Liquid - typical amounts $1 to $5 million. Bid/offer spread 5 basis points.

Maturity range one day to one year. Typical maturities are two weeks to six months.

Settlement: same day, next day and spot settlement basis.

Delivery - through Euroclear, and CD clearing systems.

Issued through sole and multiple dealerships.

No commitment on either side to deal.

Calculations are similar to T-Bill since it is a discount instrument.

FRN

The Eurodollar Floating Rate Note (FRN) is a form of Eurobond. It differs from a fixed rate Eurobond in that the coupon is renewed on a one, three, or six monthly basis by reference to London Interbank deposit rates. They have become an attractive source of funds for banks to match their medium-term eurocurrency loans.

FRN's are popular with investors during periods of interest rate volatility. They have attracted investors away from bank deposits and CD markets because of their higher yields.

Investors are able to purchase FRN's fixing over tenors ranging from one week up to twelve months. Some FRN's have maximum coupons or rate caps. Most FRN's have minimum coupons. Most deals include borrower's call options (borrower can call the notes and pay up). Some issuers offer noteholders redemption options which allow investors to put the FRN back to the issuer on a specified date prior to maturity.

Because of the capital adequacy requirements by the Bank of England, the UK banks were prompted to raise more capital. Due to expensive process of issuing shares, banks issued perpetual FRN's which are primary capital and rank equal to equity shares. However, no interest is paid to investors if no dividend is paid to equity shareholders. US Saving and Loans issues dominate the Collateralized FRN market. Collaterals are mortgage back securities or Treasury securities giving them a very high rating. Other important characteristics of FRN's are listed below:

- Obligations of sovereign, bank and corporate borrowers

  Interest bearing.

  Negotiable - secondary market active for larger issues.

  Liquid: typical amounts $1 to $5 million.
  Typical bid/offer spread 5 to 15 basis points.

  Final maturities:
  Range 5 years to perpetuity.
  Typical maturities ten to twenty years.
  Coupon set periodically with reference to Euro deposit interest rates. Typical coupon runs - three and six months.
  Interest generally paid on coupon set date.

  Settlement: 7 day basis.

  Delivery - usually through Eurobond clearing systems.

FRCD - Medium term Floating Rate Bank Certificates of Deposit. Typical obligors are smaller banks

Interest bearing - coupon set periodically relative to short-term Euro deposits.

Negotiable. Secondary market small.

Liquidity - limited. Issue size generally small.
Typical secondary market amount $1 million.
Bid/offer spread around 20 basis points.

Final maturities range between three and eight years.

Settlement - seven days.

Delivery - CD clearing and Eurobond clearing systems.

Various instruments discussed above are compared in Table II-B below:

TABLE II-B: COMPARISON OF MONEY MARKET INSTRUMENTS

Instrument	Return for comparable instruments	Credit Risk	Maturity	Liquidity	Quotation basis (based on actual days in 360-day year)	Other Comments
Treasury bills	Lowest in market	U.S.government	Three months, six months, one year	Very liquid. Secondary market maintained by dealers	Discounted	Three and six month bills are offered weekly, one-year bills offered monthly. Can be purchased at initial auction or from dealers. Minimum is $10.000
Federal funds	Highly variable	Commercial banks and some other financial institutions	Mostly overnight	Very liquid, no secondary market	Par basis. Interest and principal paid at maturity	These bank borrowing are not subject to reserve requirements or interest rate ceilings
Certificates of deposit (CD)	Higher than Treasury bills but lower than time deposits. Prime banks pay less than smaller banks	Issuing commercial bank	Over 30 days, but mostly under six months	Very liquid, particularly on prime paper. Secondary market maintained by dealers	Yield basis, interest and principal paid at maturity	Subject to reserve requirements and insurance. Exempt from interest rate ceilings if over $100,000
Commercial paper	Higher than CDs. Spread subject to credit rating	Issuing company	Mostly under one month	No active secondary market, but dealers willing to buy back paper sold through them	Discounted. Occasionally interest bearing	Minimum usually $100,000
Repurchase agreements (RP)	Slightly above Treasury bills	Two-way credit: institution borrowing funds plus security purchased	Negotiated or left open	No secondary market, but it is common practice to return securities held under RPs if funds are needed	Flat (interest on security used in RP is ignored). Interest and principal paid at maturity of RP	Funds borrowed under RPs are not subject reserve requirements or interest rate ceilings
Bankers' acceptances (BA)	Slightly above Treasury bills	Three-ways-out paper: accepting bank, payee, and merchandise	Under six months	Very liquid. Secondary market maintained by dealers	Discounted	Rediscounted BAs are not subject to reserve requirements or interest rate ceilings. Usually traded in round lots with minimum of $100,000
91-day Treasury bill futures	Treasury bill rate expected by market for delivery date	Exchange's clearinghouse guarantees transaction	For specific delivery dates	Very liquid	Price basis. In dollars per $1 million face value	Traded in exchange. Margin requirements must be met in each contract. Standard contract is $1 mill

SOURCE: Riehl, H. and R.M. Rodriguez, Foreign Exchange and Money Markets, Mc. Graw Hill, New York, 1983 p.262

Banks in Turkey have much less freedom in terms of meeting their liquidity requirements. The first instrument employed to provide liquidity is Interbank borrowing. The banks in Turkey can borrow from other banks in two ways. The first is through the Central Bank. The Central Bank, at he beginning of 1986, has established a borrowing limit for each bank participating in the Interbank system. Any participating bank can offer (borrow) funds (multiples of one hundred million TL) requiring a certain interest rate for one night, one week, two weeks, 3 weeks, and 4 weeks. The Central Bank personnel try to match offers and bids within limits. Both the offering and borrowing party pays 0.5% of the interest involved to Central Bank as commission. The limits are updated from time to time by the Central Bank. The introduction of this system brought a degree of efficiency to the functioning of the banking system.

Various ratios are shown in Table II-C. The ratio of liquid assets to deposits dropped significantly from an average level of 22.45% prior to April 1986 when the Interbank system was instituted to an average level of 21.56%. Thus one percentage point drop in this ratio implies that approximately 90 billion TL was made available to more efficient uses.

The ratio of liquid assets to total assets also decreased from an average level of 14.92% to an average level of 13.68% indicating also that sector funds were diverted to more efficient uses. A similar result can be drawn from the cash to loans and cash to total assets ratios.

The ratio of cash to deposit did not change significantly in the period in question. However, this could be due to disponibility requirements.

The foregoing analysis, although it is not based on any statistical analysis, seem to indicate that the introduction of Interbank system brought a certain degree of efficiency into the banking sector in Turkey. The system of Open Market Operations which was later introduced by the Central Bank, along with the Interbank System, is now quite efficiently used to regulate liquidity in the sector.

TABLE II-C: BANKING SECTOR'S LIQUIDITY RATIOS

(TL million)

DATE	LIQUID ASSETS		DEPOSITS	LOANS	TOTAL ASSETS	LIQUID ASSETS TO DEPOSITS	LIQUID ASSETS TO TOTAL ASSETS	CASH TO DEPOSITS	CASH TO LOANS	CASH TO TOTAL ASSETS
	CASH	BONDS								
Oct. 85	261,067	1,113,631	6,966,301	4,456,890	10,018,215	19.73%	13.72%	3.75%	5.86%	2.61%
Nov. 85	228,005	1,261,778	7,051,286	4,628,588	10,272,692	21.13%	14.50%	3.23%	4.93%	1.12%
Dec. 85	389,011	1,426,106	8,037,577	5,567,959	11,758,876	22.58%	15.44%	4.84%	6.99%	3.31%
Jan. 86	252,580	1,448,239	7,389,633	5,351,980	11,531,758	23.02%	14.75%	3.42%	4.72%	2.19%
Feb. 86	252,532	1,466,988	7,594,309	5,498,825	11,734,977	22.64%	14.65%	3.33%	4.59%	2.15%
Mar. 86	322,329	1,637,254	8,554,463	6,135,568	12,256,353	22.91%	15.99%	3.77%	5.25%	2.63%
Apr. 86	318,286	1,618,988	8,630,030	6,364,801	12,615,861	22.45%	15.36%	3.69%	5.00%	2.52%
May 86	286,926	1,645,514	8,884,336	6,591,643	12,912,419	21.75%	14.97%	3.23%	4.35%	2.22%
June 86	373,474	1,698,619	9,175,993	7,243,605	13,837,838	22.58%	14.97%	4.07%	5.16%	2.70%
July 86	327,050	1,752,729	9,258,890	7,366,501	14,116,087	22.46%	14.73%	3.53%	4.44%	2.32%
Aug. 86	320,616	1,638,832	9,329,898	7,359,978	19,112,699	21.00%	10.25%	3.44%	4.36%	1.68%
Sep. 86	392,889	1,677,878	9,693,763	7,947,296	14,897,935	21.36%	13.90%	4.05%	4.94%	2.64%
Oct. 86	379,415	1,660,421	9,933,469	8,204,002	15,301,022	20.53%	13.33%	3.82%	4.62%	2.48%
Nov. 86	362,205	1,782,421	10,085,236	8,374,787	15,727,199	21.27%	13.64%	3.59%	4.32%	2.30%
Dec. 86	618,662	2,226,802	11,749,537	10,052,781	18,479,700	24.22%	15.40%	5.27%	6.15%	3.35%

Source: Central Bank Statistics Department

The second way to borrow from other banks is on one to one basis. Prior to 1986, this was the only way to obtain funds in Interbank market. Although this method of obtaining funds lost its preeminence, it still is very important source of funds. It requires good marketing skills by the treasurers.

Swapping of currencies was introduced as another instrument of liquidity in 1987. With that instrument banks can lend to Central Bank its excess funds in a given currency to provide liquidity for itself in another currency for a specified time and cost.

Repos, selling of securities with a contract to buy it back at a specified priced at a given date, is another effective liquidity instrument in use today in Turkey.

Even though the Banking Sector in Turkey is facing similar set of uncertainities as in more developed countries, the number of liquidity instruments available to it to meet the challenges of uncertainity is few making liquidity management a difficult task.

Next, the concept of liquidity for the Banking Sector in Turkey will be described from a practical point of view.

It must be evident, however, that if Interbank market has not yet been exhausted, it could be assumed that a certain bank does not yet have a liquidity problem. The liquidity problem arises when a bank has to sell (buy) an asset. In Turkey these assets are foreign currency and T-Bills, and Interbank lending (in case of excess cash). In case of liquidity needs the first asset to be tapped (for liquidity in excess of Interbank limits) is T-Bills. However, T-Bills can not be sold on a short notice due to inactive secondary market for this instrument. Before tax return for this instrument is equivalent to 83% 4/. The second asset to be tapped is Nostro Accounts 5/. The return on this instrument, including devaluation is around 45-50% for dollar accounts 6/. The main reason for tapping this instrument second to T-Bills is the requirement that the banks should keep at least 20% of their foreign currency obligations in their nostro accounts 7/.

In case of excess liquidity, the first asset to purchase is foreign currency due to the uncertainity of its availability in Turkey and the possibility of very high commissions earned from its sale. The second asset to purchase is T-Bills. Again due to the nature of secondary market for this instrument, this is not immediately possible. T-Bills can be purchase from the government only on Wednesdays, the day of the auction. The Treasurers of banks, in this case, can either lend their excess liquidity on Interbank market untill Wednesday and buy T-Bills on that day or buy T-Bills on the open market. Thus the problem which will be formulated as a simulation model in the next section is a 4 asset Miller and Orr problem overviewed in the second chapter.

4/ Interest rate on T-Bills is around 45%. Since interest income on T-Bills is tax free, before tax equivalent of this income is 45/(1 - tax rate) = 45/(1 - 0.46) = 83%.

5/ Funds kept in foreign banks are called Nostro (our) Accounts.

6/ Return on such accounts are calculated as:
Return = (1 + devaluation rate) (1 + interest rate) - 1, or in approximate numbers for a dollar account;
Return = (1 + 0.35) (1 + 0.08) - 1 = 46%

7/ Other banks are tapped last in the case of extreme need.

CHAPTER III
THE SIMULATION MODEL

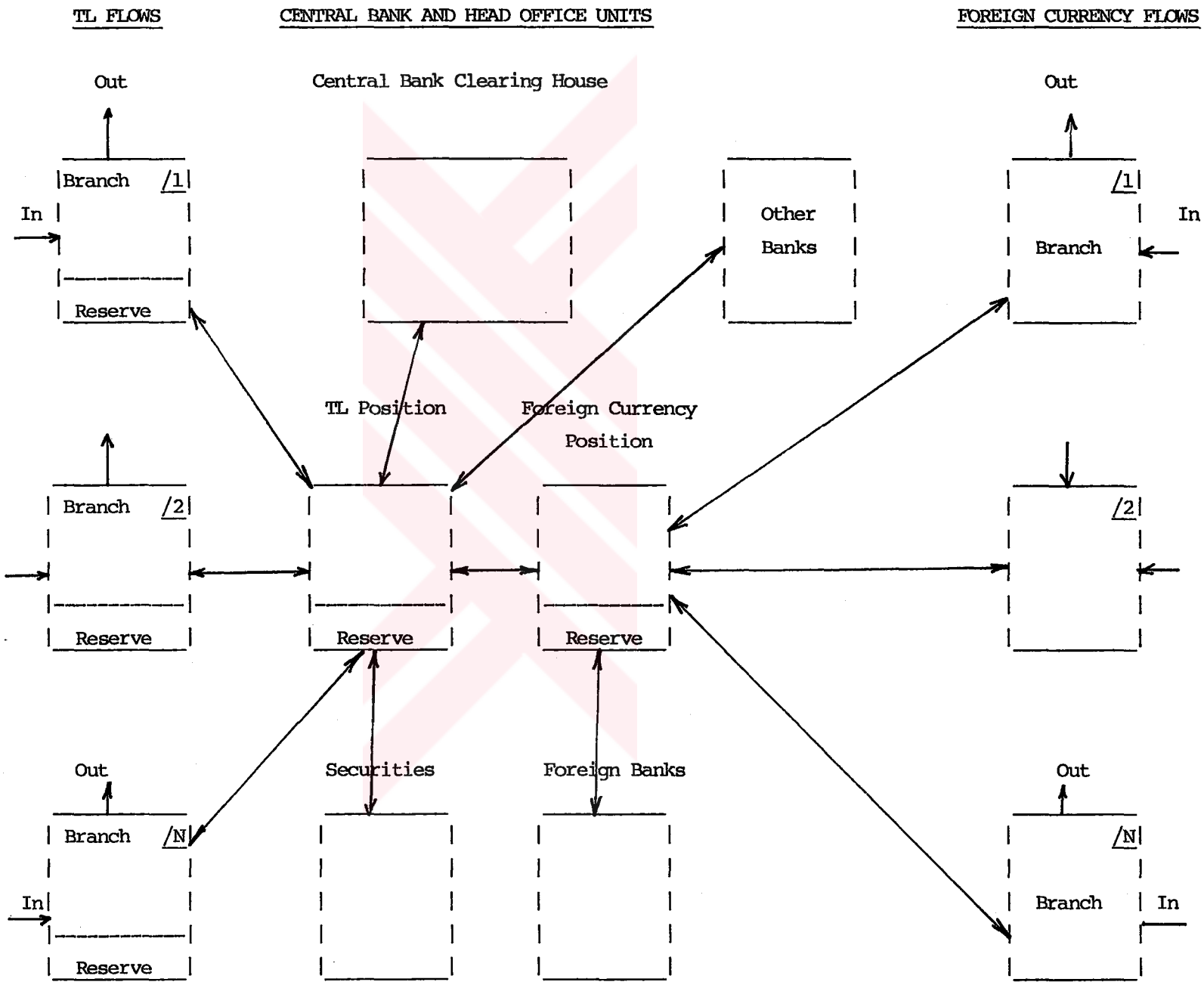
The liquidity problem was throughly studied as a single firm problem. To our knowledge the model which will be described here is the first attempt to solve the problem, using simulation techniques, for a multi-branch, multi-currency problem.

In a typical bank with N number of branches, the treasury department at the head office regulates the funds flow to balance liquidity with profitability. In a large multi-branch bank there are particular problems to be considered, associated with the degree to which responsibility is handed to branches or retained at the head office. It is believed that to decentralize to the extent where each branch had total responsibility for its own financing would prevent any possibility of optimizing cash resources of the organization as a whole.

In figure III-A cash flows in an N-branch bank is presented.

Each branch has stochastic TL inflows and outflows. Branch manager asks for funds from the head office when he thinks that his reserves are too low. He asks head office to withdraw from his reserves when he thinks they are too high. Head office is expected to meet branch requirements. At times head office can not fulfill branch requirements. This situation is costly to both the branch and the bank as a whole. Thus each branch must have an optimal reserve policy. According to Miller and Orr[12] branch manager should ask head office for funds when his reserves dip to a certain level to increase them to the optimal level. He should transfer some of its reserves to head office to decrease them to the optimal level.

The head office has a different kind of problem. Each time a branch asks for (or provides) additional funds, its reserves decrease (increase) by that amount. Each day treasurer has to also deal with the Central Bank Clearing House. The Securities Department acts also as a branch. At times he is requested to provide TL for foreign currency purchase from other banks. The problem described so far refers only to TL funds.


