A MODEL FOR THE EFFICIENT INVESTMENT OF TEMPORARY FUNDS BY CORPORATE MONEY MANAGERS

DISSERTATION

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By

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In this study seventeen various relationships between yields of three-month, six-month, and twelve-month maturity negotiable CD's and U.S. Government T-Bills were analyzed to find a leading indicator of short-term interest rates.

Each of the seventeen relationships was tested for correlation with actual three-, six-, and twelve-month yields from zero to twenty-six weeks in the future.

Only one relationship was found to be significant as a leading indicator. This was the twelve-month yield minus the six-month yield adjusted for scale and accumulated where the result was positive. This relationship held for CD's only and resulted in an R^2 of .715716 when leading the actual three-month yield by thirteen weeks.

This indicator (variable nineteen in the study) was further tested for usefulness as a trend indicator by transforming it into a function consisting of +1 (when its slope was positive), 0 (when its slope was zero), and

-1 (when its slope was negative). The actual three-, six-, and twelve-month yields were transformed in a like manner, then compared to variable nineteen for incidence of like signs.

When tested against the modified three-month data variable nineteen (transformed) had like signs .6666 of the time. This is significant at the .999+ level.

Stage II of the study consisted of constructing a computer-aided model employing variable nineteen as a forecasting device. The model accepts a week-by-week minimum cash balance forecast, and the past thirteen weeks' yields of three-, six-, and twelve-month CD's as input.

The output of the model consists of a cash time-availability schedule, a numerical listing of variable nineteen values, the thirteen-week history of three-, six-, and twelve-month CD yields, a plot of variable nineteen for the next thirteen weeks, and a suggested investment strategy for cash available for investment in the current period.

The model was tested against three investment strategies:

1) Buy all shortest available.

2) Buy longest for which cash available.

3) Buy maturity with current highest yield.

The test was made over a twenty-six-week period, using actual CD yields and comparing profit indexes.

$$P = Y(0)n(0) - Y(i)n(i)$$

where:

P = Profit index

Y(0) = Yield in period 0

n(0) = Weeks to maturity in period 0

Y(i) = Yield in period i

n(i) = weeks to maturity in period i.

The instruments were assumed to be purchased at a discount to mature at face value. This is true for T-Bills but not actually for CD's.

The model only slightly out-performed the other strategies, but this may be explained by the simplicity of this first model and the fact that the calculated model strategy was not tempered with use of information provided by the plot of variable nineteen. The model strategy was based solely on the regression line of the variable and did not take advantage of indicated peaks or valleys.

A more complex model is now being developed which will be capable of a more accurate use of variable nineteen and which will also maintain week-to-week running records of investments and changes in cash position.

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CHAPTER I

INTRODUCTION

Today's manager of large cash accounts is under pressures brought about by two very strong forces, inflation and high short-term interest rates.[1]

Because of a high rate of inflation, idle cash balances experience a constant eroding of their real value. Because of high short-term interest rates there is an opportunity for very profitable investment in money market instruments.[2]

Beginning in the late thirties and continuing into the mid-fifties of this century neither the inflationary

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[1]The Consumer Price Index has risen to 144 in April, 1974 from 130.7 the year before and 100 in 1967. Bureau of Labor Statistics, as reported in Business Week (May 25, 1974), 1.

[2]In this study short-term is defined as a period of less than or equal to one year. The "Money Market" refers to a group of markets for short-term credit instruments such as Treasury bills, commercial paper issued through dealers, or issued directly, banker's acceptances, negotiable certificates of deposit, repurchase agreements, and Federal funds. Instruments of the Money Market, Federal Reserve Bank of Richmond (Richmond, Virginia, August, 1970) pp. 5-6.

pressure nor the profit opportunity existed to the extent to which they do today. Figure 1 illustrates this fact rather clearly. Fortunately, the opportunity for profit that accompanies the inflationary pressure provides the skillful money manager a means of combatting the one with the other.

During periods of relative economic stability, when both interest rates and inflation rates are low, the money manager is primarily concerned with planning for the liquidity needs of his firm and providing for the safety of the funds entrusted to his care. Idle funds are not in danger of shrinking in real value and complex short-term investment strategies are hardly worthwhile for the low returns available.

These conditions have not existed, however, since the Eisenhower years. Today the money manager must employ all the skill he possesses in the management of his company's cash and financial assets. Poor judgment used in short-term investment can result in capital losses, as will be shown in Chapter II, and idle balances simply lose purchasing power.

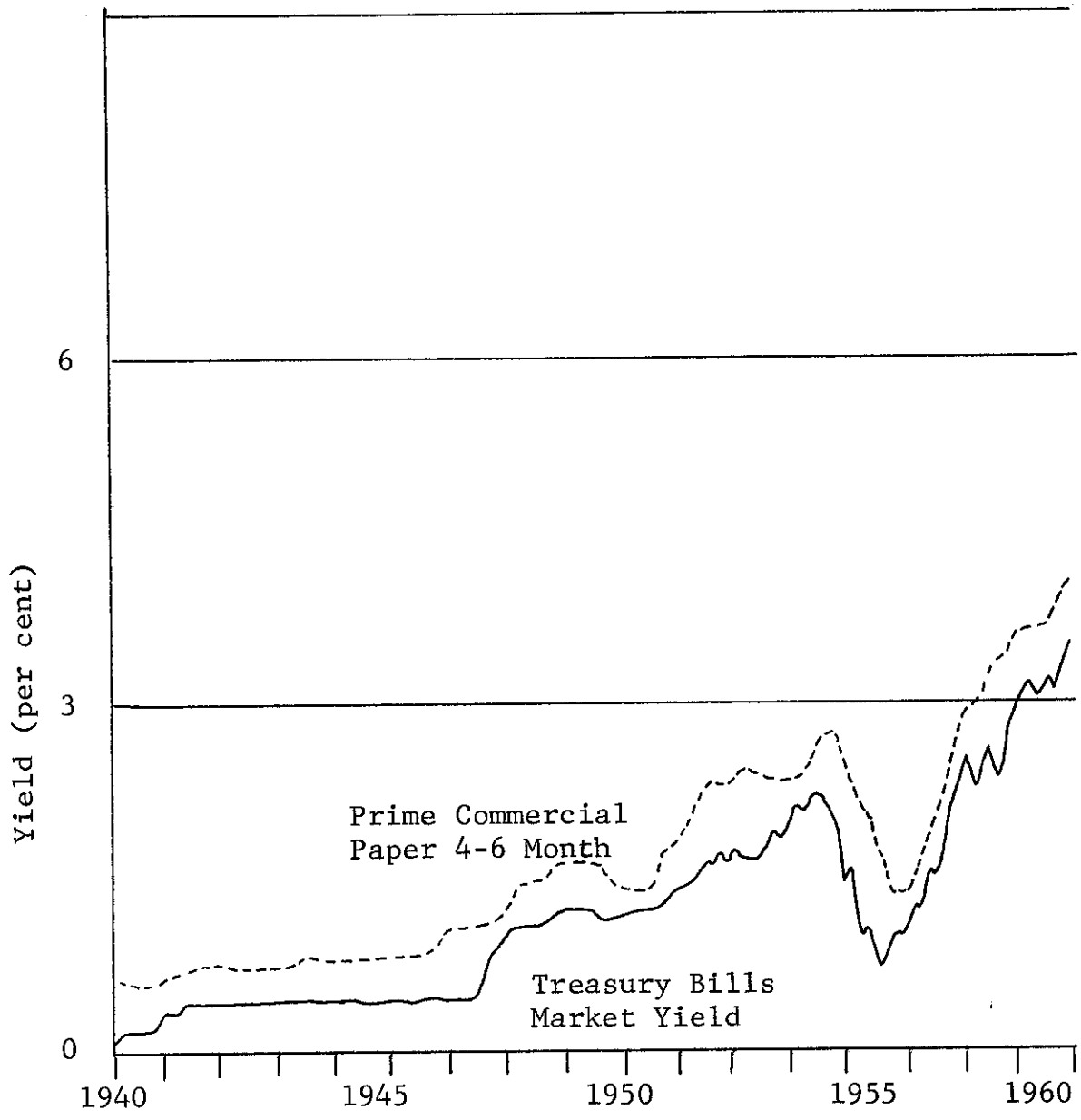

Figure 1--Short-Term Interest Rates

Source: Historical Chart Book, Federal Reserve Board.