BRANCH
TL FLOWS
CENTRAL BANK AND HEAD OFFICE UNITS
FOREIGN CURRENCY FLOWS
Out
Central Bank Clearing House
Out
Branch /1
In
Other Banks
/1
In
Branch
Reserve
TL Position
Foreign Currency Position
Branch /2
/2
Reserve
Reserve
Reserve
Out
Securities
Foreign Banks
Out
Branch /N
/N
In
Branch
In
Reserve

Foreign currency side of the problem alone is less complicated. Branches do not have to have reserves of their own since all foreign currency inflows and outflows are controlled by the head office. Thus the optimal level of foreign currency reserves could have been determined easily if it were not for the fact that at times TL is needed to purchase foreign currency and vice-versa. This implies that TL reserves become an asset for optimal reserve determination for foreign currency and vice-versa. Special attention must be paid to the this situation in the process of simulating this problem. If TL is needed to replenish foreign currency at the same time foreign currency position is needed to replenish TL position certainly a paradox will be on hand. However, if this situation occurs only few number of times no alteration of the simulation method may be needed.

A case like this, although the values of the parameters are optimal, implies that the simulation does not approximate the real life. In real life very seldom such a case occurs. The values of the paremeters should be altered in such a way as to make TL an asset for foreign currency reserve since they can not be replenished in any other way except by buying foreign currency (with TL) whereas TL reserves can be replenished by securities in addition to foreign currency sales. The simplest alteration that can be made is to increase the foreign currency reserve limit above its legally set value till the paradoxical situation does not occur in the simulation runs.

The problem described above may perhaps be solved analytically if the real life constraints such as:

- Legal ratios to be held,
- Minimum amount of funds to be held at a branch,
- Borrowing limits of Interbank system,
- Borrowing limits of other banks,
- Continously changing foreign exchange rates affecting a bank's profits greatly,
- Changing interest rates for securities, foreign exchange, etc.
- Term structure of securities and other loans

were non-existing or unimportant. However, these constraint exist and are very important and thus the simulation technique will be employed to solve the problem.

PROCEDURE FOR BRANCHES:

Branches are dependent on the head office only through excess TL they provide to the head office and their need for TL from it. Thus, the head office acts an an asset for branches. Each branch therefore, can be considered as a two-asset firm for which Miller and Orr model can be applied. (*)

(*) Assumptions that the mean of the changes in the cash balance is zero and that distribution is normal will be tested.

In Miller and Orr it was determined that the distribution of changes in cash balance will have a mean of zero (.. = 0) and variance $\sigma_n^2 = 4ntp.qm^2$ where;

n: Interval studied in terms of days

t: Fraction of a working day "an hour"

p=q=1/2= Probability of cash balance increasing or decreasing by an amount m

m: Average amount of cash flow

$\sigma = \frac{\sigma_n^2}{n} = m^2t$ = the variance of daily changes in cash balance

For each branch cash balance for each day is available. Cash balance for a branch will be considered as sum of vault cash, interbank deposit, and vault cash in foreign currency. However, these balances included inflows from and outflows to the head office. Thus.

Balance at the end of the day(B_1)

= Balance at the beginning of the day (B_o)
+ Net inflows and outflows (C)

Assuming flows are independent

$$VAR\ (B_1) = VAR\ (B_o) + VAR\ (C)$$

or:

$$VAR\ (B_1 - B_o) = VAR\ (C)$$

From available date VAR (B_1-B_o) can be determined which in turn, determines VAR (C) to be used in optimal values of parameters

$$Z^* = \left(\frac{3\gamma m^2 t}{4\iota}\right)^{1/3} = \left(\frac{3\gamma\ VAR\ (C)/n}{4\iota}\right)^{1/3}$$

$h^* = 3Z^*$ where

γ = Cost per transfer per day (different fro each branch) and ν = interbranch interest rate.

The value of ν is fixed figure (Interbranch interest rate).

The cost per transfer (γ) to send and receive cash from head office should be estimated correctly. The components of this cost are (1) calling head office involving telephone costs and time of personnel both at the branch and head office, (2) preparation of papers, (3) transportation costs. The sum of these estimated components will give a first degree approximation for γ. To get a close basis for comparison with actual decisions the model will be run under various alternative assumptions about the true value of the transfer cost. That is a conservatively high value will be assumed for γ and ν, optimal values of h and z will be computed, model will be run against actual data, purchases and sales (requests of TL from head office and sending TL to head office) will be tabulated, the process will be continued until the model is forced to make the same number of transfers as the manager of the branch.

The process described in this subsection will be repeated for each of the branches.

PROCEDURE FOR FOREIGN CURRENCY RESERVES:

Theoretically, procedure for foreign currency reserves is same as branches except for the fact that the quantities are now in foreign currency. All quantities are expressed in one foreign currency such a US$ even though the banks hold reserves in many foreign currencies. The estimation of γ, the transfer cost now also includes the premium (over Central Bank purchase rate) which has to be paid to other banks to purchase foreign currency. However, when selling foreign currency to Central Bank γ includes the difference between the Central Bank's purchase and sales rate. Amounts of foreign currency purchases and sales are available from the Foreign Operations Department. Thus, the optimal foreign currency reserves can be determined by the same procedure outlined in the previous subsection keeping in mind the paradoxical situation mentioned at the beginning of this chapter. h_f, z_f, and l_f will denote the maximum, optimum, and the minimum amounts of foreign currency reserves.

PROCEDURE FOR TL RESERVES AT THE HEAD OFFICE:

Additional factors to be considered here are:

1. Central Bank Clearing account
2. Securities Department

The balances of the Central Bank Clearing account shows the amount due to or due from the Central Bank. It is the net of amount of other banks' checks presented to a bank minus the amount of checks presented to all other banks. The failure to clear this account when in deficit is a clear indication of a bank in duress. Thus, the fist act of treasurer is to clear this account. Treasurers try to maintain a suitable level in this account for operational purposes.

Securities Department is where mostly Government Securities are traded. In times of extreme liquidity requirements it is theoretically possible to sell securities. However, in reality, it is often very time consuming process to do so to be of help. Thus, securities are assets which can only be increased by purchases and decreased by amount of maturing securities. In addition, since the income from securities kept in the portfolio is tax free, the bank usually try to keep a certain amount of securities in the form of T-Bills and Government Bonds to minimize their income tax.

With these factors in mind, the simulation process for the determination of optimal reserve parameters for TL is described below:

1. Assume certain values for H and Z for the Head Office.

2. Generate a random flow for branch i.

3. Update the level of cash at branch i. Assume the branch starts with the optimal level of cash. For each branch i, zi*, hi* are calculated for given levels of γ and ν.

4. Check if the level has reached hi (the maximum level) or zero.

5. If maximum level is reached transfer hi-zi to the Head Office. Record the cost of transfer for the Head Office.

6. If the minimum level (zero) is reached require amount Zi from head office. Record the cost of transfer for the Head Office. Update profit function.

7. Repeat steps 1-6 for each of the branches. Update costs and profit function.

8. Calculate the net inflow or outflow from the Head Office reserves. Denote that amount by I.

9. Generate a random inflow or outflow for Central Bank Clearing Account, C. Record cost to clear Central Bank Account. If C is positive transfer it to TL department without cost, if it is negative clear it.

10. Calculate I + C.

11. Update balances at the Head Office.

12. Check if H or zero (or some minimum amount) is reached. If neither go to step 2. If H is reached, continue, otherwise (if zero is reached) go to step 16A.

12A Choose between FC, securities, interbank according to their profits. There is a probability attached to finding securities.

13. Check if foreign currency reserves is at their maximum hf. If yes, go to 16. Otherwise continue.

14. Purchase as much foreign currency as possible with the available amount hf-zf. Update costs and profits. If the total available amount is exhausted go to 2. Otherwise continue. Foreign currency earns $(1 + \frac{\text{devaluation}}{360}) \times (1 + \frac{\text{interest}}{360}) - 1$ per day

15. Purchase as much securities as possible with the remaining amount of TL. Update costs and profits. If the total amount is exhausted go to 2. Otherwise, continue. Update level of securities. There is no upper limit, but there will be a lower limit. Securities earn a certain interest per day.

16. Place remaining amount with Interbank Money Market. Update costs and profits. Go to 2. Update interbank level and free securities level.

16A Check all branches, receive from them any amount over their optimum levels. If this amount is enough go to 2. Otherwise continue.

16B Choose between FC, securities, and interbank according to their cost. If amounts collected from these divisions is enough go to 2. Otherwise, collect from branches all that is available. If that is not also enough, flag danger 1/. Otherwise go to 2.

17. If zero is reached (See check at step 12). Check if the limit at Interbank money markets is greater than Z. If yes, withdraw from Interbank Markets, update costs and profits. Update interbank levels and free securities levels, and TL cash levels. Go to step 2. Otherwise continue.

18. Withdraw as much as possible from Interbank Markets. Update costs and profits, interbank and free securities level.

1/ Flag Danger is named as DEADLOCK in the simulation program.

18A If not enough continue, otherwise go to 2.

19. Sell as much securities as possible to increase cash balance at Head Office to level Z. Update costs and profits. Update securities levels and TL levels. Check if lower limit is reached. If yes, go to 21. Otherwise go to 2.

20. Check if Z is reached. If yes, go to step 1, if not continue.

21. Check foreign currency reserves. If they are at lower limit. Flag danger. Otherwise sell as much foreign currency as possible to increase cash balance at Head Office to Z. Update costs. Check if lower level in foreign currency reserves is reached. If yes flag danger, if not continue.

22. Go to 2.

23. Run steps 2-22 for 30 days. Print costs, number of transfers, balance at Head Office, number of times balances reaches H or O, etc.

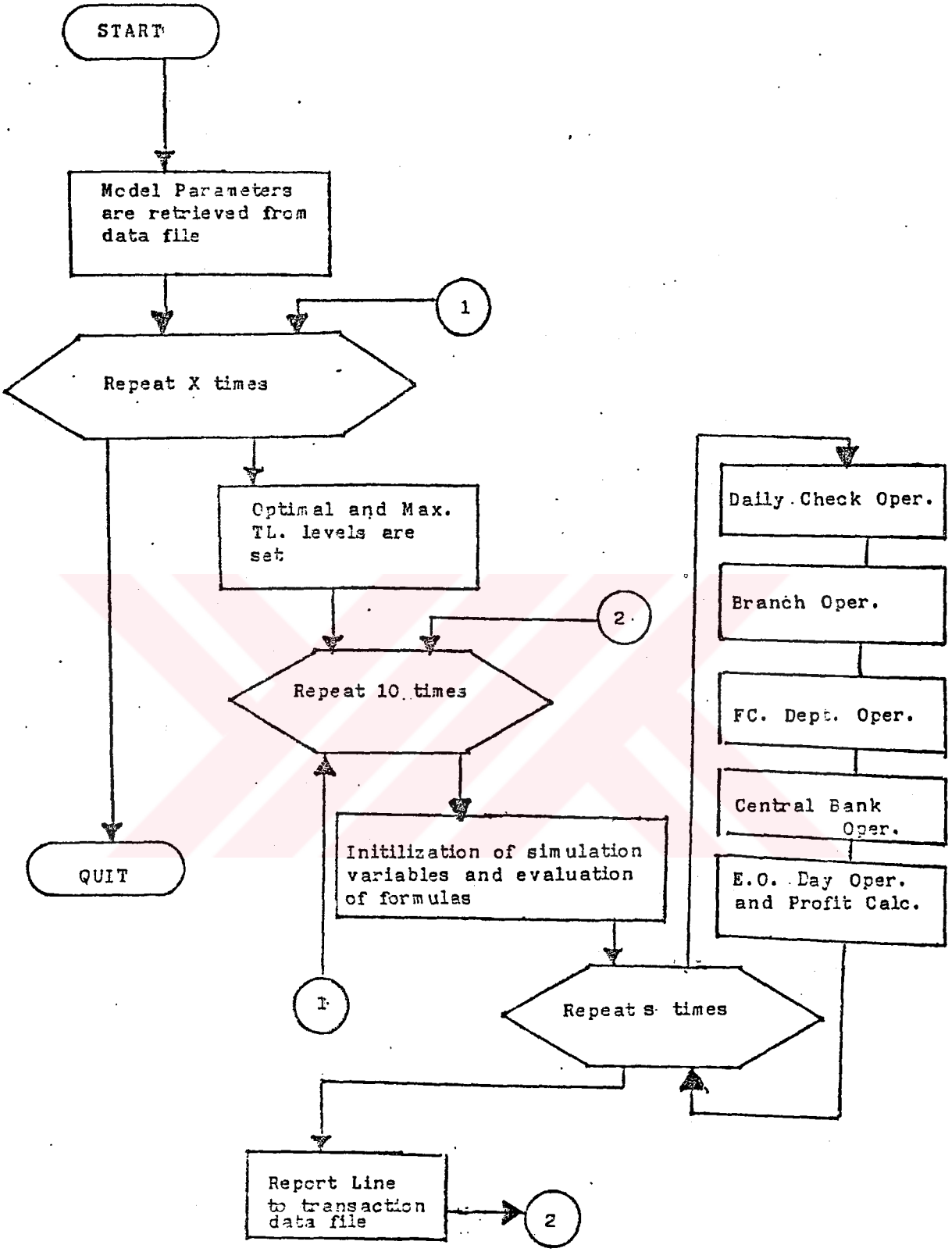
24. Run steps 1-23 for varying levels of H and Z.

25. Choose H and Z which result in maximum profit.

26. Given maximum and optimal levels for foreign currency reserves, run a simulation program for the reserves at the same time steps 8-22 are run. Check if the paradoxical situation ever occurs. When it does flag danger. Increase the lower limit for foreign currency step by step.

With this description of the model, data will be tested to determine if it conforms with the requirements of Miller and Orr Model in the next chapter. A simplified Flowchart is presented in Appendix III-B.

FIGURE III. B - FLOWCHART OF SIMULATION MODEL



CHAPTER IV -- STATISTICAL ANALYSIS OF CASH FLOW DATA

The Miller and Orr Model is based on the assumption that inflows and outflows are stochastic generated by a Gaussian function. Miller and Orr showed in [12! that their assumptions concerning the demand for cash in the corporate sector are extremely robust. They showed that extreme changes in the assumption of their earlier paper [11! turn out to have trivial impact upon its prediction of crucial relationships.

In this chapter, the assumption that the mean of changes in the cash balance is zero (i.e. the stationarity of the distribution of cash flows) and the assumption of normality are tested (Using Kolmogorov - Smirnof test). The data involves 16 branches and the head office (including Central Bank clearing account results, net foreign currency inflows, Central Bank account, and securities department).

In Appendix 4.A relevant statistics to test the hypothesis that the means of distributions are zero are presented. Examination of data in Appendix 4.A shows that all distributions, except the fourth, have means not significantly different from zero at the level of significance = 0,05. The fourth distribution's means is not significantly different from zero at = 0,075.

In Appendix 4.B results of normality tests are presented. Examination of data reveals that all data come from normal distribution, since the critical difference (D_{crit} : 0.185755) is greater than the maximum absolute value of the difference between theoretical and actual distribution functions.

Tests of serial correlation are not performed since the model which will be developed here is for short-term use only.

In the next chapter, a simulation model using these distributions and the cost paremeters mentioned in previous chapters will be developed.

Appendix 4.A : Statistics for Testing the Hypothesis That Means Are Zero

Sample Size = N = 77

Branch	Mean (1)	St. Error (2)	Z (3 = 1/2)	2 P (Z ⩾ 3)
1	-0.0260	8.5474	-0.003	1
2	0.3766	9.9935	0.038	0.97
3	0.0649	8.2745	0.008	0.99
4	1.5974	8.3717	0.190	0.85
5	0.6234	5.4713	0.114	0.91
6	0.0779	7.3470	0.011	0.91
7	0.4805	5.3246	0.090	0.92
8	1.9091	14.0862	0.136	0.90
9	0.2597	12.0902	0.021	0.95
10	0.3766	2.9939	0.126	0.90
11	-0.3117	6.0906	-0.051	0.96
12	-0.4416	7.7059	-0.057	0.96
13	0.5197	8.8166	0.059	0.95
14	-0.5844	5.1517	0.113	0.91
15	0.0909	1.1588	0.078	0.96
16	0.5325	6.7178	0.079	0.94
17	9.8571	104.8962	0.094	0.92
18	-1.3636	71.5612	-0.019	0.95
19	-17.7801	298.3920	-0.059	0.96
20	-1.8684	84.0416	-0.022	0.95

APPENDIX 4.C NORMALITY TEST RESULTS

	1	2	3	4	5	6	7	8	9	10
Freguency Distribution	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	2	1	0	0	1	0
	2	4	2	2	1	0	2	4	1	1
	11	3	7	8	6	8	9	5	10	12
	24	32	34	30	30	33	29	26	27	25
	29	30	22	25	27	23	27	32	30	24
	9	4	9	9	10	10	8	8	7	14
	2	3	2	3	1	1	2	2	1	1
	0	0	1	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
Distribution Function	0	0	0	0	0	0	0	0	0	0
	0	0.012987	0	0	0.025974	0.012987	0	0	0.012987	0
	0.025974	0.064935	0.025974	0.025974	0.038961	0.012987	0.025974	0.051948	0.025974	0.012987
	0.168831	0.103896	0.116883	0.129870	0.116883	0.116883	0.142857	0.116883	0.155844	0.168831
	0.480519	0.519480	0.558441	0.519480	0.506493	0.545454	0.519480	0.454545	0.506493	0.493506
	0.857142	0.909090	0.844155	0.844155	0.857142	0.844155	0.870129	0.870129	0.896103	0.805194
	0.974025	0.961038	0.961038	0.961038	0.987012	0.974025	0.974025	0.974025	0.987012	0.987012
	1	1	0.987012	1	1	0.987012	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
Difference between Theo. and Actual Distribution Functions	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
	0.0013	0.011687	0.0013	0.0013	0.024674	0.011687	0.0013	0.0013	0.011687	0.0013
	0.003174	0.042135	0.003174	0.003174	0.016161	0.009812	0.003174	0.029148	0.003174	0.009812
	0.010131	0.054803	0.041816	0.028829	0.041816	0.041816	0.015842	0.041816	0.002855	0.010131
	0.019480	0.019480	0.058441	0.019480	0.006493	0.045454	0.019480	0.045454	0.006493	0.006493
	0.015842	0.067790	0.002855	0.002855	0.015842	0.002855	0.028829	0.028829	0.054803	0.036105
	0.003174	0.016161	0.016161	0.016161	0.009812	0.003174	0.003174	0.003174	0.009812	0.009812
	0.0013	0.0013	0.011687	0.0013	0.0013	0.011687	0.0013	0.0013	0.0013	0.0013
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
D : Max Diff	0.019480	0.067790	0.058441	0.028829	0.041816	0.045454	0.028829	0.045454	0.054803	0.036105
Dcrit	0,185755									