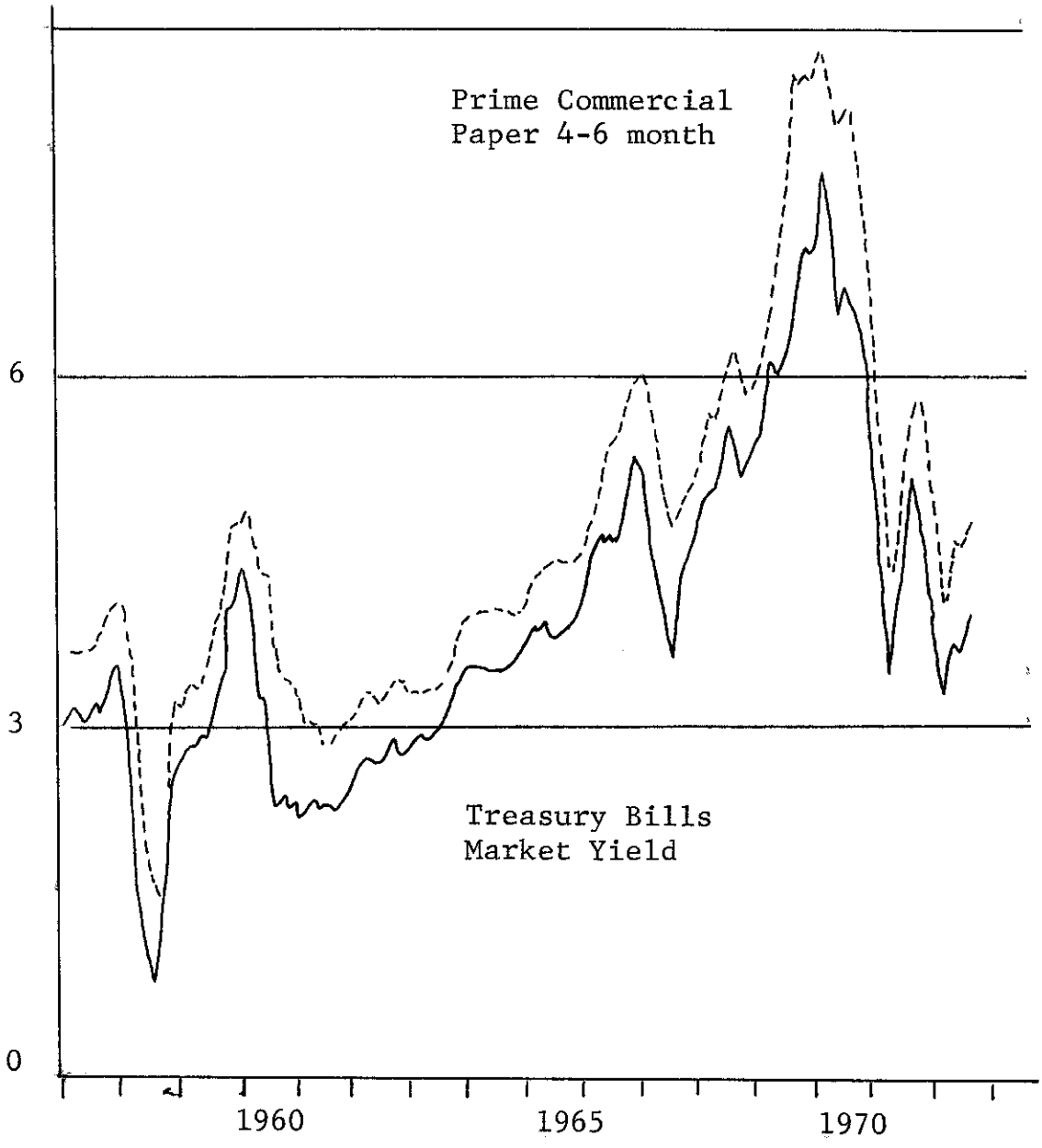

Figure 1--Short-Term Interest Rates--Continued

The objective of this study is to construct a computer-aided model which will assist a money manager in selecting an optimum short-term investment strategy consistent with the projected liquidity needs of his firm and his own risk standards.

This objective is achieved by providing a leading indicator for short-term interest rates, converting a cash forecast into a time-availability schedule, and applying an optimum search technique to the resulting figures.

The model is designed so that the leading indicator is displayed graphically and numerically so that the manager may apply his own judgment and intuition to temper the investment strategy suggested by the model. This will be further explained in Chapter IV, which deals with the actual details of the model.

The advantages of using this model are 1) the manager is relieved of the drudgery of the mathematics involved, 2) the manager is forced to consider possible short-term fluctuations in interest rates, 3) the manager is provided with a picture (graph) of recent rates plus a graph of the leading indicator. He may compare these and modify the model's suggested strategy. In addition to the

added advantage of rapid calculation, the model provides the flexibility for adding a more accurate leading indicator when one is available.

The options available to a money manager, so far as the investment of temporarily idle funds is concerned, are many. His first option is, of course, to allow the funds to remain idle. The disadvantages of this strategy have already been discussed. He may also opt to purchase only very short maturities in order to protect himself against price drops. Of course, with this strategy, he will fail to avail himself of profits occurring due to price rises (interest rate declines). Another strategy he might employ is to buy the longest maturities for which he has funds available. He may purchase the maturity with the highest current yield or he may follow a mixed strategy and combine two or more of the above as conditions warrant.

The model developed in this study employs a mixed strategy. Depending on current yields, the time-availability of funds, and the predicted short-run behavior of yields, the model selects maturities which are apparently the most profitable. The criterion used to judge the success of the model is very simple. If the selections of

maturities based on the model results are more profitable than the selections made on the basis of the second, third and fourth strategies in the above paragraph, the model is obviously successful.

The key to the performance of the model is its ability to accurately predict short-term interest rate trends. Given the accuracy of the forecast it is very easy to show that the strategy employed by the model is optimal. It was in search of such a forecasting indicator that more than half the research of this study was conducted.

The expectations theory holds that long-term interest rates are simply the average of expected short-term rates.[3] For example, if the current yield of an instrument maturing six months in the future is 5 per cent and the current yield of an instrument of the same class maturing three months in the future is 4 per cent, the expected yield of a three-month maturity instrument three months hence is expected to be 6 per cent, thus causing the yields of the two maturities to be equal over the six-month period.

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[3]Friedrich A. Lutz, "The Structure of Interest Rates," Quarterly Journal of Economics, LV (1940), 37.

$$(.05) \text{ X } 1/2 = (.04) \text{ X } 1/4 + (x) \text{ X } 1/4$$

$$4 \text{ X}((.05) \text{ X } 1/2 - (.04) \text{ X } 1/4) = x$$

$$x = .06$$

According to Richard Roll,

> If the pure expectations hypothesis is correct the expected return from holding any default-free bond for one period is the current short-term rate and is completely independent of the maturity of the bond. ... The pure expectations hypothesis assumes that investors are indifferent to risk associated with maturity and, if the risks on all bonds are equal, the expected returns must be equal over any holding period.[4]

There are some interesting implications of this theory that suggest that it may be used in some way as a "short cut" forecasting device. A money manager would certainly need a simple forecasting model if he were to make short-term, say weekly, forecasts. Otherwise the cost and complexity of the model could destroy its usefulness.

Essentially three methods are used by capital market observers to predict or forecast interest rates. These are 1) excogitation, 2) extrapolation, and 3) sources and uses analysis.[5]

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[4]Richard Roll, The Behavior of Interest Rates (New York, 1970), p. 37.

[5]Murray E. Polakoff, Financial Institutions and Markets (Boston, 1970), p. 464.

The first of these, excogitation, is merely the act of reflecting upon the economic climate, current and anticipated business trends, and current and anticipated governmental action, and their effects on the demand for funds in the future. Since interest rates generally tend to rise with increasing business activity, and fall with decreasing activity, the forecaster attempts to project the business cycle and make inferences concerning interest rate trends. The method is qualitative rather than quantitative, and more art than science. The success achieved by the forecaster using excogitation depends on his intuition, wisdom, and judgment.

Figure 2 shows an historical comparison between the Federal Reserve Board Index of Industrial Production and yields on four-to six-month prime commercial paper. The general relationship between the two since 1951 indicates that the trends in interest rates could have been forecast with some degree of accuracy given an accurate forecast of business activity. Note that, except for counter-movements in 1954 and 1955, the index and commercial paper yields tended to move together.

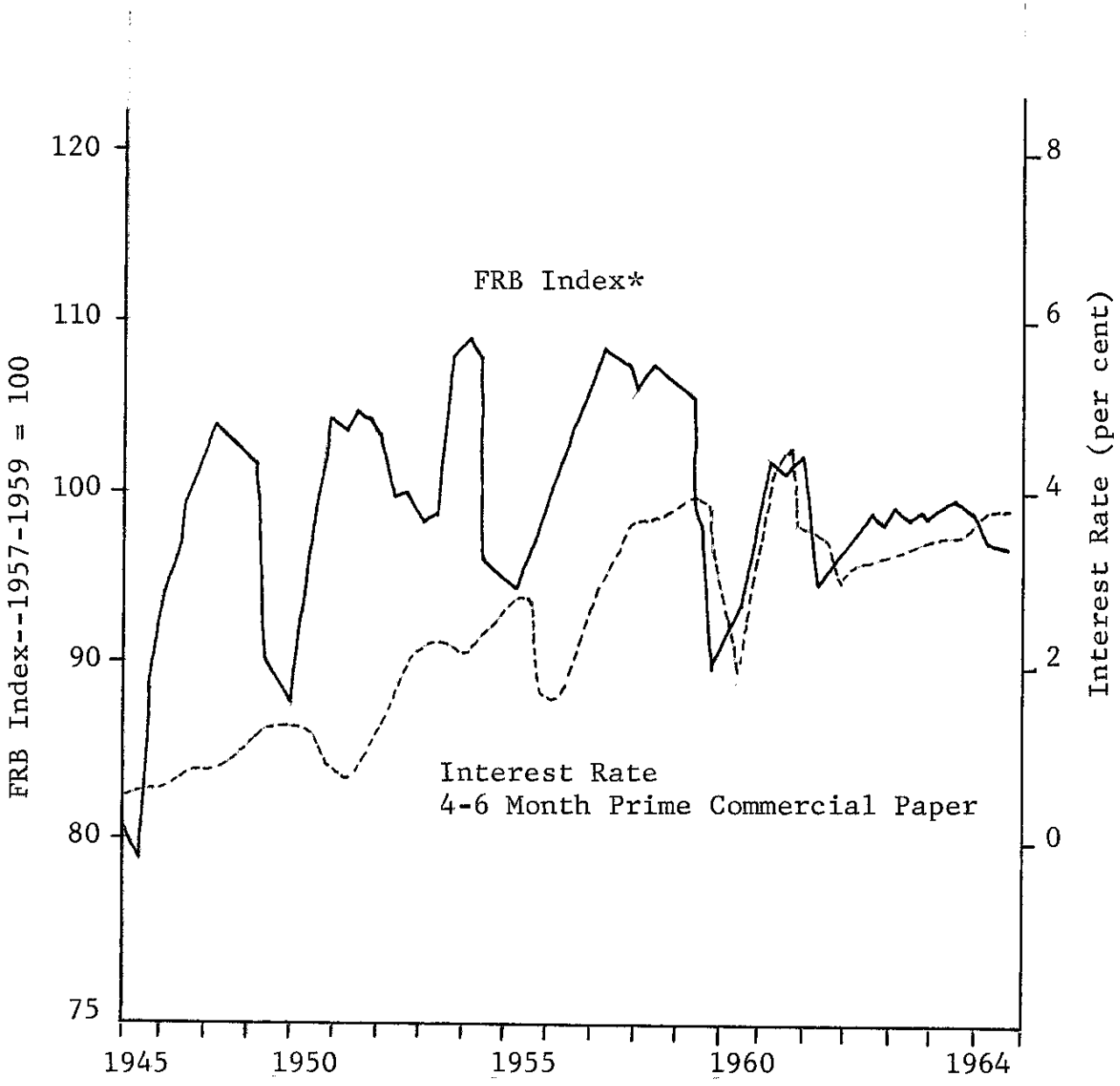

Figure 2--FRB Index and 4-6 Month Commercial Paper Yields

Source: William C. Freund and Edward D. Zinbarg based on Federal Reserve Data.

*Actual index as per cent of 5-year moving average, centered.

Extrapolation is a more mechanical method of forecasting. It is merely the projection of historical trends into the future. Naturally this method does not lend itself to the prediction of very short-term cycles. Obviously, any method of forecasting interest rates must be capable of short-term prediction in order to be of use to a money manager investing in short-term instruments.

Sources and uses analysis attempts to forecast all the factors making up the two sides of the financial market: the demand for and the supply of funds.

The Federal Reserve has developed a system which accounts for the flow of funds (supply and demand) through the financial markets on a quarterly basis and adjusts for recurring seasonal fluctuations.[6] Based on the statistics furnished by the Flow of Funds statement, other institutions such as Bankers Trust Company, Salomon Brothers and Hutzler, and the Life Insurance Association of America construct financial and investment "outlooks."[7]

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[6]William C. Freund, "An Appraisal of the Sources and Uses of Funds Approach to the Analysis of Financial Markets," Journal of Finance, (May, 1958), 275-294.

[7]William F. Butler and Robert A. Kavesh, editors, How Business Economists Forecast (New Jersey, 1966), 131.

Interest-rate forecasts based on flow of funds tabulations still require the forecaster to estimate economic activity. For example, the outlook for mortgage financing can ge gauged only by estimating construction activity and then adjusting for cyclical and secular changes in loan-to-value ratios.[8]

Forecasting models based on flow of funds analysis tend to be quite complex. The Dawson model, for example, incorporates twenty-six variables. Eleven of these variables are exogenous and include such items as new durable goods expenditures by households, consumer net income, corporate net income, federal government net income, and net income of the insurance sector. Fifteen of the variables are endogenous and include average interest rate of government and corporate securities, demand for additional corporate securities by consumers, and supply of and demand for additional mortgages, among others.[9]

The author believes that a cash manager may take advantage of the results of the sophisticated models, such as the Dawson, and the wisdom and judgment of experienced

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[8]Polakoff, op. cit. p. 480

[9]John C. Dawson, "A Cyclical Model for U.S. Financial Markets," American Economic Review XLVII (May, 1957), 187-219.

and knowledgeable money market analysts by simply observing the behavior of yield differentials between different maturities of the same class of instrument.[10]

The Dow theory takes essentially the same view of the forecasting of stock market averages. The basis for the Dow theory is that the stock market is its own best barometer and that current, relevant information is discounted by buyers and sellers in the market well before actual events take place.[11] If it is possible to forecast stock market trends with some degree of accuracy based on past behavior of particular groups of stocks, it certainly seems reasonable to believe that an even higher degree of accuracy could be attainable using the same sort of approach to the forecasting of yields. After all, there are no money market instruments that "buck the trend." Figure 1 shows that Treasury bills and prime commercial paper, two very different classes of money market instruments, have followed essentially the same trends since World War II.

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[10]The "same class" of instrument means instruments issued by the same institution or agency and having the same legal status. For example, a 91-day T-bill and a 182-day T-bill are of different maturities but are of the same class.

[11]John C. Clendenin and George A. Christy, Introduction to Investments (New York, 1969), p. 245.

Current interest rates or yields represent a consensus between lenders and borrowers of the appropriate "price" of money. This price reflects current demand and availability as well as expectations for the future and "discountable" information. Based on this the following hypothesis is stated.

> All available information pertaining to future behavior of money market yields is reflected in current behavior of these yields. Specifically, the expectations of borrowers and lenders are manifest in current yield differentials between varying maturities of the same class of instrument. Furthermore, the relationships may be used to predict future short-term trends in yields.

In Chapter III a leading indicator of short-term interest rates based purely on yield differentials is developed. In the same chapter the pure expectations theory is examined as a useful indicator.

In Chapter IV the leading indicator, the optimum strategy, and several bookkeeping routines are combined into the investment model. Chapter V reports on the results of the model and its performance.

The last chapter in the study deals with recommendations for further study and possible refinements of the existing model.

CHAPTER II

SHORT-TERM INVESTMENT STRATEGY

A rational money manager is concerned with three things when plotting a management or investment strategy. He is, of course, primarily concerned with the safety of the funds with which he is intrusted. Equally, he is concerned with providing for his firm's liquidity needs. A third concern is the profitable investment of idle cash balances.[1]

The first of these concerns, safety, refers to the objective of minimizing risk. This includes risk of default of the issuer, purchasing power loss due to inflation, and interest rate risk when the value of an instrument drops due to a rise in interest rates.[2]

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[1]T. C. Committe, Managerial Finance for the Seventies, (New York, 1972), pp. 211-216.

[2]The four "risks" are purchasing-power risk, generally referred to in terms of the uncertain purchasing power of income derived from investments. It is not a function of investment instruments but of the value of the dollar. Interest-rate risk, is a function of the change in interest rates. A fixed-return security purchased when rates are low loses value when rates rise. Market risk takes the form of a decline in the investment value of a security

The risk of default, or financial risk, may be controlled by the manager's selection of investment instruments. United States Treasury Bills, for example, may be assumed to have no risk of default. However, since part of the interest paid on a loan is a premium for default risk,[3] these instruments normally yield less than most others. Consequently, an objective of maximum profit would be somewhat compromised when achieving minimum financial risk.

The risk of purchasing power loss and interest rate risk are not so easily controlled by the manager. They may be minimized only with accurate forecasting and the use of effective investment strategy.

In order to provide for his firm's liquidity needs, the money manager should assure that instruments he purchases are easily marketable. The maturity profile of his investment portfolio should be planned so that cash is

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that is not a function of the change in the business prospects of the issuer. This risk does not apply to fixed-return securities. The last risk is Financial risk and refers to the risk that the issuer of a security will not be able to meet the financial claims against him. This risk is assumed to be non-existent in the case of government securities. Committee, op. cit. pp. 351-354.

[3]George A. Christy and P.F. Roden, Finance: Environment and Decisions (San Francisco, 1973), p. 68.

available when its need is planned. In addition, the forced sale of instruments before maturity should not cause undue capital loss because of changes in interest rates. Unforeseen opportunities and contingencies can often cause a sudden need for cash.

The strategy that is employed in this study seeks to minimize all the above risks while maximizing investment profits.

Stated generally, the strategy is quite simple and is apparent to anyone having a basic knowledge of money management. The money manager should simply buy a class of instrument that suits his financial risk standards, buy short maturities in the face of rising interest rates, and buy longer maturities when rates are falling.

That this is the most logical strategy can be best illustrated by example:

In period T(0) an investor purchases three instruments of the same class but of different maturities. One instrument matures in one month (period T(1)), another in three months (period T(3)), and the other in twelve months (period T(12)). The instruments are purchased at a discount and mature at face value. Assume the instruments to have the following yields at T(0):

one-month - 7.00%

three-month - 6.50%

twelve-month - 6.00%

The original prices of the instruments are then calculated to be:

$$P(1) = \frac{\$10,000}{1 + \frac{(30)(.07)}{360}} = \$9942.0053$$

$$P(3) = \frac{\$10,000}{1 + \frac{(90)(.065)}{360}} = \$9840.0984$$

$$P(12) = \frac{\$10,000}{1 + \frac{(360)(.06)}{360}} = \$9433.9622$$

Where: \$10,000 is the face value of the instruments

thirty, ninety, and 360 are the respective days to maturity of the one-month, three-month and twelve-month instruments.

If, at time T(1), (one month after purchase), interest rates have increased by only 10 per cent, the three instruments will have the following values:

$$P(1) = FV = \$10,000$$

$$P(3) = \frac{\$10,000}{1 + \frac{(60)(.0715)}{360}} = \$9882.2372$$

$$P(12) = \frac{\$10,000}{1 + \frac{(330)(.066)}{360}} = \$9429.5143$$

Had sale of the instruments been forced at time T(1) a gain of \$57.9950 would have been realized from the one-month, \$42.1389 from the three-month, and a negative \$4.4479 from the twelve-month. The advantage of holding the one-month instrument over the three-month would have been \$15.8561, and over the twelve-month \$62.4429.

Given the same situation and assuming a fall in yields of 10 per cent, the prices of the three instruments would be as follows:

$$P(1) = FV = \$10,000$$

$$P(3) = \frac{\$10,000}{1 + \frac{(60)(.0585)}{(360)}} = \$9903.4414$$

$$P(12) = \frac{\$10,000}{1 + \frac{(330)(.054)}{(360)}} = \$9528.3468$$

In this case the advantage of holding the twelve-month instrument over the three-month would have been $31.0416, and over the one-month $36.3896. Price is inversely proportional to interest rate and time to maturity.