11	12	13	14	15	16	17	18	19	20	Theo Normal Dist.
0	0	0	0	0	0	0	0	0	0	0.00003
0	0	0	0	0	0	0	0	0	0	0.0013
0	0	0	0	0	1	1	0	0	1	0.0228
0	1	0	0	2	2	3	0	3	2	0.1587
1	0	1	1	13	4	7	14	10	8	0.5
13	5	9	10	18	30	26	28	25	27	0.8413
30	33	27	30	35	32	28	22	31	28	0.9772
19	34	32	25	7	5	12	10	6	7	0.9987
13	3	4	8	2	2	0	3	2	3	1
1	0	3	3	0	1	0	0	0	0	1
0	0	1	0	0	0	0	0	0	0	
0	1	0	0							

0	0	0	0	0	0	0	0	0	0.013157
0	0.012987	0	0	0	0.012987	0.012987	0	0.038961	0.039473
0.012987	0.012987	0.012987	0.012987	0.025974	0.038961	0.051948	0	0.168831	0.144736
0.181818	0.077922	0.129870	0.142857	0.194805	0.090909	0.142857	0.181818	0.493506	0.5
0.571428	0.506493	0.480519	0.532467	0.428571	0.480519	0.480519	0.545454	0.896103	0.868421
0.818181	0.948051	0.896103	0.857142	0.883116	0.896103	0.844155	0.831168	0.974025	0.960526
0.987012	0.987012	0.948051	0.961038	0.974025	0.961038	1	0.961038	1	1
1	0.987012	0.987012	1	1	0.987012	1	1	1	1
1	0.987012	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	

0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
0.0013	0.011687	0.0013	0.0013	0.0013	0.011687	0.011687	0.0013	0.0013	0.011857
0.009812	0.009812	0.009812	0.009812	0.003174	0.016161	0.029148	0.0228	0.016161	0.016673
0.023118	0.080777	0.028829	0.015842	0.036105	0.067790	0.015842	0.023118	0.010131	0.013963
0.071428	0.006493	0.019480	0.032467	0.071428	0.019480	0.019480	0.045454	0.006493	0
0.023118	0.106751	0.054803	0.015842	0.041815	0.054803	0.002855	0.010131	0.054803	0.027121
0.009812	0.009812	0.029148	0.016161	0.003174	0.016161	0.0228	0.016161	0.003174	0.016673
0.0013	0.011687	0.011687	0.0013	0.0013	0.011687	0.0013	0.0013	0.0013	0.0013
0	0.012987	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

0.071428 0.106751 0.054803 0.032467 0.071428 0.067790 0.029148 0.045454 0.54803 0.027121

CHAPTER V - APPLICATION OF THE MODEL AND CONCLUSIONS

The program simulates the activities of a bank treasury with real world data. The Turkish Lira Department forms the core of the system. The branches act independently of any other department in the system and are presumed to behave according to the Miller and Orr model. They are always able to borrow from the TL. Department and lend their excess funds to the same department at the rate of Interbranch Interest Rate.

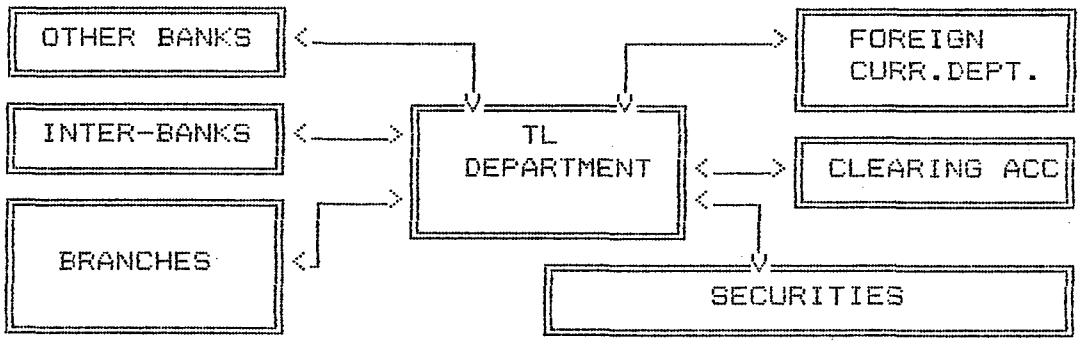
Each day the Central Bank Clearing Account has to be cleared and the failure to do so carries a very heavy penalty that no bank wants to pay. Foreign Currency Department is just like any other branch except that the funds are now denominated in foreign currency . The bank can sell foreign currency or invest in it if it is profitable to do so.

The bank also can borrow from and lend to other banks and the Interbank system for very short time, usually overnight. The Interbank system sets a credit limit for every bank. This limit can only be changed by the Interbank officers. Even though there is no predefined limit to borrowing from another bank the historical relationship between the banks sets a limit. There is no limit to lending to another bank if the risk and return of such lending are justified.

The Securities Department buys and sells T-bills, Government Bonds, Common Stock, Private Sector Bonds, and other securities. The Central Bank requires the banks to invest a certain percentage of their deposits in T-bills. The banks may want to keep more than the legally required amount due to liquidity and tax reasons. It should be recalled that the income on T-bills are tax exempt.

Since the secondary market for T-bills are well developed in Turkey, the amount of investment in such securities is very sound source of income and liquidity.

A brief sketch of the simulation model is presented below:



The procedure starts with the branches as independent units. Each branch, considering the standart deviation of its flows, the transaction cost, and the interbranch interest rate, calculates the optimum and the maximum level of its cash level. İf at any point in time the level of cash exceeds the maximum level the branch lends a certain amount to TL. Department to bring the level of cash at the branch to its optimum level. The reverse is true for the minimum level which is determined by the manager heuristically. The same procedure is repeated at every branch and the Foreign Currency Department.

Each day the Central Bank Clearing Account has to be settled also. The TL. Department borrows from Interbank and other banks or sells securities or foreign currency depending on the cost to provide liquidity to the system. In case of excess liquidity the reverse is repeated depending on the yield.

The objective of the treasurer is to balance liquidity with profitability by keeping enough funds on hand to serve the customers promptly but not too much to forego profits.

The simulation model is composed of three major subprograms:

* Model Data Entry Program which enables the user to change the parameters.

* Simulation Run Program runs the simulation routine with the updated parameters.

* Run Output Program exhibits the output of the simulation run and highlights the optimal cash and profit levels.

Any financial institution's treasurer can use this program provided that the parameters are properly estimated.

The simulation model described in Chapter III. is coded in TURBO-BASIC language.

A diskette which contains:

- A MODEL DESCRIPTION PROGRAM which describes how the model will be run
- A MODEL DATA ENTRY PROGRAM which describes how the parameters will be modified
- A SIMULATION RUN PROGRAM which runs the simulation model with updated parameters
- A RUN OUTPUT PROGRAM which displays the results of the simulation model
- AN EXIT MODEL enables the user to exit from the model
- A SOURCE PROGRAM with comment statements to enable the reader to go through the program

is included.

The MODEL DESCRIPTION PROGRAM is an overview of the model .

The MODEL DATA ENTRY MODEL allows the user to alter input data set. The input data set is divided into three sections.

The first part contains the POLICY VARIABLES which are controllable by treasurers. They are:

Interbranch Interest Rate:

This is the interest rate charged by the head office for the funds it lends to branches. It must be set at a level as to be high enough for branches to go after for deposits and other funds but low enough as to allow them to extend credits to their customers. If it is set too low , it may cause branches to extend credits less than the marginal cost of funds causing a decrease in the bank's profits. If it is set too high, it may cause branches to accept deposits at high interest rate causing also a decrease in the profits.

Minimum Level Ratio:

The ratio of minimum amount of cash to be held to the optimum level of funds is defined as the "minimum ratio". Even though it is theoretically possible to replenish the amount of cash at a branch instantaneously, in reality, it takes several hours for branches in Istanbul, up to a day otherwise.

Higher this ratio is, lower will be the profit of a branch and vice-versa.

A bank treasurer can change this ratio to keep the balance between cost of shortage of cash at branches (dissapointed customers) and profits.

Minimum Security Level:

The banks are required to keep a certain percentage of their deposits (TL.) in government securities. Currently this ratio is 22% . Penalty for not keeping the required amount of securities in portfolio is to pay a very high rate of interest for the duration of shortfall. However, the banks can hold more such securities if they find it profitable to do so. At times, because of their tax advantage, investing in such securities is even a better alternative than investing in credits. Sometimes banks keep such securities in their portfolio for liquidity purposes. So,in general,banks can adjust the minumum level of such securities as to keep the balance between liquidity, profitability, and the mentioned penalty.

Initial Minimum Ratio for Security:

This ratio is defined as the ratio of securities in portfolio when the simulation program is started to the minimum of securities to be held. As mentioned in the proceeding paragraph, a bank may, indeed, find it profitable to keep more securities in their portfolio than the required minimum.

The EXEGENEOUS VARIABLES are those which are not controlled by treasurers but which significantly affect the results of the model. They are:

Interbank Credit Limits:

The Central Bank sets a maximum borrowing limit (credit limit) for every bank. Even though this limit can be regarded as exegeneous variable, it can be changed (increased) through good relations with the Central Bank. A bank which chooses to comply with all Central Bank rules and regulations and participate normally in the systems introduced by the Bank (Interbank, Open Market Operations) can work to increase this limit.

Other Banks Credit Limit:

In addition to borrowing from the Central Bank, the banks can borrow funds from each other. In theory, there is no limit to such borrowing . However, in reality there is such a limit. This limit depends on factors as interest rate, timeliness in paying back, size of borrowing bank, personnel relations etc. A bank treasurer can work on such factors to increase this limit.

Transportation - Communication - Transaction Cost:

This variable is one of the most basic variables of the model. It represents the cost of conversion of an asset into cash and delivering the cash to where it is needed. For example, selling securities requires several phone calls, collecting the cash from the Central Bank, and delivering it to the branches. Tel cost (telephone cost) is a component of this cost. For some transactions only information is required. Asking the branches if they have funds (in case of emergency) is such a transaction which only requires a telephone conversation if the answer to the inquiry is negative.

Variance of Cash Flows

Branches - Variance of cash flow at branches is very difficult to control and will be taken as given .

Central Bank Clearing Account- In a bank with good controls on credit use by customers, it is possible to predict the variance of this account. However, the treasurer has to take this variance, as given. By running the model for varying levels of variance of this account, the effect of good credit planning controls can be observed.

Foreign Currency - All such flows are only partially controlled by treasurers. Even with the best controls, especially if a bank significantly depends on foreign funds, the variance of foreign currency flows will be very high and their variance will be amplified by exchange rate. The model will be run for varying levels of variance of such flows to observe the effects of controls on such flows.

The SIMULATION RUN Parameters are those which control the running of the simulation program.

Number of Simulation Run is the parameter which defines the number of different levels of TL. cash level for which the simulation will be run for "Number of days in cash run". "Incrementation rate in TL. department" shows how the level of TL. cash level is adjusted.

The SIMULATION RUN PROGRAM simply runs the simulation program with the given run parameters.

The RUN OUTPUT model lists the cash level held at TL. department versus the profit and highlights the TL. level at which the profit is maximum.

The result of simulation runs for important policy and exegeneous variables are presented in Appendix V.B

Appendix V.B-1 shows the results for varying levels of interbranch interest cost. A summary of this appendix is presented below.

Interbranch Interest Rate	Optimum Cash Level	Profit
45	684	882
50	465	872
55	465	869
60	159	886
65	* 760 (465)	* 938 (931)
70	684	876
75	* 465 (800)	* 866 (840)

(*) The numbers in paranthesis shows an alternate cash level for which the profit is very close that of the cash level not in paranthesis.

This table shows that as the interest rate is increased the level of cash to be held at TL. department decreases first and then increases. This is due to the fact that as interest rate increases, branches keep less cash on hand increasing the number of times the branches must ask the head office for additional funds (lower amounts at each time however). Therefore, the head office may find it more profitable to keep lower funds on hand. However,if the interest rate is too high , number of times the branches ask for funds from the head office may increase so much as to make TL. department to keep higher cash on hand.

Appendix V.B-2 shows the results for varying levels of Minimum Level Ratio. A summary of this appendix is presented below:

Minimum Level Ratio	Optimum Cash Level	Profit
0.00	465	871.6
0.05	465	870.9
0.10	465	869
0.15	465	869.8
0.20	465	869.1
0.25	465	867.9

Apparently. the minimum level ratio does not affect the optimum cash level. However, the total profit decreases slightly as expected. The main reason for the insensivity of the optimal cash level to minimum level ratio is the relative size of the variances of the branch flows compared to that of Central Bank and foreign currency flows.

Appendix V.B-3 shows the results for varying levels of Minimum Security Level. A summary of this appendix is presented below:

Minimum Security Level	Optimum Cash Level	Profit
5000	Deadlock at every try	
6000	" " " "	
7500	684	604
8000	684 (581)	674.5
9000	465	790.4
10000	465 (349)	869 (848)
11000	465	1013
12000	465 (349)	1030 (1006)
13000	684	1208
14000	244	1253
15000	465 (349)	1270 (1242)

At low minimum security values the system breaks down to indicate that enough liquidity can not be injected into the system.

As the minimum level is increased the optimal cash level held at TL. department stabilizes around 365-465 million while the total profit increases.

Appendix V.B-4 shows the results for different values of Initial Minimum Ratio for Securities. A summary of this appendix is presented below:

Ratio	Optimal Cash Level	Profit
1.00	Deadlock for several runs	
1.25	" " " "	
1.50	" " " "	
1.75	581	815
2.00	465	869
2.25	465	970
2.50	684 (349)	1197 (1118)
2.75	465 (349)	1170 (1146)

The system fails for low levels of initial security increases (as the ratio increases) the optimal cash level stabilizes around 349-465 levels as in Appendix V.B-3.

Appendix V.B-5 shows the results for different values of Interbank Credit Limits. A summary of this appendix is presented below:

Interbank Limit	Optimal Cash Level	Profit
0	465	867
2500	465	862
5000	684 (349)	862 (855)
7500	465	867
10000	465	869

As seen from this table, the Interbank Limit has no effect on the optimal cash level at TL. department. This is expected as long as funds can be borrowed from other banks at the same cost.

Appendix V.B-6 shows the results for various levels of Other Banks Limits. A summary of this appendix is presented below:

Other Banks Limits	Optimal Cash Level	Profit
0	Deadlock	
5000	"	
7500	465	870
10000	465	869
12500	465	870
15000	760	876
17500	465	871
20000	465	871

As seen, at low Values of Other Banks Limit, the model fails because of insufficient liquidity. At higher values, optimal value and the profit level remain essentially the same as expected.

Appendix V.B-7 shows the results for different values of transaction costs. A summary of this appendix is presented below:

Transaction Cost	Optimal Cost Level	Profit
0.01	465	880
0.02	465	878
0.03	465 (800)	902 (991)
0.04	581	912
0.05	465	869
0.06	581	906
0.07	465	914
0.08	465	858
0.09	465	855
0.10	465	851
0.12	465	842
0.15	465	830
0.18	465	818

Transaction cost is one of the main driving elements of the Miller and Orr ( ) model. However, it does not seem to affect the optimal cash level. This is an expected result since the level of transaction cost is very small compared to interest rates in Turkey.

Appendix V.B-8 shows the results of the simulation runs for various values of standard deviation of foreign currency flows:

Standard Deviation	Optimal Cash Level	Profit
100	581	853
200	581	853
400	581	744
600	581	846
800	581	842
1000	581	838
1200	465	882
1400	465	858
1600	465	869
1800	Deadlock	

The results are similar to interbranch interest case as expected. However, for large standard deviations the model, as expected, fails due to inadequate liquidity.

Finally, Appendix V.B-9 shows the results of the simulation runs for various values of standard deviation of Central Bank clearing account flows.

Standard Deviation		Optimal Cash Level	Profit
0		465	892
100		465	891
200		760	896
300		465	886
400		684	919
500		465	880
600		465	915
700		465	876
800		581	893
920	(Base Case)	465	869
1000		465	868
1200		800	842
1400		727	869
1600		Deadlock	
1700		"	
1800		"	

Just as in the Central Bank case (Appendix B-8) the optimal cash level does not seem to be affected by the standard deviation of the flows for standard deviations less than 1000. For larger standard deviations higher cash level is required. For deviations larger than 1400 ,the model fails due to insufficient liquidity as expected.

Summarizing;

Model is sensitive to :

* Interbank interest rates (Policy Variable)

* Minimum Security Level (Policy Variable)

* Other Banks Limit (Exegeneous Variable) . This variable, even though it is an exegeneous variable, can be increased by good interbank relations.It is interesting to note that the Interbank Credit Limit is not important when this variable is at a significant (10000) level.