Figure 3 is a plot of iso-price, or constant price, curves for one-month, two-month, three-month, six-month, and twelve-month maturity instruments. The vertical axis shows the per cent increase in interest rate from the time of purchase and the horizontal axis shows the number of weeks the instrument has been held. The curves represent constant prices for the five maturities; for example, a horizontal line from 100 on the vertical scale intersects the one-month curve at approximately 1.8 on the horizontal axis. This means that if the interest rate increases by 100 per cent in 1.8 weeks, the selling price of a one-month maturity instrument would be the same as its purchase price 1.8 weeks previously. If the holder were forced to sell 1.8 weeks after purchase, under these conditions, he would realize no interest income.

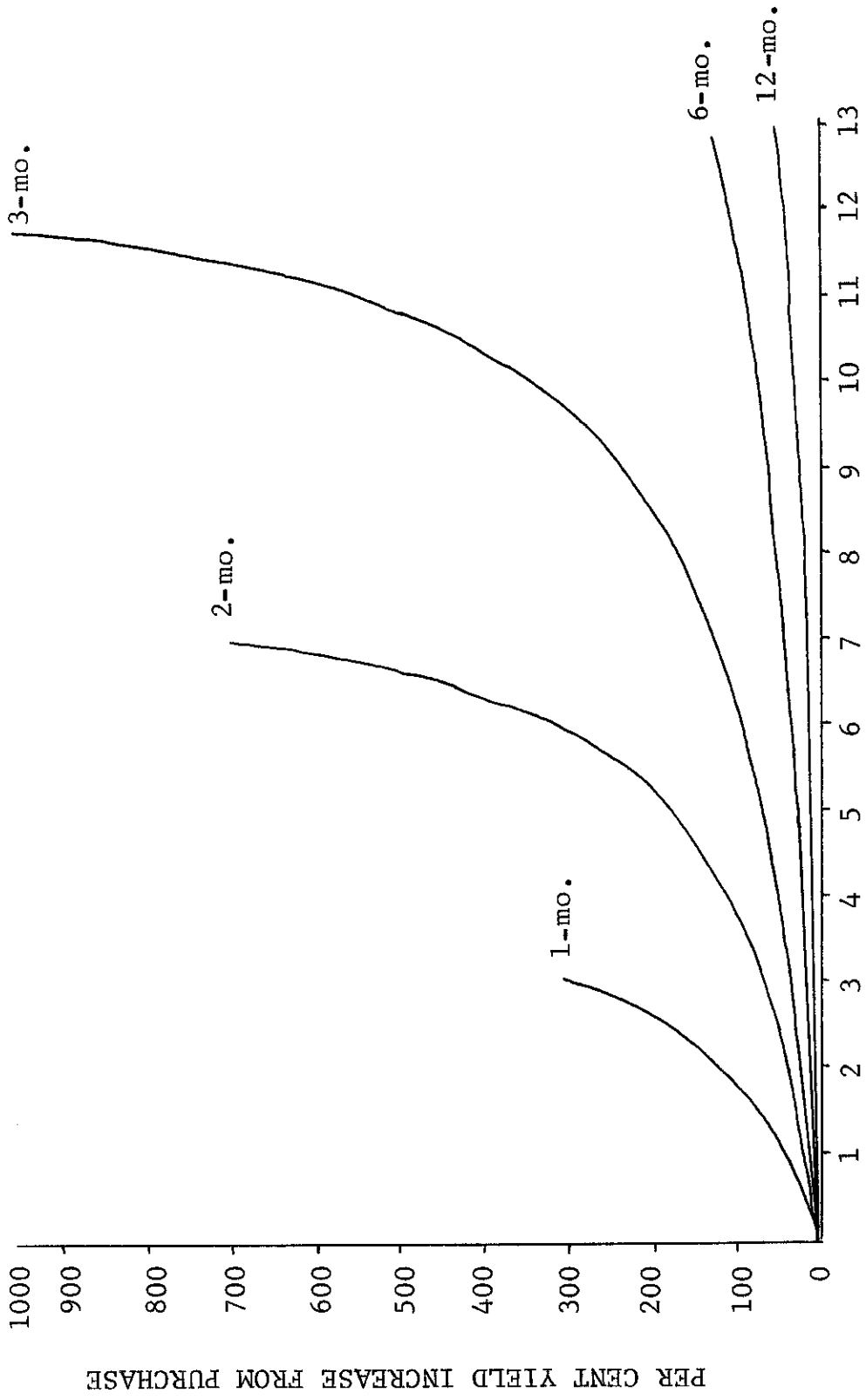

Figure 3--ISO-Price Curves

This, of course, is a highly unlikely situation. A more realistic case is an increase of nine per cent in four weeks. Under these circumstances the selling price of a twelve-month instrument would be the same as its purchase price four weeks previously. A rise in the interest-rate of more than nine per cent would actually result in a loss to the holder if he were forced to sell at that time.

Since these curves are based on per cent increase in interest-rate from time of purchase they are completely independent of actual interest-rates.

The curves were determined by setting the price equations for each period equal and solving for the yield at each period. The general price equation is

$$P = \frac{FV}{1 + \frac{Y(w)}{52}}$$

Where: P = Price

FV = Face value

Y = Yield

w = Weeks to maturity

52 = Weeks per year

Using the following definitions:

P(i) = Price in period "i"

Y(i) = Yield in period "i"

w(i) = Weeks to maturity in period "i"

n = Total maturity in weeks

the general price equation becomes

$$P(i) = \frac{FV}{1 + \frac{Y(i)(w(i))}{52}}$$

Solving for Y(i):

$$Y(i) = \frac{\left(\frac{FV}{P(i)} - 1\right)52}{w(i)}$$

Since the desired relationship is $\frac{Y(i)}{Y(0)}$, multiples of Y(0), we have the following relationship:

$$\frac{Y(i)}{Y(0)} = \frac{\frac{\left(\frac{FV}{P(i)} - 1\right)52}{w(i)}}{\frac{\left(\frac{FV}{P(0)} - 1\right)52}{w(0)}}$$

Setting P(0) equal to P(i) and simplifying, the final relationship becomes

$$\frac{Y(i)}{Y(0)} = \frac{w(0)}{w(i)} \quad \text{or} \quad \frac{Y(i)}{Y(0)} = \frac{n}{(n - 1)}$$

Figure 3 therefore illustrates how yields would have to rise over time in order to bring the gain from holding a particular maturity to zero. The steeper the curve, the greater the change in yield required to do this.

Figure 4 shows the dollar gain in price for one-, two-, three-, six-, and twelve-month instruments experiencing a yield decline of 10 per cent per month over the price of the same instrument at a constant yield. The instruments are assumed to have face values of $10,000. The initial yield is assumed to be 10 per cent. The 10 per cent monthly decline is not compounded. In other words the decline is a constant .25 per cent per week. As in Figure 3, the horizontal axis represents weeks from date of purchase. Figure 4 merely shows that the longer the maturity held, the greater is the profit potential.

From the above discussion it should be clear that the risk-averting money manager would always, in the face of uncertainty, choose a strategy of buying only short

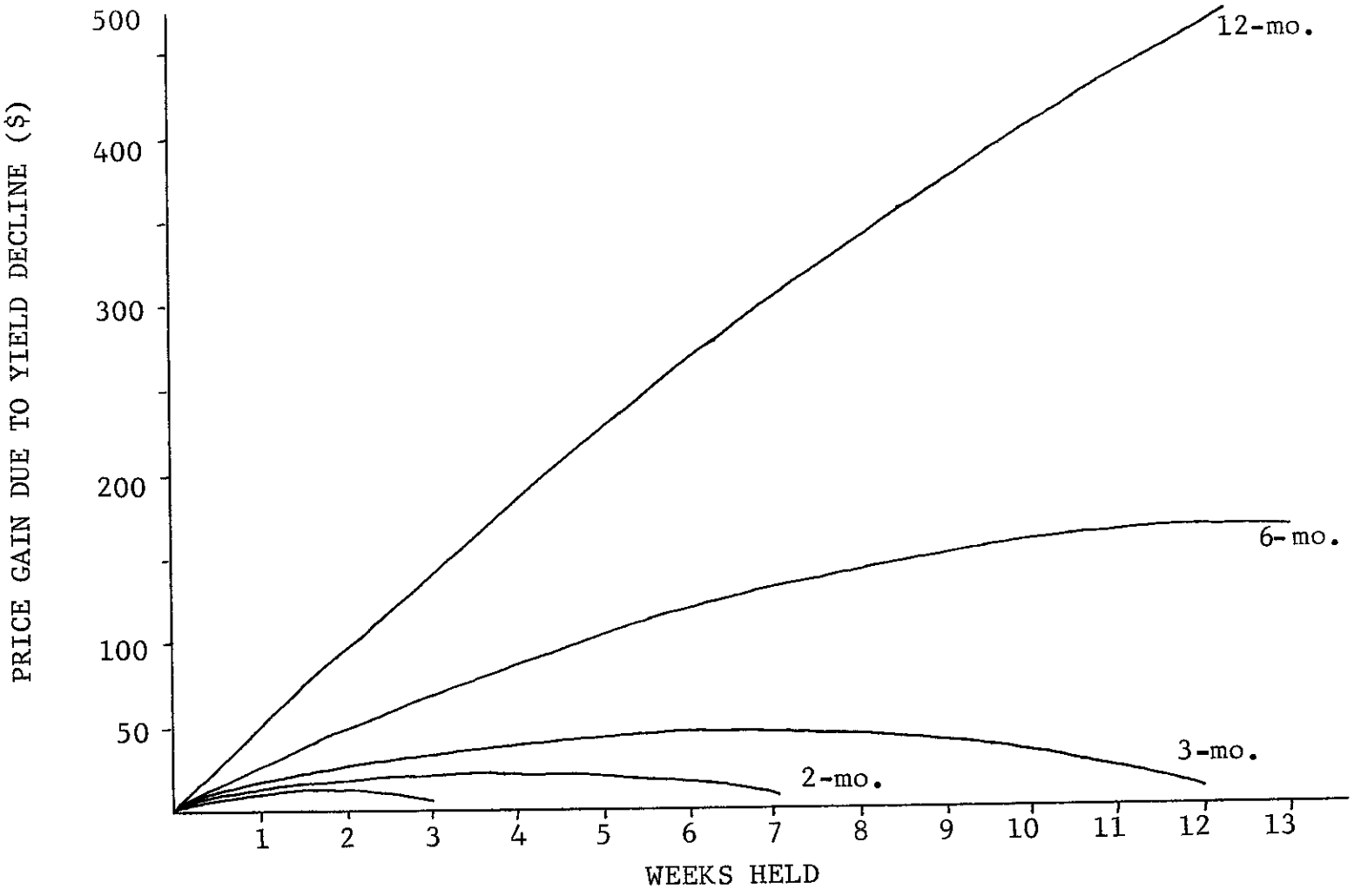

Figure 4--Price Curves (Decreasing Yields)