* Central Bank and Foreign Currency flows' standard deviations (at high levels) cause the bank to fail thus indicating the importance of cash flow planning to reduce the variance of these flows.

The model is insensitive to , contrary to the Miller and Orr model, transaction cost because of the relative smallness the transaction cost compared to the interest cost in Turkey.

CHAPTER VI - CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The main objectives of this study were :

- To build a simulation model for funds management of a multi-branch, multi-currency bank (or financial institution) applicable in real life environment with most of its constraints, thus bridging the gap between theory and practice and ,

- to observe the effects of changes in various parameters on the conduct of funds management.

The model was tested with real life data of a small bank. The base parameters was estimated using real life data. The output of the model (the optimal amount of funds to be held at TL. Department) was close to real numbers at almost every run of the model . Thus ,the first objective of the model is met.

To observe the affects of the changes in some of the parameters on the model performance, the model was run for varying levels of selected parameters. It was concluded that :

- The interbranch interest rate significantly affects the performance .

- The minimum level of funds at the branch level does not affect the performance.

- Starting level of securities is very important especially at low levels. At such levels "deadlock" which indicates insufficient liquidity occurs.

- Maximum amount of funds that can be borrowed from other banks and the Interbank System are important at low levels. At such levels due to insufficient liquidity the system fails.

- Transaction costs which have a very strong affects on the performance in the Miller and Orr (11) model does not affect the performance. This is due to the fact that the level of interest rate in Turkey (around 70-80 %) is much higher than the interest costs mentioned in (11) (around 5-10 %) whereas the transaction costs in Turkey are of comparable magnitude to those in that paper (around 40 $ or 50.000 TL)

- Standard deviations of flows in foreign currency and Central Bank clearing account are very important at especially high levels indicating the need for systematic cash flow planning.

From a theoretical point of view the model does not bring forth any new findings. However, it shows clearly that there is much more to do to improve the theoretical foundation laid down in various papers in the bibliography to make the theory somehow adaptable to real life problems. The study was simply a basic bridge between theory and practice.

From a practical point view the model is capable to give a treasurer an idea about the order of magnitude of the optimum level of funds to be held at the TL. Department. Given, as far as we know, that this is the first attempt to solve such a problem, the model needs further modifications. However, they are left for further research. They include:

- Term structure of instruments may be taken into account more precisely.
- More than one type foreign currency may be included into the model,
- Availability of funds from other banks can be made probilistic.

Even without these modifications,the model represents a fair estimate of reality and thus it is a novel step for better funds management.

Appendix V.B - 1 : Results of Simulation Runs for Different Values of Interbranch Interest Rates.

INTERBRANCH INTEREST RATE=.45

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	833.1	199.3	12.2	1.3	46.5	44.1	127.7	17.1	6.6	27.6	36.1	518.4
	760	830.0	200.0	12.1	1.0	48.0	45.3	128.1	16.6	5.8	26.2	36.7	519.9
********)	684	882.3	203.1	12.9	1.7	51.9	48.9	122.8	17.5	8.6	27.1	38.2	532.7
	581	829.8	209.8	11.6	2.3	58.9	59.4	127.1	17.2	9.4	27.5	42.3	565.4
	465	711.5	223.3	12.7	3.3	64.7	67.1	130.7	18.9	10.9	28.2	44.1	603.7
	349	749.3	219.0	13.7	5.1	71.5	75.7	130.5	21.7	13.5	28.1	45.4	624.1
	244	822.9	223.7	11.9	4.9	76.5	74.7	127.9	22.9	16.6	28.8	44.7	632.7

INTERBRANCH INTEREST RATE=.50

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	843.8	199.6	11.7	1.3	44.8	43.2	133.1	17.2	7.1	27.6	35.8	521.4
	760	806.1	209.4	12.6	1.3	51.6	48	126.1	17.9	6	26.9	38	537.9
	684	836.9	204.1	12.5	1.1	47	44.5	134.5	16.8	6.3	26.6	36	529.4
	581	820.4	207.4	13.4	2.4	58.1	57	127.5	17.7	9.9	27.2	41.7	562.3
********)	465	872.3	218.8	12	2.3	59.4	58.2	126.7	21.2	12.3	28	41.6	580.5
	349	847.4	216.4	11.8	3.7	70.5	71.7	132.8	19.9	13.7	28	44.8	613.3
	244	682.1	231.2	13	5.3	78.1	82.9	134.6	21.1	15.2	28.5	46.6	656.5
	159	763.5	219.6	12.2	4.5	85.4	86.3	131	24.9	17.4	28.4	46.5	656.2
	75	698.4	229.4	14.1	7.5	100.8	80.8	135.5	28.4	20.8	28.8	22.6	668.7
	52	822.6	230.4	11.8	6	117.3	81.7	131.7	31.6	33.2	28.9	19.2	691.8

INTERCBRANCH INTEREST RATE=.60

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL$
800	747.3	214.2	12.6	1.8	43.1	47.6	136.6	15.6	5.4	26.7	37.1	540.7
760	778.0	213.2	12.9	1.4	54.7	57.9	126.0	19.6	7.4	26.8	43.1	563.0
684	772.5	210.4	12.5	1.2	53.2	49.1	128.2	16.7	6.3	27.7	37.6	542.9
581	814.1	223.8	13.5	3.7	58.6	65.3	132.4	19.6	10.0	28.1	44.2	599.2
465	788.2	215.6	12.9	2.2	60.6	58.3	132.8	18.9	10.7	28.6	41.4	582.0
349	800.6	217.5	12.8	4.0	68.4	70.7	130.0	19.3	13.6	28.6	45.0	609.9
244	767.0	225.2	10.2	4.8	73.3	74.1	135.9	23.5	15.1	28.1	44.7	634.9
******* 159	886.8	229.2	11.1	4.1	83.7	79.8	133.5	26.8	21.5	28.8	45.6	664.1
95	826.2	223.1	11.5	4.0	90.3	61.2	133.6	29.2	22.9	28.9	18.5	623.2
52	747.4	250.4	14.0	7.5	105.7	83.9	135.6	35.8	32.7	28.9	18.7	713.2

INTERBRANCH INTEREST RATE=.65

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL$
800	773.6	204.4	13.3	1.7	48.7	49.5	134.9	16.2	5.7	26.9	38.3	539.5
760	937.9	189.8	11.7	1.1	47.0	42.9	131.6	17.6	7.0	25.0	35.3	509.1
684	823.0	203.6	12.4	1.7	51.0	52.5	135.6	18.3	7.9	27.0	39.9	549.1
581	852.3	207.4	12.0	1.9	56.1	56.1	132.3	19.9	9.5	26.9	41.7	563.7
465	931.0	210.3	11.7	2.1	59.3	58.5	134.9	19.6	12.3	28.0	41.4	578.1
349	707.7	225.4	12.7	5.1	70.4	73.1	139.6	19.1	13.7	28.8	45.3	633.2
244	771.2	227.9	12.6	5.3	76.4	81.5	138.1	24.5	17.0	28.9	46.3	658.4
159	690.9	237.3	13.6	5.7	83.5	97.5	136.3	24.6	17.1	28.7	46.7	620.9
95	769.1	221.6	12.1	6.9	103.5	77.8	142.1	23.1	23.6	28.7	22.8	567.1
52	942.5	227.7	12.1	6.1	116.5	91.1	135.4	40.3	38.8	28.8	19.2	706.0

INTERBRANCH INTEREST RATE=.70

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	828.7	203.1	12.6	1.3	46.1	43.8	139.3	17.5	6.6	27.7	35.9	534.0
	760	824.5	203.9	12.5	1.2	47.7	44.7	140.0	16.7	5.9	25.7	36.6	534.9
******)	684	875.9	210.1	13.2	1.8	53.2	51.5	134.3	18.3	9.3	27.1	39.5	558.3
	581	825.1	211.5	11.7	2.1	57.5	59.3	137.9	17.9	9.3	27.2	42.1	576.6
	465	705.5	227.6	13.1	3.3	64.7	68.1	142.9	19.1	11.0	28.3	44.4	622.3
	349	742.3	224.4	13.9	5.4	71.9	76.1	142.0	22.3	14.0	28.1	45.3	643.5
	244	816.7	228.2	12.6	5.2	77.3	75.3	138.7	24.0	18.0	28.9	45.0	653.2
	159	799.0	229.3	12.1	5.0	82.1	84.6	140.9	27.7	19.8	28.8	46.2	676.5
	95	708.1	224.5	12.6	7.0	103.5	77.5	140.5	28.0	22.2	29.0	22.7	667.5
	52	761.3	226.3	12.3	7.1	126.1	93.3	141.5	34.7	33.9	28.9	20.5	724.7
	26	741.5	230.7	12.4	6.8	133.0	101.9	141.5	43.3	44.7	29.0	18.9	762.1
	12	781.8	233.0	12.9	6.9	138.3	102.8	138.9	44.6	47.1	28.9	19.7	773.1

INTERBRANCH INTEREST RATE=.75

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	840	202.2	12.1	1	44.1	41.6	143.6	17.3	6.9	27.9	34.8	531.4
	760	892.7	211.7	12.6	1.6	50.3	47.3	136.7	18.4	6.3	27	37.8	549.7
	684	832.3	210.1	12.7	1.1	48	46.3	145	17.5	6.5	27	37.3	551.3
	581	815.1	211.3	13.6	2.2	56.4	56.4	138.3	17.7	10.1	27.2	41.5	574.7
********)	465	866.4	225.2	12.3	2.5	60	59.5	136.4	21	12.5	28.1	42.1	599.6
	349	842.3	223.7	11.9	4	70.1	72.8	143.6	21.1	14	28	44.9	634.1
	244	677.2	240	13.7	5.4	78.8	84.3	146.7	22	16	28.7	47.3	682.9
	159	756.6	227.1	12.5	5.2	87.5	88.7	142.9	26	18.4	28.5	47.2	683.9
	95	691.4	232.9	14.3	7.6	103.1	82.2	145.7	29.5	22.6	28.8	22.6	689.3
	52	815.5	235	12.5	6.8	121.3	84.6	141.7	35.5	37.5	28.9	19	722.8

Appendix V.B -2 : Results of Simulation Runs for Different Values of Minimum Level Ratio.

MINIMUM RATIO=.00

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	845.0	198.0	11.7	1.1	44.7	42.2	127.4	17.4	7.1	27.6	35.1	512.3
	760	806.2	207.4	12.4	1.6	51.2	47.8	120.5	17.8	6.3	26.9	38.1	530.0
	684	838.3	201.9	12.3	1.0	47.2	45.1	127.7	17.2	6.6	26.8	36.2	522.0
	581	821.1	205.6	13.3	2.3	56.1	56.0	121.7	17.7	9.7	27.2	41.1	550.7
*******>	465	871.6	216.7	11.8	2.2	58.3	56.9	120.4	20.7	12.3	28.0	41.4	568.7
	349	847.1	216.3	11.4	3.8	69.8	71.0	128.1	20.3	13.7	28.0	44.4	606.8
	244	682.4	233.2	13.0	5.5	78.0	83.4	128.7	21.4	15.2	28.5	47.0	653.9
	159	763.2	221.2	11.9	4.3	84.6	86.9	126.7	25.0	17.7	28.4	46.8	653.5
	95	699.4	226.9	13.8	7.1	99.6	79.2	128.2	29.2	21.5	29.8	22.6	656.9
	52	822.8	228.4	11.6	6.3	117.7	81.7	126.4	32.1	34.3	28.9	19.3	686.7

MINIMUM RATIO=.05

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	844.3	199.0	11.7	1.3	44.9	42.8	131.1	17.5	7.1	27.6	35.6	518.6
	760	805.7	209.6	12.3	1.6	51.1	47.7	124.3	17.9	6.3	26.9	38.0	535.7
	684	837.4	203.5	12.3	1.1	47.0	44.9	132.3	17.2	6.5	26.8	36.1	527.7
	581	819.9	208.2	13.4	2.2	57.0	56.6	125.9	17.5	9.9	27.2	41.3	559.2
*******>	465	870.9	219.3	11.9	2.1	58.2	57.4	125.2	20.6	12.2	28.1	41.4	576.4
	349	846.6	217.6	11.6	3.7	69.9	71.5	131.7	20.2	13.8	28.0	44.6	612.6
	244	681.6	234.1	13.0	5.4	78.4	83.3	132.3	21.2	15.2	28.5	46.9	658.3
	159	762.8	221.0	12.0	4.3	84.5	86.5	129.9	24.9	17.5	28.4	46.7	655.7
	95	698.0	228.8	14.1	7.3	100.5	80.3	133.1	28.8	21.3	28.3	22.6	665.6
	52	822.0	229.4	11.9	6.5	118.5	81.8	130.0	32.3	34.0	28.9	19.2	692.5

MINIMUM RATIO=.2

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
		*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******
	800	841.9	200.9	12.2	1.3	44.7	42.3	144.4	17.2	7.0	27.6	35.1	532.7
	760	804.2	212.0	12.7	1.5	51.1	47.4	137.6	18.1	6.2	27.0	37.8	551.4
	684	834.4	210.6	12.8	1.1	47.4	45.5	146.2	17.5	6.5	27.0	36.9	551.5
	581	818.4	211.6	13.5	2.2	57.0	56.4	139.6	17.5	9.8	27.2	41.4	576.2
*******	465	869.1	224.9	12.4	2.4	59.3	57.4	137.4	21.1	12.2	28.2	41.0	596.3
	349	844.4	221.9	11.8	3.7	70.4	71.9	144.6	20.5	13.7	27.9	44.6	631.0
	244	678.6	238.0	13.6	5.6	79.7	84.5	147.9	21.5	15.4	29.7	47.2	682.1
	159	760.5	224.5	12.5	4.5	86.4	87.6	143.3	25.1	17.6	28.5	46.7	676.7
	95	694.7	231.9	14.5	7.0	102.7	83.6	146.7	29.0	21.3	28.8	22.9	688.4
	52	819.4	233.4	12.7	6.7	117.9	82.1	142.9	32.9	34.8	28.9	19.1	711.4

MINIMUM RATIO=.15

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
		*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******
	800	842.8	200.1	12.1	1.3	44.7	42.7	140.0	17.3	7.0	27.7	35.3	528.2
	760	804.3	211.2	12.6	1.5	50.3	47.4	132.6	17.7	6.2	26.9	37.9	544.7
	684	835.9	207.8	12.6	1.0	46.7	44.8	140.9	17.0	6.5	27.0	36.6	540.9
	581	819.4	210.0	13.5	2.2	56.9	56.6	134.3	17.9	9.8	27.2	41.3	569.7
*******	465	869.3	221.3	12.2	2.4	59.4	56.5	132.3	20.9	12.3	28.2	41.6	589.1
	349	845.4	221.0	11.8	3.4	70.3	71.8	140.6	20.3	13.7	27.9	44.7	625.5
	244	679.6	236.3	13.4	5.7	78.8	84.4	142.2	21.5	15.3	28.6	47.2	673.4
	159	761.1	224.3	12.4	4.6	86.0	87.3	138.8	25.0	17.6	28.5	46.6	671.1
	95	696.0	229.8	14.3	7.1	101.7	82.3	141.9	28.9	21.0	28.8	22.7	677.5
	52	820.3	233.8	12.4	6.8	117.7	81.5	138.0	32.8	34.5	28.9	19.1	704.0

MINIMUM RATIO=.25

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL%
	800	841.0	203.3	12.7	1.3	45.2	42.3	149.5	17.3	7.1	27.7	35.0	541.4
	760	803.6	213.8	12.7	1.5	51.4	47.4	142.6	18.0	6.3	26.9	37.5	558.1
	684	833.9	210.1	12.8	1.1	47.5	45.6	150.6	17.5	6.5	27.0	36.9	555.6
	581	817.6	213.7	13.6	2.0	57.2	56.4	144.4	17.8	9.9	27.2	41.4	583.6
********)	465	867.4	227.4	12.5	2.5	60.5	59.1	143.1	21.2	12.4	28.2	41.8	608.7
	349	843.4	222.5	11.9	3.9	70.6	72.1	149.0	20.4	13.7	28.1	44.7	636.9
	244	677.7	239.5	13.8	5.4	79.9	84.3	153.2	21.5	15.5	29.7	47.1	688.9
	159	759.0	225.5	12.6	4.6	87.4	87.7	150.3	25.2	17.7	28.5	46.5	686.0
	95	693.7	232.7	14.6	7.0	103.1	84.0	151.1	29.2	21.5	28.8	23.0	695.0
	52	818.6	234.6	13.2	7.0	118.9	82.9	147.7	32.7	34.6	28.9	19.2	719.7

Appendix V.B - 3 : Results of Simulation for Different Values of Minimum Security Level.