maturities. However, if his level of uncertainty could be reduced with an accurate leading indicator for yield trends, he would employ a strategy of selecting short maturities when yield trends were up and longer maturities when yield trends were down. This strategy would avoid capital losses during rises and take advantage of capital gains when rates were falling.

The above is actually an oversimplification of the strategy that will be detailed in Chapter IV. The model that is developed in that chapter actually compares all possible maturities in light of projected yield trends.

CHAPTER III

DATA COLLECTION AND ANALYSIS DEVELOPMENT OF A LEADING INDICATOR

The data used in this study were collected from two sources. Weekly averages of the market yields of United States Government Treasury-Bills were taken from the Federal Reserve Bulletin for the periods from January, 1960 through February, 1974. These are market yields on three-month, six-month, and nine-to-twelve-month bills computed from daily closing bid prices.[1]

Yield quotations on Bank Negotiable Certificates of Deposit ($100,000 or more) were taken from the Wall Street Journal "Money Rates" section for the period January, 1973 through April, 1974. Daily quotations were collected for one-month, two-month, three-month, six-month, and twelve-month CD's and averaged for each week.[2]

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[1] Federal Reserve Bulletin, Board of Governors of the Federal Reserve System (Washington, January, 1960 through February, 1974).

[2] The Wall Street Journal, January 5, 1973 through April 26, 1974.

The weekly averages for three-, six-, and twelve-month T-Bills and one-, two-, three-, six-, and twelve-month CD's were transcribed onto standard eighty-column IBM punched cards for computer analysis.

T-Bills and Negotiable CD's were chosen for analysis for two basic reasons. The data were available on a regular and dependable basis, and the instruments were of a highly marketable type.[3]

Other money market instruments could have been chosen, such as Banker's acceptances, Finance Company Commercial Paper, Prime Commercial Paper, or Government Agency Issues. However, the author could find no advantage in selecting any of these over the instruments chosen for the study.

The first, and most obvious, step in the data analysis was a test of the pure expectations theory as a leading indicator of yield rates. This involved calculating future three-month rates from current three-and six-month rates and calculating future six-month rates from current six-and twelve-month rates as was shown in Chapter I. Thus, the expected three-month rate three months in the future is

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[3] Instruments of the Money Market, Federal Reserve Bank of Richmond (Richmond, Virginia, August, 1970), pp. 18 and 56.

$$Y(3\text{-}3) = (2)(Y(6\text{-}0)) - Y(3\text{-}0)$$

Where: $Y(3\text{-}3)$ = Yield of a three-month instrument three months hence.

$Y(3\text{-}0)$ = Current yield of a three-month instrument.

$Y(6\text{-}0)$ = Current yield of a six-month instrument.

By the same token, the expected yield of a six-month instrument, six months in the future is

$$Y(6\text{-}6) = (2)(Y(12\text{-}0)) - Y(6\text{-}0)$$

Figure 5 shows the results of these calculations for CD's. Table I is a tabulation of these calculations.

Three and six month expectations calculations were made for both CD's and T-Bills. Plots for T-Bill expectations were made by computer on a fifty-inch sheet and were not significantly different from the results of the CD's.

Figure 5 shows plots of the actual yields of three-month maturity CD's, and the calculated expectations of three-month yields for a period from late March through November, 1973. Not only did the expectations theory fail to predict the major peak and valley of the yield curve, but also failed to predict the correct direction of change twenty-five weeks out of thirty-six. Two functions with a

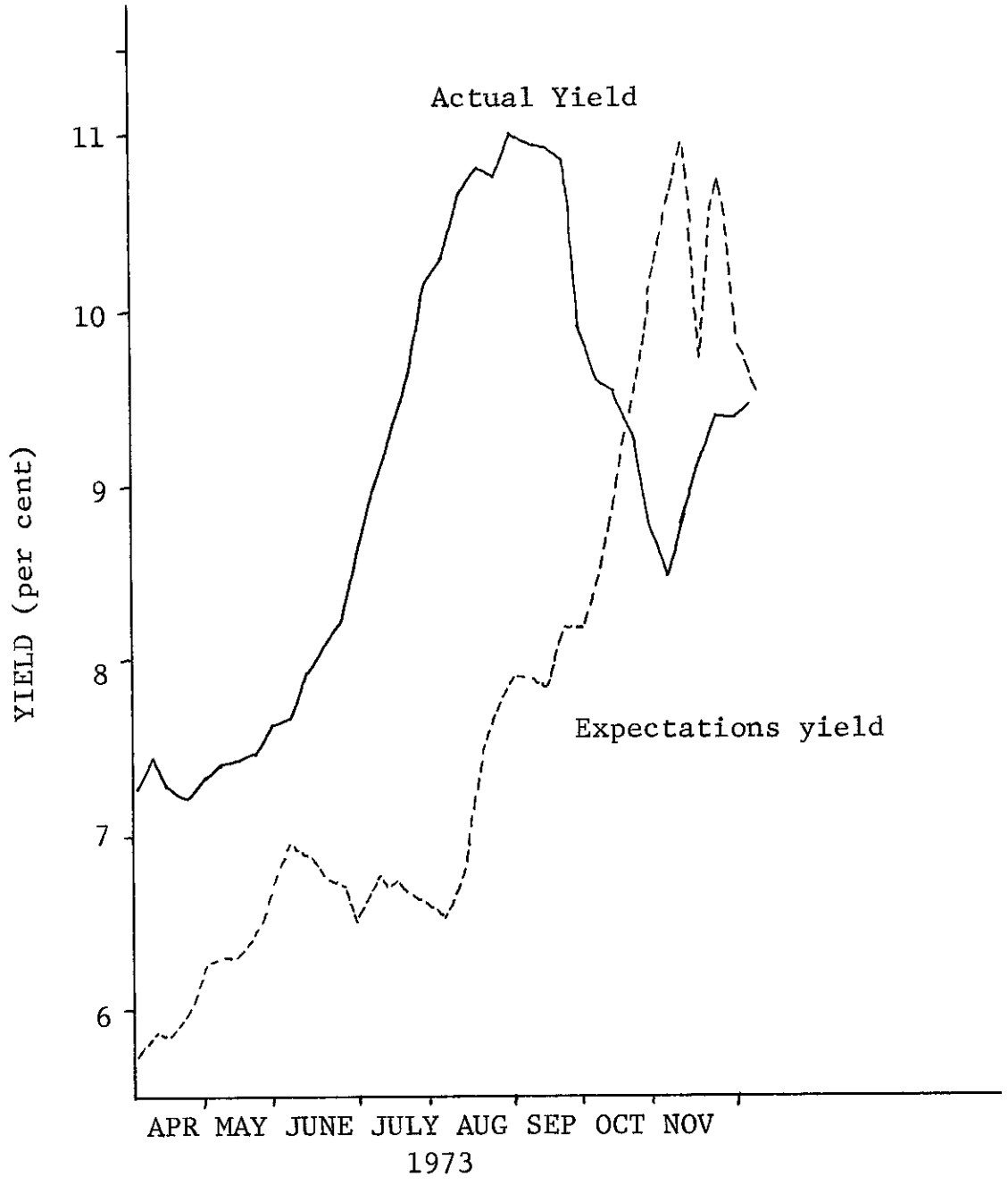

Figure 5--Three Month CD Yields vs Three Month Expectations

completely random relationship could be expected to perform as well. Consequently, the expectations theory was rejected as a useful predictor of yield trends.

The next step in the search for a useful leading indicator consisted of formulating sixteen additional relationships between yields of different maturities during the same time period and relationships between subsequent yields of the same maturities. A computer program was written which would calculate these relationships and then test them against actual yield trends for correlation in future time periods. Table II is a list of the relationships that were used. Both CD and T-Bill data were analyzed with the program.

This step in the analysis was quite lengthy and consumed a great deal of computer time. This was no surprise considering the amount of data processed and the number of steps required for each of the relationships.

There were three dependent variables, consisting of the yields of the three month, six month, and twelve month instruments. Each of the calculated relationships, which were independent variables, were compared with each of the dependent variables over their entire range in one week intervals. A single step consisted of calculating the

TABLE I

EXPECTATIONS VS ACTUAL YIELDS FOR THREE MONTH CD'S

Date	Expectations	Actual	Date	Expectations	Actual
03/30/73	5.75	7.27	10/26/73	10.225	8.825
04/06/73	5.85	7.445	11/02/73	10.70	8.50
04/13/73	5.875	7.21	11/09/73	11.00	8.875
04/20/73	5.975	7.26	11/16/73	9.70	9.18
04/27/73	6.30	7.345	11/23/73	10.80	9.40
05/04/73	6.30	7.40	11/30/73	9.80	9.38
05/11/73	6.30	7.44	12/07/73	9.54	9.48
05/18/73	6.48	7.48	12/14/73	9.36	9.31
05/25/73	6.75	7.63	12/21/73	8.50	9.135
06/01/73	7.00	7.73	12/28/73	7.99	9.183
06/08/73	6.92	7.97	01/04/74	7.88	9.10
06/15/73	6.77	8.08	01/11/74	7.775	8.985
06/22/73	6.73	8.245	01/18/74	7.375	9.10
06/29/73	6.555	8.625	01/25/74	7.30	9/06
07/06/73	6.79	9.01	02/01/74	8.125	8.66
07/13/73	6.74	9.26	02/08/74	7.82	8.08
07/20/73	6.665	9.605	02/15/74	8.24	8.00
07/27/73	6.60	10.14	02/22/74	7.92	7.98
08/03/73	6.56	10.275	03/01/74	8.47	8.14
08/10/73	6.78	10.69	03/08/74	8.24	8.33
08/17/73	7.50	10.845	03/15/74	7.86	8.49
08/24/73	7.77	10.80	03/22/74	7.567	8.885
08/31/73	7.95	11.02	03/29/74	7.65	9.505
09/07/73	7.90	10.95	04/05/74	7.015	9.75
09/14/73	7.875	10.92	04/12/74	7.56	10.06
09/21/73	8.225	10.885	04/19/74	8.06	10.18
09/28/73	8.23	9.895	04/26/74	7.72	10.505
10/05/73	8.54	9.61			
10/12/73	9.025	9.52			
10/19/73	9.63	9.225			

TABLE II

YIELD RELATIONSHIPS

Variable Number	Description
4	First difference or slope of 3 month maturity yields. $Y(3)(i) - Y(3)(i-1)$
5	First difference or slope of six month maturity yields. $Y(6)(i) - Y(6)(i-1)$
6	First difference or slope of 12 month maturity yields. $Y(12)(i) - Y(12)(i-1)$
7	3 month first difference divided by 3 month yield, multiplied by 100
8	6 month first difference divided by 6 month yield, multiplied by 100
9	12 month first difference divided by 12 month yield, multiplied by 100
10	12 month yield minus 3 month yield.
11	6 month yield minus 3 month yield.
12	12 month yield minus 6 month yield.
13	Variable 10 divided by 3 month yield, multiplied by 100
14	Variable 10 divided by 12 month yield, multiplied by 100

TABLE II--Continued

Variable Number	Description
15	Variable 11 divided by 3 month yield, multiplied by 100
16	Variable 11 divided by 6 month yield, multiplied by 100
17	Variable 12 divided by 6 month yield, multiplied by 100
18	Variable 12 divided by 12 month yield, multiplied by 100
19	Variable 12 during periods of inverted term structure of interest rates but cumulative during periods of normal term structure. The range of resulting variable is adjusted to eliminate negative numbers
20	Pure expectations calculated by multiplying the current 12 month rate by 2 and subtracting the current 6 month rate

linear regression line for the dependent variable and the independent variable one week in the past then calculating the correlation between the two. Next the regression line was calculated for the independent variable two weeks in the past then, once again, making the correlation calculation. This was repeated until the independent variable had been lagged behind the dependent by twenty-six weeks. This is comparable to treating the independent variable as a leading indicator.

Peak correlation between dependent variables and independent variables four through eighteen calculated from CD data occurred at either a lag of zero or a lag of twenty-six weeks. Peak correlation at zero lag is easily explained. It is quite easy to predict today's results from today's data. The peaks occurring at twenty-six weeks' lag were probably due to the small number of points being compared. Where peaks occurred at zero lag there was a constant decline in correlation over the entire range.

Only two of the relationships calculated from the CD data showed results contrary to the pattern. These were variables nineteen and twenty. Nineteen had peak correlation at a lag of thirteen weeks, with R squared equal to

.716. Twenty had peak correlation at a lag of three weeks, with R squared equal to .796.

All variables calculated from T-Bill data had peak correlation at a lag of zero. This would tend to confirm that some CD relationships peaked at a lag of twenty-six due to lack of data, since there were 725 T-Bill data points and only sixty CD points.

Table III is a list of peak R's for the seventeen variables calculated from the CD data.

Figure 6 shows plots of three-, six-, and twelve-month CD yields, ninety-one day T-Bill yields, and variable nineteen projected thirteen weeks in the future.

Since the objective of the analysis was to find a leading indicator for yield trends, a further test was devised to determine the incidence of like signs between the first derivatives of the leading indicator, variable nineteen, and the actual yields. A high coincidence of like signs would indicate that the indicator would accurately predict increases and decreases in the yield curves.

To accomplish this the first derivatives, slopes, of the four variables were calculated. Four new variables were created in the following manner:

TABLE III

MAXIMUM CORRELATIONS BETWEEN DEPENDENT AND INDEPENDENT VARIABLES

Independent Variable	Dependent Variable (1)		(2)		(3)	
	Lag	R	Lag	R	Lag	R
4	26	.745	26	.763	26	.780
5	26	.707	26	.741	26	.770
6	26	.721	26	.745	26	.768
7	26	.751	26	.768	26	.784
8	26	.710	26	.743	26	.777
9	26	.721	26	.746	26	.771
10	0	.842	26	.775	26	.784
11	26	.714	26	.785	26	.842
12	0	.859	0	.813	26	.784
13	0	.825	26	.796	26	.832
14	0	.803	26	.785	26	.816
15	26	.713	26	.788	26	.855
16	26	.714	26	.744	26	.853
17	0	.829	0	.774	26	.779
18	0	.828	0	.767	26	.779
19	13	.846	13	.841	13	.823
20	3	.892	3	.867	0	.915

1. When the slope of the original variable was positive the new variable was given a value of plus one
2. When the slope of the original variable was negative the new variable was given a value of minus one

3. When the slope of the original variable was zero the new variable was given a value of zero.

The result of this was the creation of three dependent variables and one independent variable, having values of only plus one, minus one, and zero.

When testing the independent variable, that derived from variable nineteen, against a dependent variable, the possible combinations of signs would be

(1,1), (1,-1), (1,0), (-1,1), (-1,-1,), (-1,0)
(0,1), (0,-1), (0,0)

Since, of the nine possible combinations only three, (1,1; -1,-1; and 0,0) show like signs between the two variables, one would expect coincidence of signs one-third of the time due to chance. A strictly random relationship would yield a coincidence of signs one-third of the time.

For this test the null hypothesis was that the relationship between the independent variable and any of the three dependent variables was random, or P, the proportion of like signs, was equal to one-third.

The highest level of significance was found when comparing the independent variable against the dependent