MINIMUM LEVEL FOR SECURITIES=7500

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL$
		******	******	******	******	******	******	******	******	******	******	******	******
	800	591.5	220.2	13.3	1.8	49.0	53.1	134.1	16.5	6.1	26.5	40.5	561.1
	760	492.8	216.8	13.9	1.1	48.9	51.2	127.2	15.7	4.9	27.5	39.3	546.5
******)	684	604.3	213.9	13.1	1.8	56.2	56.9	127.7	18.5	9.7	27.9	42.0	566.7
	581	527.0	223.4	12.9	3.1	58.4	65.8	135.1	19.3	8.8	28.3	45.1	600.2
	465	507.6	222.9	13.5	3.8	60.4	64.5	129.7	18.1	9.9	28.7	43.8	595.3
	349	585.3	230.9	12.0	3.4	64.6	67.8	130.0	21.7	13.0	28.7	44.4	616.5
	244	551.2	216.8	12.8	5.3	78.1	83.0	134.5	23.4	16.8	28.5	46.9	646.1
	159	479.6	242.2	14.6	6.9	80.8	92.6	142.5	26.4	17.9	29.9	47.1	699.9

MINIMUM SECURITIES LEVEL=5000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL$
		*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******
	800	648.7	203.5	12.9	1.8	48.5	50.6	129.7	15.0	6.0	25.7	38.9	532.6
	760	567.6	230.5	15.0	3.8	45.2	57.5	138.9	17.7	6.5	27.2	41.2	583.5
******)	684	674.2	213.5	13.5	2.1	49.9	53.7	135.4	20.1	8.7	27.4	40.0	564.3
*******)	581	674.5	221.0	12.5	1.8	56.3	56.4	132.1	18.4	9.4	28.7	40.3	577.4
	465	589.2	225.0	12.9	3.9	62.6	68.6	132.4	20.8	11.9	28.2	44.1	610.4
	349	645.0	227.1	12.1	4.2	64.6	70.3	133.3	22.3	14.4	28.1	44.2	621.2
	244	559.2	222.0	12.4	5.0	75.6	79.3	133.1	24.3	15.7	28.4	46.7	662.7

MINIMUM SECURTIES LEVEL=9000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
		******	******	******	******	******	******	******	******	******	******	******	******
	800	763.9	201.2	12.0	1.4	44.3	42.6	136.3	17.5	7.0	27.6	35.5	525.4
	760	725.7	211.0	12.5	1.5	50.7	47.4	129.1	17.9	6.2	26.9	37.7	540.9
	684	756.8	206.0	12.5	0.9	46.0	44.0	137.2	17.1	6.3	26.7	36.2	532.9
	581	740.3	210.9	13.6	2.2	56.6	56.4	129.5	17.6	9.8	27.2	41.3	565.1
*******>	465	790.4	219.7	12.0	2.4	58.9	58.6	128.6	20.6	12.2	26.1	41.7	582.8
	349	766.0	219.6	11.8	3.8	70.3	72.0	135.6	20.2	13.7	27.9	44.8	619.7
	244	600.4	239.1	13.4	5.7	77.2	84.2	137.9	21.2	15.3	28.6	46.9	669.5
	159	681.8	224.2	12.3	4.3	84.8	86.9	134.6	24.8	17.5	28.5	46.5	664.4

MINIMUM SECURITIES LEVEL=11000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
		*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******
	800	947.6	197.9	11.0	1.6	44.9	45.4	129.0	17.4	6.0	25.7	36.2	516.1
	760	904.3	209.9	13.1	1.7	55.2	53.4	131.5	17.8	6.9	27.7	40.2	557.4
	684	888.7	207.0	11.9	1.4	51.3	48.5	127.2	16.9	7.0	26.9	38.6	536.7
	581	787.2	216.3	11.9	3.4	61.7	64.5	133.7	18.8	8.7	28.1	44.9	592.0
*******>	465	1013.7	212.6	12.8	2.7	54.2	60.5	130.9	20.8	12.0	26.9	41.3	575.7
	349	828.7	225.2	14.2	4.3	67.1	70.4	134.6	19.4	13.0	29.1	43.7	620.0
	244	822.9	229.5	12.5	4.6	75.0	79.1	129.3	20.2	14.5	28.4	46.6	644.6
	159	962.7	227.0	10.4	5.5	87.7	84.9	132.8	26.0	20.3	28.8	46.5	669.5
	95	865.1	229.4	11.6	4.6	89.3	89.9	128.9	25.1	22.1	28.8	21.7	631.4

MINIMUM SECURITIES LEVEL=12000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL$
	800	1003.2	199.7	11.9	1.3	44.6	42.4	135.8	17.5	7.0	27.6	35.5	523.3
	760	965.8	208.6	12.3	1.3	51.0	47.3	128.3	18.0	6.2	26.9	37.7	537.6
	684	996.7	207.9	12.6	1.1	46.2	43.9	137.2	16.9	6.3	26.7	36.1	534.9
	581	980.1	208.5	13.4	2.1	56.8	56.2	128.7	17.6	9.8	27.2	41.3	561.6
********)	465	1030.5	216.7	11.8	2.3	59.9	58.5	127.8	20.6	12.3	28.1	41.6	579.6
********)	349	1006.4	217.6	11.6	3.5	70.8	71.5	134.6	20.3	13.7	27.9	44.7	616.2
	244	841.2	228.4	12.7	5.5	81.3	83.0	135.5	21.3	15.3	28.6	46.9	658.5
	159	922.7	220.0	11.8	4.1	86.3	85.8	133.6	25.0	17.6	28.5	46.5	659.2
	95	856.5	228.8	14.2	7.6	103.2	81.0	137.2	28.9	21.2	28.8	22.6	673.5
	52	981.3	229.7	11.9	6.3	119.1	81.4	133.5	32.8	34.4	28.9	19.3	697.3

MINIMUM SECURITIES LEVEL=13000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL$
	800	1079.8	194.4	11.2	1.4	50.7	47.5	133.1	17.5	6.6	26.3	37.4	526.1
	760	1059.4	200.1	13.4	1.3	50.9	46.4	128.0	17.2	6.3	26.6	37.4	527.6
********)	684	1208.2	210.5	11.5	0.9	53.2	50.7	122.9	19.2	8.7	27.4	38.7	543.6
	581	1063.5	210.2	11.5	1.8	56.1	55.3	128.8	18.2	9.0	27.2	40.9	559.0
	465	1105.0	211.7	10.4	2.6	61.3	59.0	133.4	18.0	10.2	25.0	41.7	576.3
	349	926.4	235.5	13.8	4.9	68.2	75.0	140.6	20.9	12.6	28.7	46.6	646.8
	244	942.9	221.7	11.9	5.2	79.1	81.9	138.0	22.4	16.9	28.9	46.5	652.5
	159	852.1	233.2	12.3	5.8	85.8	91.5	133.3	24.8	17.3	29.0	48.2	681.2
	95	1007.0	234.1	12.5	5.2	91.5	69.8	131.9	28.1	22.9	28.9	20.2	645.1
	52	1093.6	230.0	11.9	6.2	113.6	78.3	130.6	38.5	33.8	29.0	17.8	689.7

MINIMUM LEVEL OF SECURITIES=14000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	1101.2	199.0	13.3	0.6	50.6	47.6	135.2	14.0	5.2	26.4	38.2	530.1
	760	1155.0	208.8	12.8	2.0	47.5	46.3	131.0	16.0	6.7	26.9	36.5	534.5
	684	1177.0	211.7	11.4	1.5	51.6	48.2	134.5	18.9	8.7	28.1	38.1	552.7
	581	1186.2	210.7	11.7	1.1	56.8	55.2	127.7	19.8	10.5	27.9	41.3	562.7
	465	1018.6	215.3	11.9	3.0	64.4	67.3	133.8	18.9	10.2	26.8	44.5	596.1
	349	1147.9	216.9	13.0	3.8	70.3	70.6	133.2	22.4	15.1	27.9	44.2	617.4
********>	244	1253.1	214.3	11.1	4.4	74.1	72.1	135.6	25.3	16.3	28.5	43.7	625.4
	159	1079.0	225.0	12.4	4.7	77.2	80.8	128.6	25.1	17.4	28.1	44.7	644.0
	95	1078.7	231.0	12.7	6.1	98.5	75.9	134.7	29.6	22.5	25.9	22.9	662.8
	52	1134.2	218.2	9.9	5.9	120.3	86.8	136.1	34.8	30.9	29.0	19.3	691.2

MINIMUM LEVEL OF SECURITIES=15000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	1242.5	198.1	11.9	1.2	46.1	42.7	135.3	17.5	7.0	27.6	35.5	522.4
	760	1205.7	208.6	12.3	1.3	51.0	47.3	128.3	13.0	6.2	26.9	37.7	537.6
	684	1237.0	203.2	12.4	1.3	47.5	43.7	135.7	17.0	6.3	26.7	36.2	536.)
	581	1219.7	208.5	13.4	2.1	56.8	56.2	128.7	17.6	9.8	27.2	41.3	561.6
********>	465	1270.2	216.7	11.8	2.3	59.9	58.5	127.8	20.6	12.3	28.1	41.6	579.6
	349	1246.3	217.6	11.6	3.5	70.5	71.5	134.6	20.3	13.7	27.9	44.7	616.2
	244	1081.8	221.2	12.3	5.4	82.1	82.3	133.9	21.3	15.4	28.6	46.9	649.4
	159	1163.0	219.0	11.7	4.0	86.5	85.4	133.0	24.9	17.6	28.5	46.5	657.1
	95	1097.5	221.4	13.5	7.5	105.4	79.8	134.9	28.9	21.2	28.8	22.6	662.3
	52	1221.3	229.0	11.8	6.3	119.2	81.2	133.4	32.8	34.4	29.9	19.3	697.5

Appendix V.B - 4 : Results of Simulation Runs for Different Values of Initial Minimum Ratio for Securities.

MINIMUM SECURITY RATIO=1.75

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	762.5	191.2	11.3	0.7	46.9	43.5	133.3	15.6	5.9	25.7	36.8	510.9
	760	791.4	202.1	13.3	0.7	50.0	47.4	126.4	17.1	7.4	27.5	38.0	529.9
********>	581	815.8	208.9	11.3	0.7	49.9	48.6	127.4	19.7	8.2	27.1	39.4	541.4
	465	637.5	233.0	13.3	3.5	55.0	62.6	140.1	16.0	8.8	28.4	42.4	603.1
	349	601.4	227.5	11.5	2.8	62.0	68.5	138.0	16.8	10.0	28.0	45.5	610.5

MINIMUM SECURITY RATIO=2.25

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	943.4	199.7	11.9	1.3	44.9	42.3	135.8	17.5	7.0	27.6	35.5	523.5
	760	905.8	208.6	12.3	1.3	51.0	47.3	128.3	18.0	6.2	26.9	37.7	537.6
	694	937.0	206.5	12.5	1.0	46.3	43.3	136.8	17.0	6.3	26.7	36.1	533.0
	581	920.3	208.5	13.4	2.1	56.8	56.2	128.7	17.6	9.8	27.2	41.3	561.6
********>	465	970.6	216.7	11.8	2.3	59.9	58.5	127.8	20.6	12.3	28.1	41.5	579.6
	349	946.2	217.6	11.6	3.5	70.8	71.5	134.6	20.3	13.7	27.9	44.7	615.2
	244	931.7	224.3	12.6	5.6	82.0	82.7	134.7	21.3	15.4	28.6	46.9	654.1
	154	962.7	229.0	11.8	4.1	86.6	85.9	133.2	25.1	17.6	29.6	46.5	659.6
	95	996.9	236.6	14.1	7.6	105.7	80.3	136.5	28.9	21.2	29.8	32.6	670.2
	52	921.2	229.0	11.8	6.3	119.3	81.3	133.4	32.8	34.4	28.7	19.3	696.5

1INIMUM SECURITY RATIO=2.5

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	967.3	207.9	11.4	1.2	52.6	50.8	129.0	19.6	6.6	27.9	39.1	546.0
	760	983.3	210.8	12.5	1.7	56.3	55.6	127.2	19.1	8.1	26.9	42.0	560.2
[illegible]>	684	1197.2	203.9	11.4	0.6	48.4	45.7	125.0	19.3	8.9	26.1	38.0	527.3
	581	1000.4	217.5	11.7	2.0	62.3	61.8	132.0	17.7	9.0	28.0	44.0	536.0
	465	1063.5	220.0	12.2	2.1	63.5	63.1	130.6	21.4	13.0	28.4	44.3	598.6
[illegible]>	349	1118.1	215.7	10.5	2.4	64.5	58.7	131.8	22.8	13.3	28.1	39.9	587.7
	244	1034.7	222.7	11.3	3.6	72.8	67.8	129.1	25.5	18.6	27.9	43.3	622.6
	159	1053.3	241.1	12.4	4.9	76.3	80.4	129.4	25.9	19.3	28.4	44.9	663.0
	95	968.1	221.5	12.0	6.1	102.2	78.0	131.9	27.9	22.8	23.9	24.0	655.3
	52	937.2	228.1	13.4	7.4	112.4	89.5	131.9	33.3	33.6	28.9	21.6	700.1

rINIMUM SECURITY RATIO=2.75

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	1142.9	196.8	11.7	1.2	46.3	42.3	134.9	17.5	7.1	27.6	33.5	520.9
	760	1105.9	208.6	12.3	1.3	51.0	47.3	128.3	18.0	6.2	26.9	37.7	537.6
	684	1137.7	196.9	11.8	0.9	47.9	43.2	134.3	17.1	6.2	26.7	36.2	521.2
	581	1120.3	208.5	13.4	2.1	56.8	56.2	128.7	17.6	9.8	27.2	41.3	561.6
[illegible]>	465	1170.4	216.7	11.8	2.3	59.9	58.5	127.8	20.6	12.3	28.1	41.6	579.6
	349	1146.2	217.6	11.6	3.5	70.8	71.5	134.6	20.3	13.7	27.9	44.7	616.2
	244	981.8	221.2	12.3	5.4	82.1	82.3	133.9	21.3	15.4	28.6	46.9	649.4
	159	1062.9	219.0	11.7	4.9	86.5	85.4	133.0	24.9	17.6	28.5	46.5	657.1
	95	997.7	221.3	13.5	7.6	105.6	78.8	134.8	28.9	21.2	29.8	22.6	663.1
	52	1121.3	229.0	11.8	6.3	119.3	81.3	133.4	32.8	34.4	28.9	19.3	696.5

Appendix V.B – 5 : Results of Simulation Runs for Different Values of Interbank Limits

INTERBANK LIMIT=0

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	836.3	207.0	12.0	5.3	69.7	69.5	136.9	17.2	6.9	0.0	56.3	580.8
760	800.2	212.5	12.5	4.8	72.8	71.3	129.8	17.7	6.1	0.0	55.9	583.4
684	829.3	208.8	12.2	4.1	71.6	71.2	138.0	17.0	6.4	0.0	55.5	584.8
581	815.8	217.4	13.4	6.2	78.2	76.7	130.4	18.1	9.8	0.0	56.2	606.4
→ 465	866.8	222.8	11.9	6.2	82.2	80.6	129.6	21.1	12.1	0.0	56.8	623.3
349	844.2	221.9	11.7	7.8	89.5	88.2	135.6	21.2	13.9	0.0	56.5	646.3
244	677.9	237.4	13.3	10.6	98.9	100.7	137.7	21.2	15.3	0.0	57.0	692.1
159	757.0	227.0	12.2	8.9	112.2	111.6	135.1	24.8	17.9	0.0	56.8	706.5
95	692.1	234.3	14.5	10.4	130.8	111.0	138.8	28.2	21.7	0.0	31.2	720.9
52	810.0	233.7	12.3	10.5	158.7	132.3	134.7	32.0	37.5	0.0	29.5	781.2

INTERBANK LIMIT=2500

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	832.8	207.5	12.0	3.3	62.1	77.5	136.8	17.5	7.0	26.8	52.1	602.6
764	796.0	212.4	12.4	3.9	64.2	78.8	129.5	18.1	6.1	26.8	52.2	604.4
684	828.1	206.8	12.2	3.4	60.0	74.1	137.3	17.5	6.2	26.2	50.0	593.7
581	810.9	216.1	13.3	4.8	71.2	87.7	130.4	18.1	9.7	27.2	54.6	633.1
########> 465	862.2	223.9	12.0	5.3	72.7	86.7	129.5	20.9	12.1	28.1	53.0	644.2
349	839.8	222.7	11.8	6.1	80.2	94.8	135.6	20.8	13.7	27.9	53.5	667.1
244	674.0	238.0	13.3	8.7	87.0	107.7	137.9	21.1	15.3	28.6	55.0	712.6
159	754.8	225.7	12.2	8.8	95.8	112.7	134.8	24.3	17.4	28.5	54.5	714.7
95	691.4	230.9	14.3	9.6	110.7	105.1	137.6	27.9	21.2	28.8	28.8	714.9
52	811.9	233.0	12.5	9.9	130.4	120.0	134.4	31.3	34.5	28.9	27.8	762.7

INTERBANK LIMIT=5000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	598.1	205.9	11.8	1.8	56.3	67.0	129.4	19.0	5.9	26.5	47.5	571.1
	760	809.0	213.3	11.7	2.5	62.2	71.0	131.1	16.8	6.4	27.5	49.0	591.5
********>	684	862.6	216.7	10.3	3.2	64.4	73.7	127.0	20.4	8.7	27.4	50.1	601.9
	581	779.7	206.6	12.8	4.8	66.5	77.1	132.1	17.4	8.7	27.3	48.4	601.7
	465	786.8	214.3	13.0	5.7	72.9	84.3	130.1	18.2	12.5	27.8	51.6	630.4
********>	349	855.3	229.0	13.1	5.6	77.1	86.9	136.4	21.9	15.1	28.6	51.6	665.3
	244	774.8	216.6	11.2	7.1	85.8	94.0	132.0	24.3	16.9	28.1	51.4	667.4
	159	691.9	221.8	12.3	7.4	94.0	102.5	137.4	24.3	17.9	28.4	51.2	697.2
	95	732.1	230.0	13.5	8.1	105.6	92.6	132.2	25.1	21.7	28.5	27.5	684.8
	52	780.0	222.7	11.5	7.9	129.1	109.9	136.8	36.6	32.5	29.0	25.1	741.1

INTERBANK LIMIT=7500

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	840.2	203.9	12.0	1.7	49.2	53.6	136.5	17.5	7.0	27.6	41.0	550.0
	760	804.0	210.0	12.4	2.5	52.5	53.5	128.6	18.0	6.2	26.9	41.1	551.7
	684	834.7	204.7	12.4	1.5	49.4	51.8	136.5	17.0	6.3	26.7	39.6	545.9
	581	817.7	210.1	13.4	3.1	60.8	64.9	129.1	17.7	9.8	27.2	44.9	581.0
*******>	465	867.1	220.6	11.9	3.1	64.7	70.0	128.9	20.6	12.1	28.1	46.7	606.7
	349	844.1	221.2	11.8	5.4	73.2	78.1	135.7	20.7	13.6	27.9	47.3	634.9
	244	678.5	237.3	13.3	6.6	80.3	91.3	137.5	21.1	15.3	28.6	49.4	680.7
	159	759.5	223.8	12.2	5.8	89.5	95.1	134.4	24.8	17.5	28.5	49.2	680.8
	95	694.9	230.6	14.3	8.2	103.9	87.9	137.2	28.8	21.2	28.8	24.4	685.3
	52	817.8	232.8	12.2	7.3	121.9	95.6	134.4	31.9	34.5	28.9	22.4	721.9

Appendix V.B – 6 : Results of Simulation Runs for Different Values of Other Bank Limits.