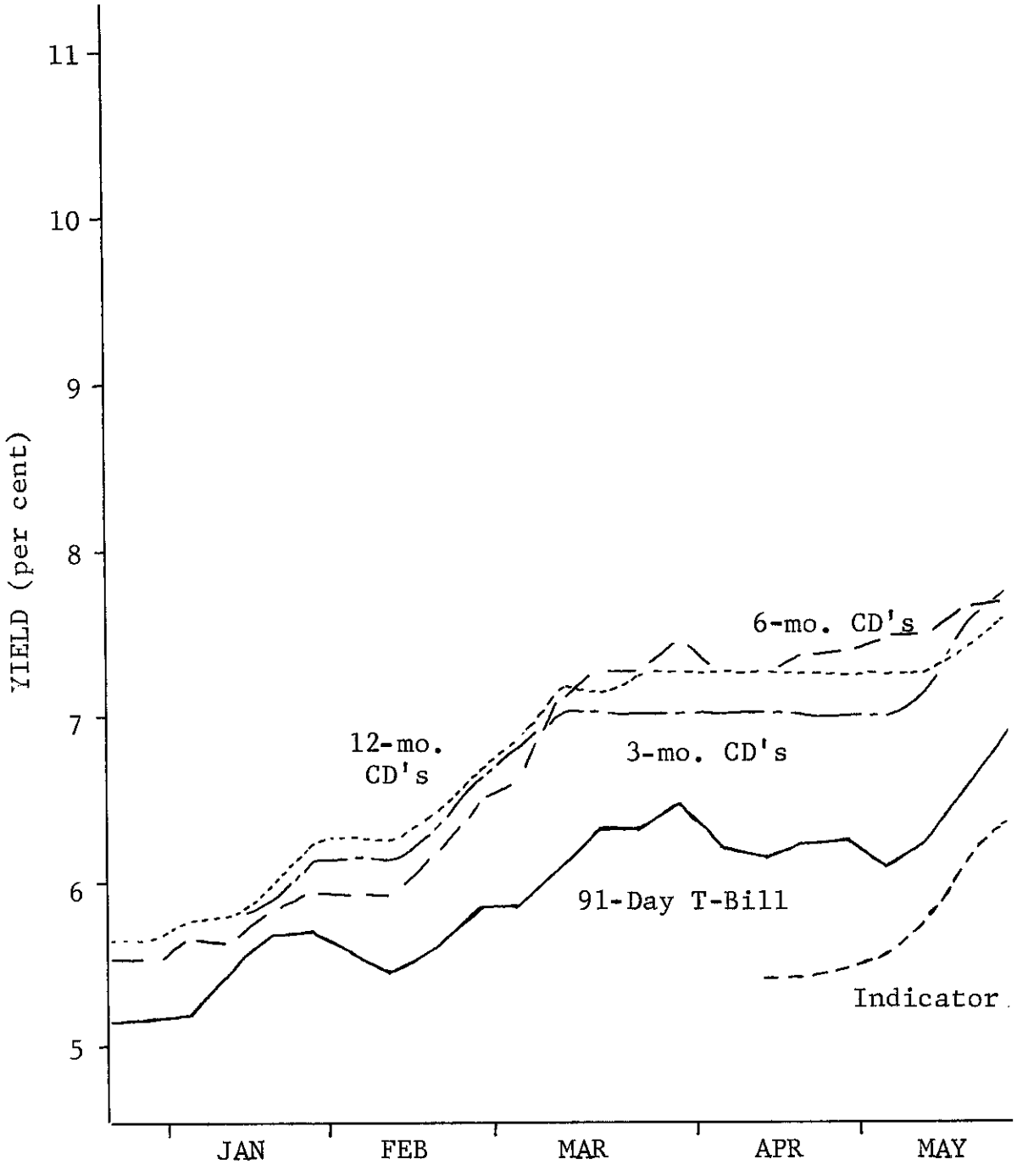

Figure 6--Yields of Various Instruments vs Indicator Yields

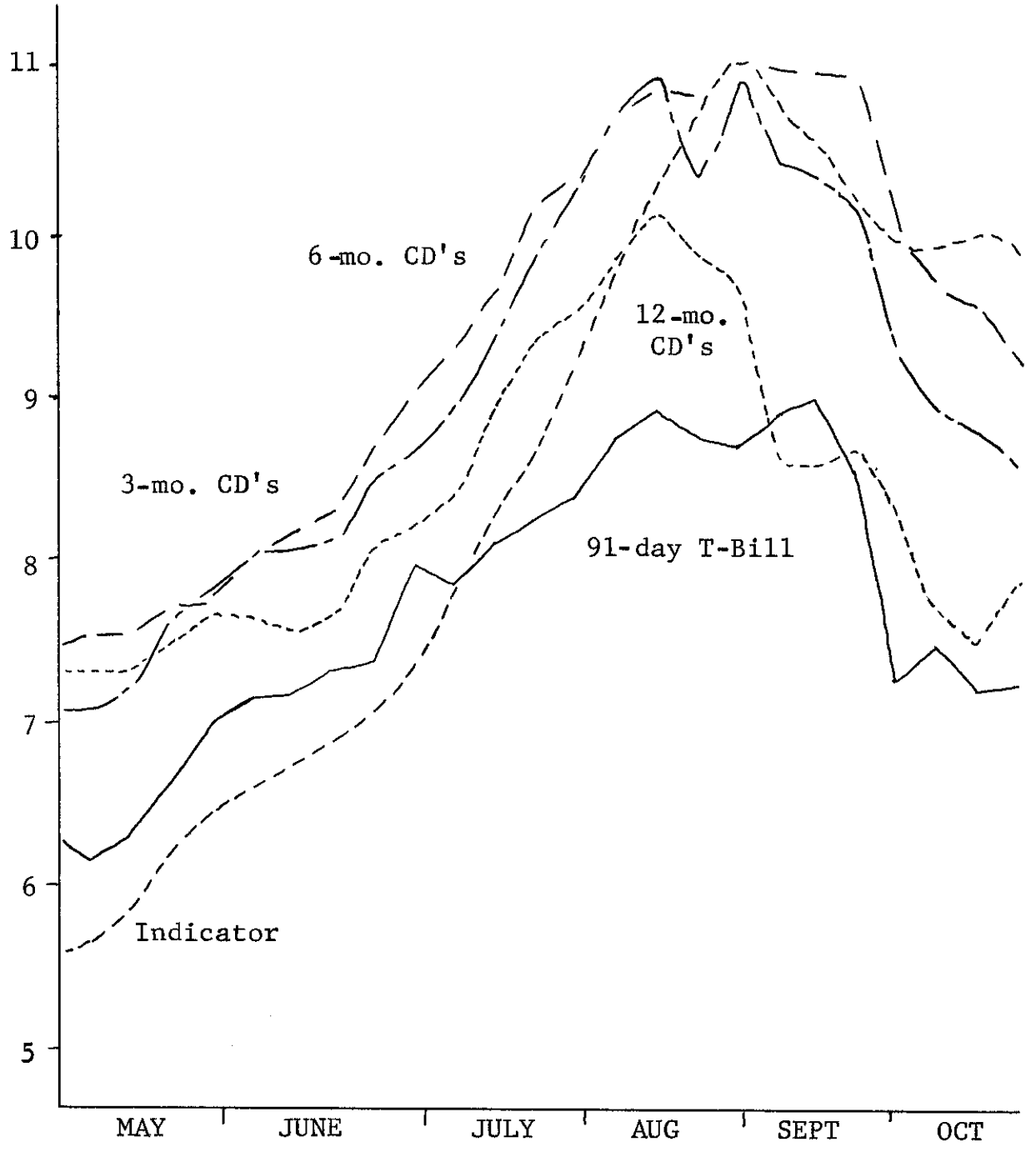

Figure 6--Continued

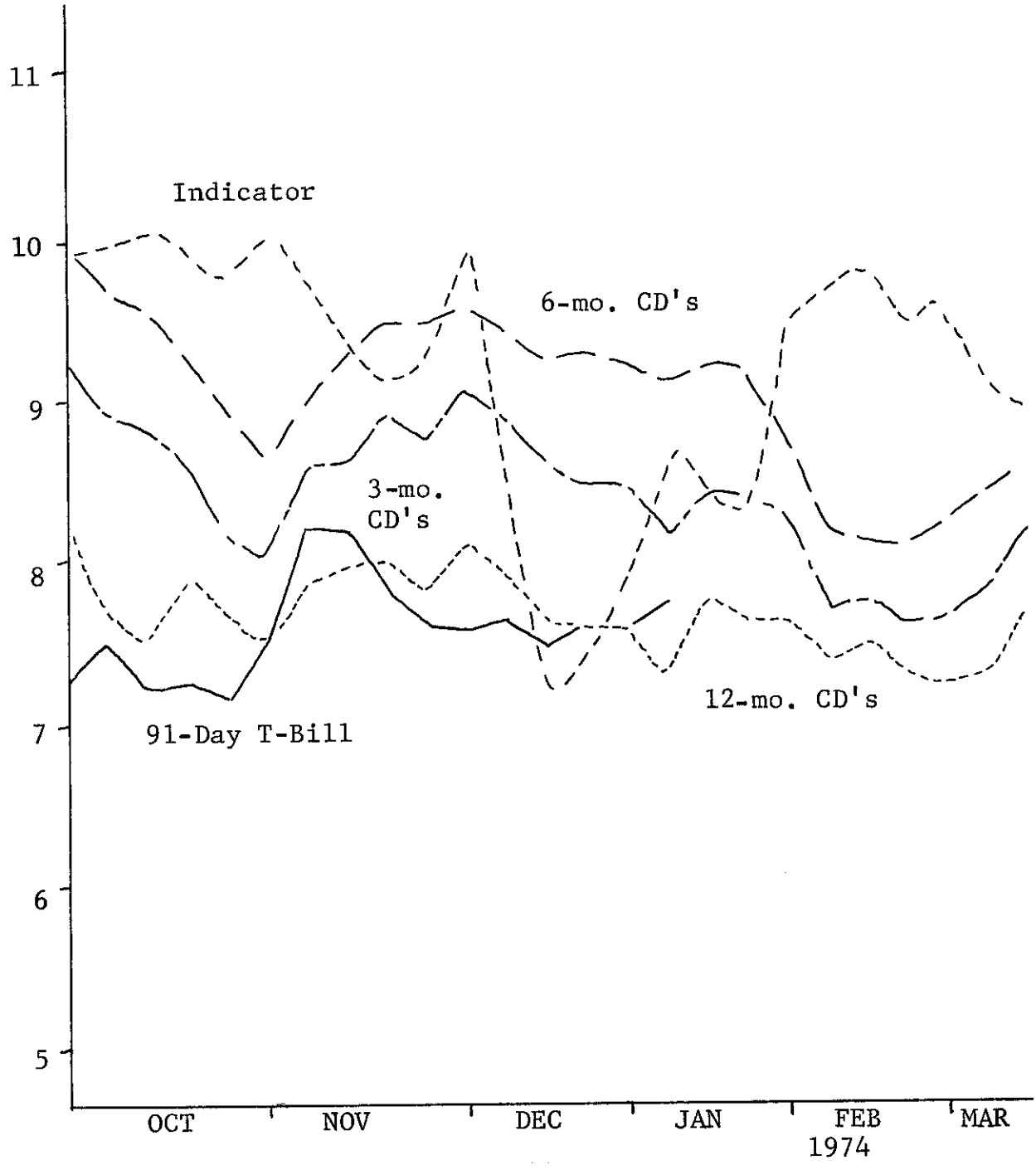

Figure 6--Continued

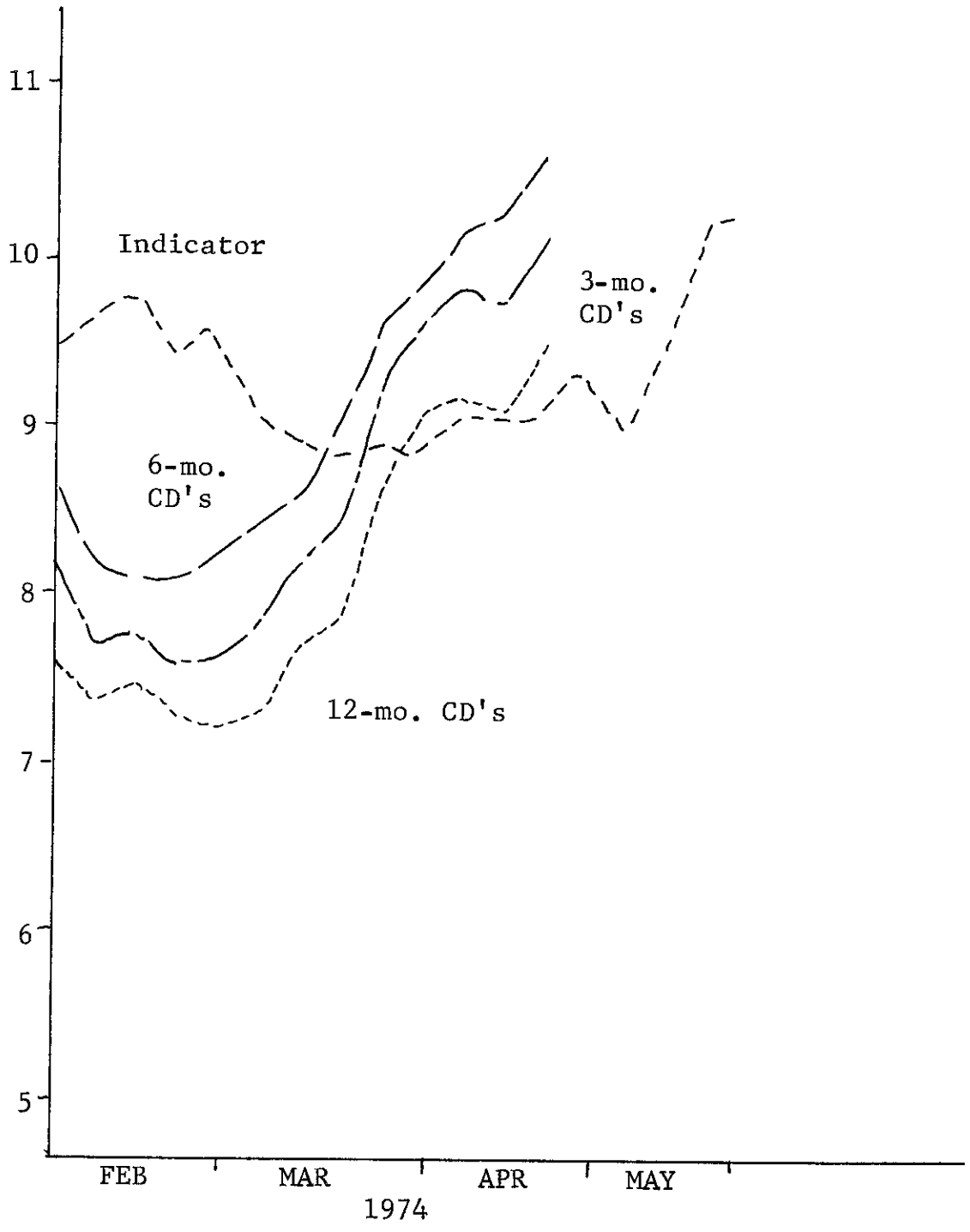

Figure 6--Continued

variable derived from the three-month maturity yield curve and was found to occur when the lag was thirteen weeks. At this lag fifty-seven points were being compared. The incidence of like signs was .6666, or thirty-eight out of fifty-seven.

Employing the normal approximation, the z value was calculated by

$$z = \frac{.6666 - .3333}{\sqrt{\frac{(1/3)(2/3)}{57}}} = 5.3379$$

This exceeds the .0010 level of significance. With the results of this test confirming the results of the regression, correlation test, it was concluded that variable nineteen was a useful leading indicator of yield trends, at least for maturities of three months or less.

CHAPTER IV

THE INVESTMENT MODEL

In Chapter II it was shown that when faced with a rising yield trend, a money manager would be wise to invest in very short term instruments. It was also shown that, faced with a falling trend in yields,he should invest in longer term instruments. The problem, of course, lies in the money manager's ability to accurately forecast the trend.

In Chapter III a leading indicator of yield trends was developed which appears, from the limited amount of data tested, to be a useful forecasting tool.

In this chapter the strategy of Chapter II will be combined with the leading indicator of Chapter III and an optimal search technique to provide an investment model for short-term instruments.

The model which will be shown here is not represented as being in the form which might be used on a week-to-week basis by a money manager. It is merely the "cadre" upon which such a model may be built. For example, transaction

costs are not treated in this model. These costs may vary depending upon the class of instrument a manager's firm chooses to deal in. Also, the span of interest of this model is one week. Investments of a shorter period than one week are not considered.

The model is extensive enough to illustrate the use of the investment strategy and the leading indicator.

The computer program for the model is written in the FORTRAN computer language, level "G," for the IBM series 370 computer. Input to the program is by punched card but need not be limited to this mode when used operationally. Output is by line printer and is restricted to eight-and-one-half by eleven-inch spaces.

Section one of the model takes a twenty-six-week minimum cash balance forecast as input and calculates a cash availability schedule. The cash forecast is determined by the cash manager and is the absolute minimum free balance for each week. Table IV is an example of such a forecast. The availability schedule is determined by, first, finding the maximum amount which can be subtracted from all periods in the forecast. This amount is tagged as available for the full twenty-six weeks. Next, the

TABLE IV

FREE CASH BALANCE FORECAST

Week	Amount Available (000)
1	4500.00
2	4500.00
3	5000.00
4	3000.00
5	3000.00
6	3500.00
7	4000.00
8	4500.00
9	5000.00
10	6000.00
11	6500.00
12	5000.00
13	5500.00
14	4500.00
15	4000.00
16	3000.00
17	2000.00
18	2500.00
19	3000.00
20	4000.00
21	5000.00
22	6000.00
23	5000.00
24	4000.00
25	3500.00
26	5000.00

amount found in step one is subtracted from the entire forecast. The resulting forecast is then scanned for the maximum amount that can be subtracted from the first period where the balance is zero. The amount found in this step is then subtracted from the balances from period one to the zero balance point and is tagged as available for that period.

This technique is followed until all balances have been tagged. Table V is an example of the cash availability schedule resulting from the cash forecast shown in Table IV.