OTHER BANKS CREDIT LIMIT=7500

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	843.7	202.8	12.1	1.7	44.1	42.8	136.3	17.5	7.0	27.6	35.5	527.4
760	805.8	209.9	12.5	1.8	50.1	46.8	128.8	17.9	6.2	26.9	37.5	538.4
684	837.5	203.5	12.4	1.1	44.8	42.0	136.3	17.0	6.3	26.7	35.5	525.6
581	820.1	210.9	13.6	2.6	56.3	56.4	129.5	17.5	9.8	27.2	41.3	565.1
########> 465	869.9	221.1	12.1	3.0	59.2	58.7	129.1	20.6	12.2	28.1	41.7	585.8
349	845.8	219.6	11.8	5.1	69.8	72.2	135.6	20.3	13.6	27.9	44.8	620.7
244	680.5	237.8	13.4	5.7	76.7	84.3	137.8	21.2	15.3	28.6	46.9	667.7
159	761.2	225.6	12.4	6.1	84.9	87.2	135.1	25.0	17.5	28.5	46.5	668.8
95	695.2	236.2	14.7	8.8	100.4	82.1	139.1	29.0	21.1	28.8	22.6	682.8
52	820.5	233.3	12.2	7.4	116.7	82.5	134.7	32.8	34.6	28.9	19.2	702.3

OTHER BANKS CREDIT LEVEL=12500

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	843.7	199.7	11.9	1.3	44.7	42.5	135.8	17.6	7.0	27.6	35.5	523.6
760	805.9	208.9	12.3	0.7	51.1	47.8	128.3	18.0	6.2	26.9	37.8	538.0
684	836.9	204.8	12.4	0.8	46.0	43.9	136.6	17.1	6.3	26.7	36.2	530.8
581	820.7	208.5	13.4	1.9	56.8	56.2	128.7	17.5	9.8	27.2	41.3	561.3
########> 465	870.6	216.7	11.8	1.9	59.9	58.5	127.8	20.6	12.3	28.1	41.6	579.2
349	846.3	217.6	11.6	3.3	70.8	71.5	134.6	20.3	13.7	27.9	44.7	616.0
244	681.0	232.9	13.0	4.5	80.1	83.6	136.8	21.2	15.3	28.6	46.9	662.9
159	762.2	221.5	12.0	4.0	86.0	86.3	133.9	24.9	17.5	28.5	46.5	661.1
95	696.5	229.8	14.2	7.0	103.0	81.3	137.4	28.8	21.2	28.8	22.6	674.1
52	821.1	230.8	12.0	6.3	118.6	81.6	133.9	32.7	34.6	28.9	19.2	698.6

OTHER BANKS CREDIT LIMIT=15000

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	789.5	198.7	13.6	1.2	52.5	52.4	129.9	15.9	5.8	25.9	39.5	535.4
760 ######>	875.9	202.9	12.0	0.8	49.6	44.4	127.6	18.8	7.2	27.4	36.4	527.1
684	752.4	219.8	12.9	2.2	56.4	59.5	130.6	17.0	7.6	27.8	42.9	576.7
581	871.6	208.7	11.6	0.7	56.3	53.0	135.7	19.4	9.1	27.9	39.9	563.3
465	841.1	206.2	12.8	1.1	61.6	60.5	129.1	19.6	11.8	27.2	41.3	571.2
349	690.1	216.9	13.6	3.7	73.3	73.9	132.7	20.1	12.9	28.3	45.5	620.0
244	803.3	220.4	11.2	3.6	78.0	77.5	132.6	26.3	17.3	28.4	46.2	641.5
159	801.3	225.7	12.0	4.7	85.2	84.4	137.5	27.6	19.2	29.0	45.3	670.6
95	799.2	220.5	12.3	4.9	95.4	67.5	135.0	29.9	24.0	29.0	21.9	640.4
52	765.0	223.0	11.4	4.7	117.0	79.8	135.9	36.6	29.8	29.0	18.8	686.0

OTHER BANKS CREDIT LIMIT=17500

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	843.8	198.1	11.8	0.9	45.9	42.4	135.3	17.5	7.0	27.6	35.5	522.0
760	805.9	208.9	12.3	0.4	51.2	47.8	128.3	18.0	6.2	26.9	37.8	537.8
684	837.1	203.2	12.4	0.5	47.0	43.7	135.7	17.0	6.3	26.7	36.2	528.7
581	820.6	208.5	13.4	1.3	56.8	56.2	128.7	17.5	9.8	27.2	41.3	560.7
465 ########>	870.7	216.7	11.8	1.3	59.9	58.5	127.8	20.6	12.3	28.1	41.6	578.6
349	846.3	217.6	11.6	2.5	70.8	71.5	134.6	20.3	13.7	27.9	44.7	615.2
244	682.1	224.7	12.5	3.0	81.6	82.7	134.9	21.3	15.4	28.6	46.9	651.6
159	742.7	220.0	11.8	2.5	86.9	86.0	133.6	24.9	17.6	28.5	46.5	658.3
95	697.7	224.1	13.8	5.1	104.5	79.7	135.9	28.8	21.2	28.8	22.6	664.5
52	821.1	223.0	11.8	5.0	119.3	81.3	133.4	32.8	34.4	28.9	19.3	695.2

OTHER BANKS CREDIT LIMIT=20000

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******
800	843.8	198.1	11.8	0.8	45.9	42.4	135.3	17.5	7.0	27.6	35.5	521.9
760	805.9	208.9	12.3	0.2	51.2	47.8	128.3	18.0	6.2	26.9	37.8	537.6
684	837.1	203.2	12.4	0.9	47.5	43.7	135.7	16.9	6.3	26.7	36.2	529.5
581	820.8	208.5	13.4	1.0	56.8	56.2	128.7	17.5	9.8	27.2	41.3	560.4
********> 465	870.9	216.7	11.8	0.8	59.9	58.5	127.8	20.6	12.3	28.1	41.6	578.1
349	846.4	217.6	11.6	1.8	70.8	71.5	134.6	20.3	13.7	27.9	44.7	614.5
244	682.8	221.2	12.3	2.5	82.1	82.3	133.9	21.3	15.4	28.6	46.9	646.5
159	763.1	219.0	11.7	2.2	86.7	85.5	133.0	24.9	17.6	28.5	46.5	655.6
95	697.9	221.4	13.5	5.1	105.4	78.8	134.8	28.8	21.2	28.8	22.6	660.4
52	821.3	229.0	11.8	4.8	119.3	81.3	133.4	32.7	34.4	28.9	19.3	694.9

Appendix V.B. - 7 : Results of Simulation Runs for Different Values of Transaction Costs.

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.01 MILLION

TRANSACTION COST=.01 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	853.2	211.4	13.5	1.4	45.3	43.5	174.2	19.3	7.4	27.7	35.9	580.1
	760	815.3	221.4	13.6	1.6	50.6	49.4	187.5	19.4	6.9	27.2	38.4	596.3
	684	843.4	217.0	13.4	1.0	48.0	47.6	175.1	19.1	6.7	26.2	37.5	591.6
	581	838.2	222.6	14.3	3.0	59.4	62.3	169.0	20.2	11.3	27.2	43.4	632.7
********)	465	850.3	233.9	13.2	2.4	60.9	64.3	166.1	22.8	12.9	28.1	44.1	648.7
	349	857.4	228.6	13.1	4.0	69.2	73.8	172.6	22.9	15.2	28.2	45.6	673.2
	244	870.6	244.4	15.3	6.3	77.0	84.6	176.6	22.9	17.4	28.6	47.0	720.1
	159	772.8	235.2	13.5	6.4	88.4	90.9	173.9	27.7	21.7	28.5	47.7	733.9
	95	705.3	243.3	15.1	8.8	106.2	88.6	175.9	34.1	29.5	28.9	23.2	750.6
	52	905.9	240.0	13.0	7.7	135.5	98.3	170.5	40.2	48.2	28.9	20.1	799.4

OPTIMAL CASH LEVEL FOR TRANSACTION COST=.02 MILLION

TRANSACTION COST=.02 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	851.5	206.5	13.2	1.1	45.5	42.7	158.3	18.1	7.0	27.7	35.3	555.4
	760	814.6	217.2	13.1	1.4	50.8	48.2	152.2	18.9	6.5	27.0	38.0	573.3
	684	843.4	215.1	13.1	1.0	47.0	45.4	160.1	18.6	6.8	26.9	36.8	570.8
	581	827.7	215.7	13.9	2.7	57.4	58.9	152.3	19.0	10.8	27.2	42.4	600.3
********)	465	578.6	226.4	12.8	2.6	61.2	62.7	149.9	21.8	13.0	28.0	43.4	621.8
	349	856.0	225.9	12.4	4.3	69.5	72.0	159.3	21.6	14.3	28.3	44.7	652.3
	244	691.9	236.9	14.4	6.0	77.2	83.8	161.6	22.1	16.6	28.7	47.0	696.3
	159	770.9	232.2	13.0	5.9	88.9	90.1	159.8	26.8	19.8	28.5	47.3	712.3
	95	703.9	238.9	15.0	8.7	105.4	88.0	161.9	32.1	25.7	28.9	23.2	724.8
	52	929.6	237.6	13.0	7.4	134.3	98.6	156.6	39.0	42.7	28.9	19.9	765.0

OPTIMUM CASH LEVEL AT .03 MILLION TL PER TRANSACTION

TRANSACTION COST=.03 MILLION TL

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
**********	800	991.0	217.4	10.9	3.1	53.2	56.2	137.2	26.0	23.9	27.2	41.0	596.2
	760	983.1	222.4	11.5	3.0	53.7	58.1	146.5	28.9	25.9	27.9	41.3	619.2
	684	770.4	223.8	13.2	4.9	64.5	71.4	145.3	25.8	24.4	28.1	47.9	649.3
	581	826.5	221.9	12.6	6.2	67.8	74.1	144.4	29.0	24.6	28.1	48.0	656.7
*********	465	902.9	229.0	12.4	4.1	60.4	64.0	144.2	30.4	26.8	28.5	42.9	642.7
	349	855.2	225.8	13.1	5.5	72.6	77.4	145.2	33.0	29.3	28.7	46.8	677.4
	244	831.0	238.8	12.0	6.0	77.9	82.4	147.8	35.3	33.5	28.9	45.6	708.2
	159	795.5	226.9	12.2	7.2	96.9	98.0	149.4	38.9	42.3	28.9	48.9	749.6
	95	709.7	245.0	14.4	8.0	111.9	83.7	145.3	40.3	47.0	28.7	20.9	745.1

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.05 MILLION

TRANSACTION COST=.04 MILLION TL

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	870.8	217.1	11.8	3.6	54.8	64.5	141.9	24.2	21.8	27.5	44.4	611.6
	760	754.8	209.4	12.2	5.0	61.2	68.1	141.4	25.6	20.5	28.5	46.4	618.3
	684	811.8	225.0	13.1	4.0	62.4	66.7	133.4	24.3	20.2	28.5	45.7	623.3
********	581	912.1	219.9	11.6	3.6	59.7	65.8	140.9	27.6	23.7	28.1	44.5	625.4
	465	721.7	225.9	13.0	6.1	68.2	74.3	140.2	27.2	24.7	28.8	46.5	654.9
	349	783.1	224.6	11.7	5.7	74.3	79.2	134.6	30.5	28.3	28.5	47.6	665.0
	244	849.7	210.8	10.9	4.7	76.9	73.6	142.5	33.8	29.4	28.4	44.6	655.6
	159	814.1	231.0	12.4	5.9	87.5	87.5	137.5	36.3	37.1	28.7	46.8	710.7

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.05 MILLION

TRANSACTION COST=.05 MILLION TL

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	843	211	12	4	57	65	137	25	22	28	46	606
	760	806	215	12	4	58	64	130	25	20	27	44	600
	684	837	226	13	4	57	62	141	26	20	28	43	618
	581	820	215	13	4	64	69	130	25	23	28	46	618
********>	465	869	225	12	5	66	70	130	27	27	28	46	634
	349	848	225	12	6	73	77	136	31	26	29	47	660
	244	680	238	13	6	81	88	138	31	28	29	48	698
	159	759	227	12	5	91	91	135	36	32	29	47	705
	95	693	232	14	8	107	84	138	38	34	29	21	703
	52	819	232	12	7	124	85	134	38	43	29	19	723

OPTIMUM CASH LEVEL FOR TRANSACTION COST =.06 MILLION

TRANSACTION COST=.06 MILLION TL

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	863.5	210.3	11.0	3.1	52.6	61.1	129.3	22.2	20.1	27.5	43.4	580.8
	760	748.5	204.3	12.0	5.0	61.5	67.8	130.3	24.6	19.6	28.5	46.1	599.7
	684	804.8	217.0	12.7	4.3	60.1	64.3	121.3	23.8	19.3	28.5	44.7	596.0
********>	581	906.0	217.9	11.2	3.4	58.1	63.6	131.3	26.3	21.9	28.1	43.8	604.7
	465	713.6	224.7	12.6	5.6	67.9	72.5	129.9	26.5	22.4	28.8	46.3	637.2
	349	775.7	222.6	11.4	5.9	73.7	77.0	125.1	29.0	24.9	28.6	47.0	645.2
	244	843.4	205.2	10.5	4.2	74.4	71.8	130.0	31.3	27.9	28.2	44.1	627.6
	159	806.5	227.8	12.3	5.7	85.3	85.0	126.5	32.6	32.9	28.7	46.5	683.3

OPTIMUM CASH LEVEL FOR TARNSACTION COST=.07 MILLION

TRANSACTION COST=.07 MILLION TL

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	835.7	202.6	11.6	3.4	56.2	63.4	127.8	23.5	20.9	27.7	45.0	582.1
	760	799.0	207.8	12.1	3.8	58.0	62.6	120.3	24.1	18.8	27.4	44.2	579.1
	644	814.5	211.8	12.1	3.7	56.8	61.5	129.4	24.3	18.8	27.8	43.2	589.3
	581	814.1	207.6	13.1	4.7	63.3	67.0	122.0	25.4	21.1	27.8	45.3	597.3
********)	465	913.7	220.0	11.3	4.0	63.9	65.8	120.6	26.3	25.4	28.4	44.8	610.6
	349	840.4	217.9	11.2	5.4	72.0	74.7	127.9	28.7	23.7	28.6	45.6	635.7
	244	670.9	232.0	12.8	6.2	78.4	85.3	128.9	28.2	24.8	28.5	47.3	672.4
	159	751.5	220.1	12.0	5.5	89.3	89.8	127.0	33.2	28.1	28.4	47.0	680.4
	95	687.4	225.6	13.6	7.5	102.3	80.6	128.8	35.4	30.0	28.8	20.6	673.2
	52	810.9	227.4	11.3	5.9	118.0	81.8	126.7	34.2	37.7	28.9	18.5	690.4

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.08 MILLION

TRANSACTION COST=.08 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	831.8	204.2	11.5	3.1	56.3	63.3	124.6	23.6	20.4	27.7	45.2	579.9
	760	795.2	207.1	11.9	3.7	57.7	61.8	116.6	23.9	18.3	27.6	43.7	572.3
	684	826.1	209.4	12.0	3.0	55.0	59.4	126.2	23.9	17.4	28.0	42.0	576.3
	581	810.3	205.4	12.8	4.7	63.3	66.8	118.6	24.7	20.6	27.8	45.4	590.1
********)	465	858.4	220.0	11.7	4.1	64.4	67.4	116.5	25.9	24.6	28.6	45.4	608.6
	349	836.1	215.6	11.2	5.8	71.7	74.2	123.9	28.4	22.8	28.6	45.4	627.6
	244	667.0	226.6	12.6	5.7	77.3	84.9	124.4	27.4	24.4	28.3	47.4	659.0
	159	747.3	218.3	11.9	4.9	87.9	88.7	122.6	32.7	27.3	28.4	46.7	669.4
	95	683.9	222.8	13.2	7.2	101.3	79.4	124.9	34.6	28.8	28.8	20.7	661.7
	52	809.1	223.3	11.3	6.0	115.1	78.6	121.3	32.9	35.8	28.9	18.4	671.6

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.09 MILLION

TRANSACTION COST=.09 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	827.9	202.7	11.3	3.1	55.0	61.5	121.6	23.3	19.2	27.7	44.5	569.9
	764	793.0	206.1	11.8	3.8	57.5	60.7	113.5	23.6	17.5	27.6	43.3	565.4
	684	822.4	208.3	12.0	2.6	54.5	58.9	123.5	23.6	17.2	27.8	42.0	570.4
	581	806.9	203.4	12.6	5.1	62.7	66.1	114.2	24.8	20.3	27.7	45.0	581.9
*******	465	855.3	219.2	11.5	3.8	64.0	66.9	114.2	25.0	23.4	28.6	45.4	602.0
	349	832.5	214.9	11.0	5.0	71.7	73.4	120.4	27.7	21.7	28.5	45.2	619.5
	244	661.5	229.0	12.7	5.7	77.0	84.5	122.3	27.2	23.3	28.3	47.3	657.3
	159	743.5	217.6	11.9	4.5	87.7	88.1	119.8	31.7	25.3	28.4	46.8	661.8
	95	679.0	224.8	13.1	6.5	100.5	79.0	122.1	33.0	27.1	28.8	20.6	655.5
	52	803.9	223.5	11.1	6.1	112.8	77.3	119.0	31.8	33.7	28.9	18.4	662.6

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.1 MILLION

TRANSACTION COST=.1 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	823.9	200.2	11.2	3.2	54.5	60.6	118.1	23.3	18.8	27.7	44.2	561.8
	760	789.4	203.4	11.5	3.8	56.9	60.7	110.6	23.5	17.0	27.6	43.3	558.3
	684	820.1	206.6	11.9	2.5	54.8	59.5	120.6	24.0	17.0	28.0	42.3	567.2
	581	802.8	202.0	12.6	4.6	62.5	65.7	111.2	24.0	20.0	27.7	44.9	575.2
*******	465	850.8	219.3	11.5	3.8	64.1	66.8	112.2	24.5	22.3	28.6	45.4	598.5
	349	828.3	213.9	10.9	5.0	71.5	72.9	117.5	27.5	21.3	28.5	44.9	613.9
	244	656.9	225.4	12.4	5.4	76.8	83.6	119.7	26.4	22.2	28.3	47.1	647.3
	159	740.5	214.8	11.8	4.5	85.6	86.3	116.0	30.7	24.1	28.4	46.9	649.1
	95	674.6	221.4	13.0	6.5	100.0	79.2	120.3	31.9	26.2	28.8	20.7	648.0
	52	801.0	222.8	11.1	5.9	109.6	76.3	116.7	30.5	31.7	28.9	18.5	652.0

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.12 MILLION

TRANSACTION COST=.12 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	816.0	196.5	11.1	2.8	54.4	60.1	112.8	22.6	18.7	27.7	43.9	550.6
	760	782.2	199.9	11.1	3.8	57.0	60.5	106.4	23.2	16.7	27.6	43.0	549.2
	684	812.5	203.6	11.9	2.5	55.0	59.6	115.5	23.2	16.4	28.0	42.2	557.9
	581	796.4	197.3	12.3	4.3	60.9	64.3	104.5	23.4	18.9	27.7	44.2	557.8
********>	465	842.3	215.8	11.4	3.7	64.3	66.2	107.6	24.9	22.0	28.4	45.0	589.3
	349	820.7	208.2	10.5	4.5	70.4	72.2	111.5	26.7	19.6	28.5	44.9	597.0
	244	648.8	220.6	12.3	5.7	76.6	83.5	116.0	25.4	20.9	28.2	47.0	636.2
	159	732.2	211.4	11.7	4.0	84.5	84.7	111.2	29.9	21.6	28.4	46.3	633.7
	95	666.6	218.7	12.9	6.3	97.8	78.5	115.2	30.7	24.6	28.8	20.6	634.1
	52	792.8	219.9	10.8	5.8	106.8	73.3	112.6	28.1	28.3	28.9	18.2	632.7

OPTIMUM CASH LEVEL FOR TRANSACTION COST=.15 MILLION

TRANSACTION COST=.15 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	804.2	195.0	10.9	2.5	54.8	59.6	107.9	22.2	18.2	27.7	43.6	542.4
	760	771.4	196.4	10.7	3.4	55.3	58.6	99.4	23.0	15.8	27.6	41.9	532.1
	684	803.1	199.2	11.3	2.2	54.7	58.5	107.7	23.0	15.9	27.6	41.7	541.8
	581	784.9	195.5	11.7	3.8	60.6	64.5	99.0	22.7	18.4	27.8	44.4	548.4
********>	465	829.6	213.2	11.1	3.6	64.2	65.9	101.6	24.3	21.1	28.6	44.7	578.3
	349	806.3	206.2	10.3	4.5	69.8	71.7	105.3	25.8	18.7	28.4	44.9	585.6
	244	636.6	218.2	12.1	5.5	75.0	82.9	108.6	23.7	19.4	28.2	46.5	620.1
	159	720.6	207.2	11.3	3.8	83.0	82.5	104.7	29.5	19.5	28.5	45.9	615.9
	95	653.5	215.5	12.7	5.9	95.8	76.0	108.8	29.2	21.9	28.8	20.1	614.7
	52	781.9	215.4	10.5	5.4	102.3	69.8	106.0	27.3	25.7	28.9	18.0	609.3

OPTIMAL CASH LEVEL FOR TRANSACTION COST=.18 MILLION

TRANSACTION COST=.18 MILLION

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	792.3	192.4	10.5	2.4	54.3	57.6	102.8	22.4	17.7	27.7	42.4	530.2
	760	761.2	194.3	10.5	3.8	54.6	57.9	93.7	22.3	15.0	27.2	41.8	521.1
	684	792.3	200.6	10.8	2.3	53.6	57.7	103.1	22.4	15.1	27.6	41.7	534.9
	581	774.0	196.1	11.4	3.1	59.4	62.8	94.3	21.8	17.3	27.8	43.9	537.9
********>	465	818.2	211.1	10.8	3.6	64.0	65.6	95.2	24.2	20.0	28.4	45.0	567.9
	349	791.7	206.4	10.3	4.7	70.7	72.3	100.8	26.4	18.2	28.4	44.9	583.1
	244	623.3	215.6	12.1	5.3	73.6	81.9	103.5	22.9	18.9	28.2	46.5	608.5
	159	707.3	206.1	11.1	4.2	80.5	80.2	99.1	28.5	18.2	28.2	45.4	601.5
	95	640.1	216.2	12.4	5.7	94.6	76.0	104.2	27.9	20.5	28.7	20.2	606.4
	52	770.8	211.5	10.4	4.9	98.2	67.7	99.4	26.7	24.4	28.9	17.6	589.7

Appendix V.B - 8 : Results of Simulation Runs for Different Values of Standard Deviation of Foreign Currency Flows.

FOREIGN CURRENCY STANDART DEVIATION =100

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
		*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******
	800	808.0	148.8	7.8	0.0	34.4	30.0	125.2	11.5	2.1	18.4	30.1	408.3
	760	795.2	166.8	8.5	0.0	34.3	28.0	119.5	11.6	1.6	21.5	28.9	420.7
	684	783.7	161.6	7.6	0.0	34.6	28.3	127.9	11.1	2.2	21.9	29.0	424.2
*******	581	853.4	172.7	8.3	0.0	36.0	28.1	122.5	11.3	4.0	21.8	29.0	433.7
	465	779.9	182.9	8.1	0.0	39.4	31.8	122.5	14.4	5.3	24.5	31.5	460.4
	349	804.7	196.6	8.0	0.0	45.2	28.8	130.5	14.2	5.8	26.2	29.7	485.0
	244	743.1	210.3	8.5	0.0	53.1	30.2	130.8	17.2	8.9	28.2	29.1	516.3
	159	722.8	209.8	8.0	0.3	61.7	38.6	132.0	20.2	10.7	28.6	32.4	542.3
	95	714.5	210.5	8.3	0.9	78.2	26.0	132.6	24.2	17.8	28.4	9.2	536.1
	52	790.2	224.1	7.4	0.1	98.4	31.5	132.6	27.7	35.2	28.8	8.2	594.0

FOREIGN CURRENCY STANDART DEVIATION=200

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
		********	********	********	********	********	********	********	********	********	********	********	********
	800	811.7	147.6	9.0	0.0	34.7	30.3	125.2	12.1	2.2	18.2	30.2	409.5
	760	797.3	168.8	9.5	0.0	35.4	28.3	120.9	12.0	1.6	21.9	29.2	427.6
	684	788.6	165.1	9.6	0.0	35.2	28.3	128.7	12.4	2.4	23.0	29.0	433.7
*******	581	853.1	173.6	9.8	0.0	36.6	28.0	122.4	12.4	4.0	21.9	29.0	437.7
	465	788.4	182.1	9.5	0.0	40.1	29.9	123.2	15.4	5.0	23.9	30.1	459.2
	349	808.6	198.7	9.4	0.0	47.1	29.1	130.7	15.2	6.0	26.7	29.8	492.7
	244	741.1	210.0	9.6	0.0	55.8	32.3	131.0	18.2	9.4	28.0	29.8	524.1
	159	726.1	211.9	9.2	0.5	64.9	41.1	132.2	21.6	12.6	28.4	32.8	555.2
	95	714.2	212.0	9.2	1.1	82.2	32.2	132.8	26.3	19.9	28.3	10.8	554.8
	52	793.1	225.4	8.8	0.3	102.1	37.0	132.8	29.2	34.5	28.8	9.5	608.4

FOREIGN CURRENCY STANDART DEVIATION=400

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	796.5	163.4	10.0	0.0	36.8	30.1	120.1	13.7	2.2	20.4	29.8	426.5
	760	744.1	182.8	11.4	0.0	37.5	28.3	122.4	12.7	1.6	25.2	29.2	451.1
	684	734.9	186.6	10.1	0.0	39.0	29.9	123.6	13.7	1.8	25.4	30.2	460.3
********>	581	943.8	162.6	9.2	0.0	36.6	28.0	120.3	17.6	5.7	20.4	29.0	429.4
	465	800.2	198.6	9.1	0.0	44.1	29.5	129.7	16.3	4.9	25.5	30.0	487.7
	349	736.3	209.5	10.0	0.6	57.8	44.8	128.9	19.2	8.9	27.9	35.9	543.5
	244	834.1	217.6	9.4	0.2	56.9	40.1	128.6	20.4	13.0	28.3	33.0	547.5
	159	733.4	215.5	10.1	1.0	75.0	57.5	132.8	22.0	16.7	28.5	37.5	596.6
	95	761.2	222.2	9.9	0.9	89.0	42.8	132.1	24.7	21.9	28.7	14.3	586.5
	52	711.8	219.2	9.5	2.6	106.4	52.4	133.5	36.5	31.4	28.8	12.5	632.8

FOREIGN CURRENCY STANDART DEVIATION=600

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	822.8	157.9	11.0	0.1	37.7	32.4	127.7	13.9	2.8	21.2	31.1	435.8
	760	803.1	176.8	11.0	0.0	37.8	29.2	122.6	14.2	2.1	23.0	29.8	446.5
	684	804.6	169.2	11.1	0.0	38.6	29.8	128.9	13.2	2.8	22.8	29.6	446.0
********>	581	846.2	194.9	11.7	0.0	42.5	30.4	125.9	16.0	5.3	24.8	29.8	481.3
	465	813.9	199.0	10.9	0.0	46.2	34.5	125.6	18.3	6.5	26.5	31.6	499.1
	349	820.6	208.9	10.7	0.5	56.4	42.2	132.6	19.3	10.2	26.9	34.2	541.9
	244	724.3	215.7	11.4	0.6	67.2	51.5	132.5	20.9	13.4	28.4	36.7	578.3
	159	737.2	216.5	10.8	1.5	74.8	57.7	132.7	23.8	17.0	28.6	38.3	601.7
	95	708.9	218.0	11.6	2.6	95.2	56.5	133.8	27.4	21.5	28.8	16.7	612.1
	52	800.0	228.4	10.3	2.7	111.4	60.1	133.4	31.9	34.9	28.9	15.0	657.0

FOREIGN CURRENCY STANDART DEVIATION=800

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	827.1	167.3	11.2	0.3	40.1	33.1	129.4	14.9	3.4	22.4	31.5	453.6
	760	803.7	186.3	11.6	0.0	40.0	31.3	124.7	14.9	2.7	24.3	31.0	466.8
	684	810.6	180.5	11.2	0.1	41.0	30.6	131.7	14.9	3.3	24.8	30.0	468.1
######>	581	842.2	199.2	12.6	0.1	45.5	35.1	126.8	16.9	6.1	25.6	31.8	499.7
	465	826.2	204.7	11.0	0.4	48.6	37.6	125.8	19.4	8.7	27.3	33.1	516.6
	349	825.7	213.0	10.9	1.1	60.2	49.9	133.0	19.2	11.3	27.4	36.8	562.8
	244	715.1	217.9	11.6	1.3	72.2	62.2	133.4	21.7	15.0	28.4	40.7	604.4
	159	742.7	216.7	10.9	1.8	77.5	64.3	132.8	24.6	17.3	28.5	40.8	615.2
	95	706.7	219.6	12.2	4.2	98.8	64.6	134.4	27.7	21.5	28.8	19.1	630.9
	52	805.2	228.3	10.7	3.6	113.2	65.6	133.4	32.9	34.2	28.9	16.3	667.1

FOREIGN CURRENCY STANDART DEVIATION=1000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	831.4	179.8	11.4	0.4	41.4	34.5	131.6	15.8	3.7	24.5	32.2	475.3
	760	804.3	192.3	11.7	0.0	42.2	33.2	126.1	16.2	3.7	25.6	31.7	482.7
	684	815.7	189.2	12.1	0.7	43.5	35.2	133.4	15.1	4.4	24.4	32.3	490.3
########>	581	838.5	202.0	12.7	0.3	47.2	39.3	127.2	17.0	6.7	26.5	34.3	513.2
########>	465	838.2	207.0	11.2	0.5	50.3	40.2	126.4	20.3	9.8	27.4	34.4	527.5
	349	830.4	215.6	10.9	1.7	63.8	57.2	133.7	19.9	12.4	27.7	39.9	582.8
	244	706.9	218.6	12.0	2.3	74.9	67.3	133.6	21.6	15.0	28.3	42.2	615.8
	159	747.4	217.3	11.3	2.5	80.5	71.0	133.0	24.7	18.1	28.5	42.6	629.5
	95	704.3	221.0	12.5	5.2	100.6	71.3	135.0	28.0	21.4	28.8	21.2	645.0
	52	809.2	228.6	10.8	4.9	115.0	70.9	133.4	32.8	34.2	28.9	17.2	676.7

FOREIGN CURRENCY STANDART DEVIATION=1400

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	840.1	196.8	11.7	1.0	42.9	37.9	135.0	17.1	5.7	27.2	33.0	508.3
	760	804.5	205.3	12.2	0.4	49.7	45.4	128.0	17.6	5.6	26.7	37.4	528.3
	684	829.6	200.9	12.5	0.9	45.8	41.6	136.0	16.5	5.9	25.7	34.7	520.5
	581	826.1	206.5	13.3	1.5	53.2	49.6	128.1	17.6	9.1	27.1	38.3	544.3
########>	465	858.9	215.7	11.7	1.6	57.6	53.4	127.8	20.5	12.0	28.0	39.8	568.1
	349	840.3	216.9	11.5	3.4	69.9	69.5	134.1	20.2	13.3	27.7	44.0	610.5
	244	689.1	230.9	12.9	4.7	79.1	81.6	136.6	21.5	15.5	28.6	46.1	657.5
	159	757.2	222.0	11.9	3.9	84.8	82.7	134.2	24.6	17.6	28.5	45.4	655.6
	95	698.9	228.2	13.9	6.8	101.4	78.3	136.8	28.4	21.4	28.8	21.7	665.7
	52	817.6	229.8	11.3	5.9	118.4	79.7	133.6	32.1	34.7	28.9	19.2	693.6

Appendix V.B - 9 : Results of Simulation Runs for Interbank Values of Standard Deviation of Central Bank Clearing Account.

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=0

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	814.7	189.1	11.8	0.8	41.4	40.1	133.8	15.7	5.2	26.5	35.2	499.6
760	818.3	196.9	12.6	0.5	39.9	37.3	127.3	14.9	4.7	26.4	34.1	494.6
684	822.2	190.5	12.4	0.4	40.4	37.1	132.9	13.8	4.5	25.0	33.6	490.6
581	761.6	207.3	13.5	1.4	49.5	50.8	128.5	15.2	7.1	27.0	39.7	540.0
########> 465	892.4	203.2	11.8	0.5	43.8	40.4	126.2	16.0	8.6	27.9	35.0	513.4
349	808.1	215.7	11.6	2.0	58.1	58.8	134.6	14.8	8.9	28.2	41.9	574.6
244	690.7	217.2	12.8	1.9	65.1	65.1	133.3	14.5	9.1	28.3	43.0	590.3
159	792.8	211.8	11.9	1.9	66.4	59.6	131.8	16.3	10.1	27.8	38.5	576.1
95	723.4	216.8	13.5	2.9	83.2	52.8	134.5	18.7	12.5	28.5	16.7	580.1
52	769.8	229.1	12.1	3.5	99.5	63.6	133.8	24.5	22.4	28.6	16.8	633.9

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=100

OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
800	818.8	189.1	11.8	0.7	41.6	40.9	133.3	15.8	5.2	26.6	35.8	500.8
760	817.7	198.3	12.6	0.5	39.8	36.9	127.5	14.9	4.6	26.7	34.0	495.8
684	824.3	193.5	12.5	0.6	40.2	36.6	133.4	13.6	4.5	25.2	33.2	493.3
581	769.0	208.3	13.5	1.4	49.0	50.4	128.7	15.4	7.1	27.0	39.7	540.5
########> 465	890.7	205.1	11.8	0.5	45.5	43.1	126.2	16.2	8.7	27.9	36.4	521.4
349	813.1	215.2	11.6	2.0	57.4	59.3	134.5	15.0	8.9	28.3	42.6	574.8
244	689.9	218.5	12.9	1.9	65.4	64.1	133.6	14.7	9.1	28.2	42.2	590.6
159	790.1	211.8	11.9	2.0	68.1	55.2	131.8	16.3	10.3	27.8	33.8	569.0
95	719.9	218.1	13.7	3.1	88.9	68.2	134.9	20.6	13.1	28.5	28.3	617.4
52	774.2	231.4	12.2	3.8	106.1	72.0	134.5	28.1	25.3	28.7	21.8	663.9

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=200

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	851.0	208.7	14.1	1.5	46.7	51.7	129.4	12.7	4.3	26.8	40.6	536.5
********>	760	896.4	181.7	10.8	0.2	40.3	39.0	125.5	15.3	5.5	23.8	35.5	477.6
	684	790.1	203.4	12.6	1.4	45.7	45.1	132.4	14.5	5.3	26.8	37.2	524.4
	581	812.4	203.8	11.8	1.2	44.4	43.6	124.2	14.7	7.1	26.5	36.3	513.6
	465	862.3	203.4	10.3	1.2	46.0	44.3	121.5	16.8	9.1	27.0	36.5	516.1
	349	810.4	212.7	11.3	1.4	54.5	51.3	129.0	17.0	9.4	28.3	38.8	553.7
	244	783.8	209.1	12.4	2.0	65.1	58.2	133.6	15.1	9.6	28.5	37.9	571.5
	159	829.9	221.4	12.6	2.6	71.7	60.9	126.3	20.1	11.9	28.3	37.8	593.6
	95	734.9	224.1	14.4	4.2	83.9	59.9	133.5	21.6	14.3	28.6	24.1	608.6
	52	733.2	235.3	13.4	4.3	99.7	73.1	130.8	30.0	26.6	29.0	19.7	661.9

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=300

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	825.1	188.1	11.8	0.6	41.4	40.8	132.9	16.0	5.7	26.3	35.2	498.8
	760	814.9	202.0	12.6	0.5	41.8	38.9	128.2	15.6	4.8	26.5	34.8	505.7
	684	827.1	198.3	12.4	0.7	40.5	36.4	134.0	14.2	4.6	25.9	32.8	499.8
	581	781.9	207.5	13.5	1.2	50.3	50.3	128.6	15.6	7.5	26.9	39.1	540.5
*******>	465	885.9	209.0	11.8	0.5	48.1	43.7	126.5	16.7	8.8	27.9	36.7	529.7
	349	821.0	211.1	11.7	2.0	60.4	57.8	133.6	15.3	9.3	27.8	39.8	568.8
	244	686.2	220.3	12.9	2.4	70.3	65.6	134.1	16.1	10.0	28.3	40.4	600.4
	159	784.3	216.2	12.0	2.3	75.7	62.8	132.6	21.7	12.0	27.9	37.8	601.0
	95	715.0	221.3	13.6	4.8	97.7	70.7	135.3	25.1	16.2	28.6	23.4	636.7
	52	786.1	232.4	12.1	4.3	112.4	72.7	134.6	31.8	30.6	28.9	18.3	678.1

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=400

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	839.2	187.8	12.1	0.9	41.3	41.0	127.7	15.7	4.5	26.0	35.7	492.7
	760	876.9	194.6	12.0	0.4	42.1	37.3	124.3	15.5	4.7	25.8	33.4	490.1
********>	684	919.2	186.1	11.8	1.3	46.0	45.5	124.5	15.7	6.9	24.5	37.4	499.7
	581	795.8	201.1	13.7	2.1	50.3	53.2	132.1	14.8	6.7	25.4	40.0	539.4
	465	812.5	212.7	11.8	1.0	53.9	52.8	129.2	17.6	9.6	28.2	39.6	556.4
	349	752.7	219.9	13.3	2.2	60.0	56.9	131.9	18.3	10.3	28.2	40.0	581.0
	244	777.0	226.2	12.1	2.4	70.6	67.6	134.1	21.1	13.7	28.7	42.2	618.7
	159	816.3	219.0	11.5	2.9	75.9	64.3	133.1	23.1	14.4	28.2	40.1	612.5
	95	835.2	222.0	10.8	3.2	86.4	49.3	130.7	27.2	19.3	28.6	17.0	594.5
	52	771.8	223.8	12.6	4.3	111.9	70.9	130.0	31.2	29.8	29.0	16.9	660.4

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=500

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	830.6	194.8	11.9	1.0	42.2	41.1	134.6	16.2	5.9	26.6	35.1	509.4
	760	810.8	205.6	12.6	1.0	45.2	41.4	128.5	16.4	5.2	26.7	35.7	518.3
	684	831.2	189.2	12.2	0.3	41.2	37.0	133.2	14.8	4.6	24.8	33.3	490.6
	581	793.9	207.8	13.5	1.1	50.3	48.7	128.5	15.8	7.6	27.1	37.5	537.9
********>	465	880.3	213.8	11.8	1.2	52.7	47.6	127.1	17.5	9.7	27.9	37.8	547.1
	349	827.6	212.9	11.7	2.3	66.6	65.4	133.9	16.3	11.0	27.6	42.5	590.2
	244	684.4	223.4	12.8	3.0	74.5	73.6	134.8	18.2	11.9	28.4	43.3	623.9
	159	778.2	217.9	11.9	3.0	80.3	72.8	133.6	23.6	13.6	28.1	42.1	626.9
	95	710.1	224.7	13.9	5.4	99.6	74.7	136.4	27.2	18.2	28.8	22.9	651.8
	52	798.0	232.6	12.2	5.6	114.3	76.0	134.6	32.6	32.0	28.9	18.7	687.5

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=600

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	841.6	195.9	12.4	0.8	45.4	43.7	126.3	15.7	4.7	26.6	36.7	508.2
	760	764.5	205.0	12.8	1.8	47.2	47.2	127.8	15.9	6.1	26.9	37.7	528.4
	684	837.1	205.0	12.1	1.5	49.0	47.8	130.5	18.6	6.6	26.8	38.5	536.4
	581	774.6	203.7	12.5	2.2	53.3	51.3	131.6	19.1	7.9	27.3	39.0	547.9
********>	465	914.6	203.8	10.8	0.9	50.1	42.3	129.2	19.5	9.3	27.2	34.9	528.0
	349	800.3	217.8	12.0	2.9	61.8	62.4	135.8	18.2	11.5	28.2	40.9	591.5
	244	662.9	231.3	14.9	5.8	81.7	84.1	138.9	19.8	13.2	28.6	46.3	664.6
	159	719.7	233.8	13.6	4.7	76.7	76.9	129.7	21.6	16.4	28.6	43.2	645.2
	95	746.2	224.8	12.5	4.3	95.0	67.6	130.8	26.1	19.8	28.9	21.2	631.0
	52	755.8	227.8	12.0	5.3	107.7	80.0	135.3	32.9	29.2	28.9	18.2	677.3

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=700

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	836.9	196.7	11.9	1.0	42.9	40.9	134.6	16.6	6.2	27.2	34.7	512.7
	760	808.4	208.8	12.6	0.7	48.6	45.1	128.6	17.2	5.9	26.7	37.1	531.3
	684	832.8	200.6	12.6	0.8	43.7	41.1	135.2	15.4	5.4	26.0	34.8	515.6
	581	807.5	208.7	13.5	2.2	55.1	53.1	128.6	17.3	9.0	27.3	39.6	554.4
********>	465	876.0	215.2	11.8	1.5	56.4	53.3	127.4	19.2	10.9	28.0	39.7	563.4
	349	837.6	216.2	11.7	3.4	68.8	68.5	134.5	18.6	12.1	27.8	43.6	605.2
	244	682.7	230.9	13.1	4.1	77.7	79.7	136.4	19.8	13.7	28.6	45.2	649.2
	159	770.9	221.0	11.9	2.9	84.1	79.9	133.8	24.3	15.1	28.3	44.3	645.6
	95	703.9	228.5	14.2	6.1	101.0	78.0	137.1	28.5	20.1	28.8	22.5	664.8
	52	809.0	233.1	12.3	5.9	115.4	78.0	134.6	32.8	33.7	28.9	18.4	693.1

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=800

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	752.6	214.7	12.2	1.2	43.5	44.6	133.6	16.6	5.2	27.8	36.7	536.1
	760	849.2	201.8	11.5	0.8	43.4	44.2	126.1	18.7	6.4	26.4	36.6	515.9
	684	612.4	216.9	14.3	3.4	57.5	62.8	135.7	15.8	6.4	27.9	43.6	584.3
*******	581	893.3	203.2	10.8	0.9	51.5	48.8	129.3	17.1	8.2	28.2	38.2	536.2
	465	817.7	213.7	12.1	2.7	61.9	62.1	128.4	19.7	10.7	28.1	42.5	581.9
	349	841.8	218.8	12.2	4.1	66.1	63.8	130.8	20.9	13.0	28.4	42.9	601.0
	244	833.3	219.8	11.8	3.9	71.6	68.4	126.0	24.6	15.3	28.3	43.0	612.7
	159	741.2	219.9	11.5	4.0	85.2	83.8	136.7	23.7	18.1	28.8	45.8	657.5
	95	670.1	228.4	13.3	5.8	97.7	73.6	135.7	26.1	19.5	28.9	22.4	651.4
	52	758.3	230.9	12.6	6.3	117.4	85.2	133.7	36.9	31.7	28.9	20.0	703.6

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=1000

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	800	845.4	202.3	12	1.1	46	43.1	136.3	17.5	7.3	27.6	35.1	528.3
	760	805	210.7	12.5	2	51.1	47.8	129	18.8	6.4	27	37.7	543
	684	838.3	206.6	12.4	1	47.5	45.8	136.7	17.6	6.7	26.9	37	538.2
	581	825.1	208.3	13.3	2.3	57.1	56.2	128.7	17.5	10	27.1	40.6	561.1
********	465	867.7	219.9	12	2.7	61	61.5	128.9	20.6	12.7	28	42.9	590.2
	349	849.2	221.3	11.8	5	71.2	73	135.8	21.5	14.8	28.1	45.1	627.6
	244	679.6	237.2	13.3	5.9	78.9	86	137.5	21.7	15.8	28.6	47.6	672.5
	159	758.2	224.5	12.2	4.9	86.5	89.2	134.8	25.1	17.9	28.5	47.4	671
	95	693.9	231.9	14.3	7.5	101.6	82.1	137.5	29.2	21.7	28.8	22.7	677.3
	52	825	232	12.1	6.5	117.9	82.8	134.2	32.7	34.8	28.9	19.4	701.3

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=1200

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
********>	800	841.7	203.3	12.0	3.0	55.7	57.6	132.7	21.3	8.4	27.1	42.3	563.4
	760	761.6	219.4	12.5	2.6	57.3	59.1	130.9	19.2	8.0	27.9	43.3	580.2
	684	799.2	216.8	12.6	2.8	55.1	56.1	131.3	19.8	9.4	27.9	40.7	572.5
********>	581	826.6	213.4	11.3	2.6	61.6	62.3	128.6	21.2	10.6	27.7	43.6	582.9
	465	717.3	220.2	12.9	5.6	69.9	72.7	136.2	22.0	12.1	28.6	45.8	626.0
	349	779.0	218.0	11.9	5.5	76.0	78.3	134.5	24.4	16.0	28.8	47.4	640.8
	244	703.1	230.9	12.4	5.9	81.6	87.8	135.1	22.8	16.4	28.7	48.4	670.0
	159	750.9	226.9	12.7	5.4	88.2	93.4	137.2	25.4	19.9	28.9	48.2	686.2
********>	95	839.0	227.1	13.3	5.0	92.1	65.7	129.2	28.9	23.6	28.9	21.4	635.2
	52	829.7	238.6	12.4	7.2	116.5	89.8	133.6	37.8	34.0	28.9	20.6	719.4

CENTRAL BANK CLEARING ACCOUNT STANDART DEVIATION=1400

	OPTIMUM	PROFIT	BRAN->TL	FC->TL	SEC->TL	INT->TL	OTH->TL	TL->BRAN	TL->FC	TL->SEC	TL->INT	TL->OTH	TOTAL#
	1000	747.8	214.6	12.1	1.5	51.8	51.6	126.0	17.4	5.2	27.3	40.3	547.8
	950	778.9	205.4	13.4	2.5	52.3	57.7	131.7	15.0	5.8	26.6	42.3	552.7
	855	791.8	221.6	13.4	3.5	55.3	62.1	130.0	17.6	7.8	27.9	44.8	584.0
********>	727	869.1	220.0	12.3	1.9	48.5	53.2	134.5	22.2	9.6	28.1	39.8	570.1
	581	737.4	224.7	12.8	4.8	63.8	71.2	133.7	21.4	12.3	28.3	46.9	619.9
	436	776.2	223.5	12.5	6.2	72.9	79.5	130.2	23.8	16.0	28.5	49.0	642.1
	305	805.2	226.7	12.6	5.5	70.2	74.0	133.9	24.2	16.5	28.2	45.9	637.7
	198	845.9	226.6	12.9	5.7	79.9	84.6	132.7	25.6	17.6	28.4	47.9	661.9
	119	772.1	226.9	12.6	7.2	88.9	97.6	138.9	28.5	22.2	28.9	47.9	699.6
	65	927.5	226.7	10.3	5.5	107.4	75.2	136.1	34.1	29.3	28.7	19.8	673.1

BIBLIOGRAPHY

1. Archer, S.H. "A Model for Determination of Firm Cash Balance". Journal of Financial and Quantitative Analysis 1, March 1966, pp.1-11

2. Baumol, W.J, "The Transaction Demand for Cash: An Inventory Theoretic Approach", Qarterly Journal of Economics, LXVI, Nov.1952

3. Beranek, W., Analysis for Financial Decisions, Homewood, ILL.1963, pp.345-87

4. Calman, R.F., Linear Programming and Cash Management / CASH ALPHA, Cambridge, Mass. MIT. 1968

5. Constantinides, G.M. and S.F. Richard, "Existence of Optimal Simple Policies for Discounted-Cost Inventory and Cash Management in Continous Time", Operations Research, Vo. XXVI, No. 4 , 4 July-August, 1978

6. Eppen, G.D. and E.F. Fama, "Solutions for Cash Balance and Simple Dynamic Portfolio Problems", Journal of Business, Vo. XVI, 1968, pp. 94-113

7. Eppen, G.D. and E.F. Fama, "Cash Balance and Simple Dynamic Portfolio Problems with Proportional Costs", International Economic Review, Vol. X, No.2 , June 1969, pp. 119-133

8. Euromoney, International Finance Yearbook, 1987 Edition, Euromoney Publications, London 1987

9. Girkis, N.M., "Optimal Cash Balance Levels", Management Science, Vol. XV, No. 3 , November 1968, pp. 130-140

10. Kaufman, D.J. Jr. and D.R. Lee, "Planning Liquidity", Magazine of Bank Administration, Feb. 1977

11. Miller, H.M. and D. Orr, "The Demand for Money by Firms: Extention of Analytical Results", Journal of Economics 80, 1966

12. Miller, H.M. and D. Orr, "The Demand for Money by Firms", Quarterly Journal of Finance, Vo. XXIII, Dec. 1968

13. Neave, E.H. "The Stochautic Cash Balance Problems with Fixed Cost for Increases and Decreases, Management Science, Vol. XVI, pp.472-1490, March 1970

14. Orgler, Y.E., Cash Management, Calif. : Wadsworth Publishing Co., 1970

15. Riehl, H. and R.M. Rodriguez, "Foreign Exchange and Money Markets",Mc. Graw H.K., New York 1983

16. Robinchek, A.A., D. Terchrow, and J.M. Jones, "Optimal Short Term Financial Decisions", Management Science, Vo. XII, Sept. 1965, pp. 1-36

17. Sethi, P.S. and G.L. Thompson, "Applications of Mathematical Control Theory to Finance: Modelling Simple Dynamic Cash Balance Problems", Journal of Quantitative Analysis, No. 12, 1970

18. Stigum, Marcia, Managing Bank Assets and Liabilities, Dow Jones - Irwin, Homewood, ILL. 1983

19. Stigum, Marcia, Money Market Calculations, Dow Jones - Irwing, Homewood, ILL. 1981

20. Tobin, J., "The Interest Elasticity of Transactions Demand for Cash", Review of Economics and Statistics, XXXVIII, August 1956.

21. Vial, J.P. "A Continous Time Model for Cash Balance Problem", Mathematical Methods in Investment and Finance, North Holland, 1972

22. White, D.J. and J.M. Norman, "Control of Cash Reserves", Operational Research Quarterly 16, No. 3 , Sept. 1965

23. Whithin, T.M., The Theory of Inventory Management Princeton, University Press, 1953

LIQUIDITY MANAGEMENT SIMULATION MODEL

by

Mustafa Akan

B.S. in Electrical Engineering, Robert College, 1971
M.A. in Business Administration, Boğaziçi University, 1973

Submitted to the Institute for Graduate Studies in Social Sciences in partial fullfillment of the Requirements for the degree of

Doctor

of

Philosophy

Boğaziçi University

Spring, 1988