Only the amounts shown as available in period one are of interest at this point in the model because the investment decisions that must be made are concerned with current available cash.

Section two of the model takes the weekly average yields of three-month, six-month, and twelve-month CD's for the past thirteen weeks and calculates the leading indicator (variable nineteen). The results are used to calculate the slope of the regression line for the leading indicator.

In section three the current yields of the three maturities are considered to be the intercepts of the

TABLE V

CASH AVAILABLE FOR INVESTMENT

Week Available	Week Back to Cash	Amount (000)
1	3	1500.00
1	16	1000.00
1	26	2000.00
3	3	500.00
6	15	500.00
7	15	500.00
8	14	500.00
9	13	500.00
10	11	1000.00
11	11	500.00
13	13	500.00
18	26	500.00
19	26	500.00
20	24	5500.00
20	26	500.00
21	23	1000.00
22	22	1000.00
26	26	1500.00

projected yield curves of the maturities with slope equal to the calculated slope of the leading indicator. Future yields are projected along these lines for the periods for which funds have been found to be available in section one. For example, if $100,000 will be available for four weeks, the projected yields for three-month, six-month, and twelve-month maturities are found for four weeks in the future by following each of the three regression lines.

Using the results of the yield projections, the program solves the profit equation:

$$P(i) = Y(0)N(0) - Y(j)N(j)$$

Where: P(i) = Profit index for maturity "i"

Y(0) = Current yield for maturity "i"

N(0) = Weeks to maturity from current period

Y(j) = Yield for maturity "i" in period "j"

N(j) = Weeks to maturity from period "j"

The profit index equation is derived from the price equation as follows:

$$PR = \frac{FV}{1 + \frac{Y(j)N(j)}{52}} - \frac{FV}{1 + \frac{Y(0)N(0)}{52}}$$

Setting FV equal to one, since relative values of PR are desired, and dividing through by fifty-two,

$$\frac{PR}{52} = \frac{1}{52+Y(j)N(j)} = \frac{1}{52+Y(0)N(0)}$$

and,

$$\frac{PR}{52} = \frac{(52+Y(0)N(0)) - (52+Y(j)N(j))}{(52+Y(j)N(j))(52+Y(0)N(0))}$$

or,

$$\frac{(PR)((52+Y(j)N(j))(52+Y(0)N(0)))}{52} = Y(0)N(0) - Y(j)N(j)$$

Thus $PR = f(y(0)N(0), Y(j)N(j))$ and varies directly as

$$Y(0)N(0) - Y(j)N(j)$$

A single profit index value has no particular significance. It becomes significant only when compared to another. A profit index of "two" means nothing alone but is twice as good as an index of "one."

After solving for values of P(i) (i = three, six, twelve), the program determines the maximum P(i). The maturity having the maximum P value is then recommended as the instrument that should be purchased with the amount

available for the period under consideration.

The final section of the model is the output section. The output consists of the forecast of free cash balances, the cash availability schedule, a thirteen-week projection of the leading indicator and its slope, recommended maturity selections, a review of the actual yields of the three-month, six-month, and twelve-month maturities for the past thirteen weeks, and a plot of the leading indicator. Figures 7 through 16, and Tables VI through XXV are examples of this output.

Note that Figures 7 through 16 have no vertical scale. This is due to the fact that the variable is a trend indicator and not an indicator of actual yield values. Though the shape of the indicator curve is of interest, the actual values are irrelevant.

These figures and tables are actual output from the model for ten consecutive weeks, using the same cash forecast shown in Table IV and based on actual CD yields for the periods. Additional output for the sixteen weeks following those shown in Tables VI through XXV may be found in the Appendix along with a complete listing of the computer program.

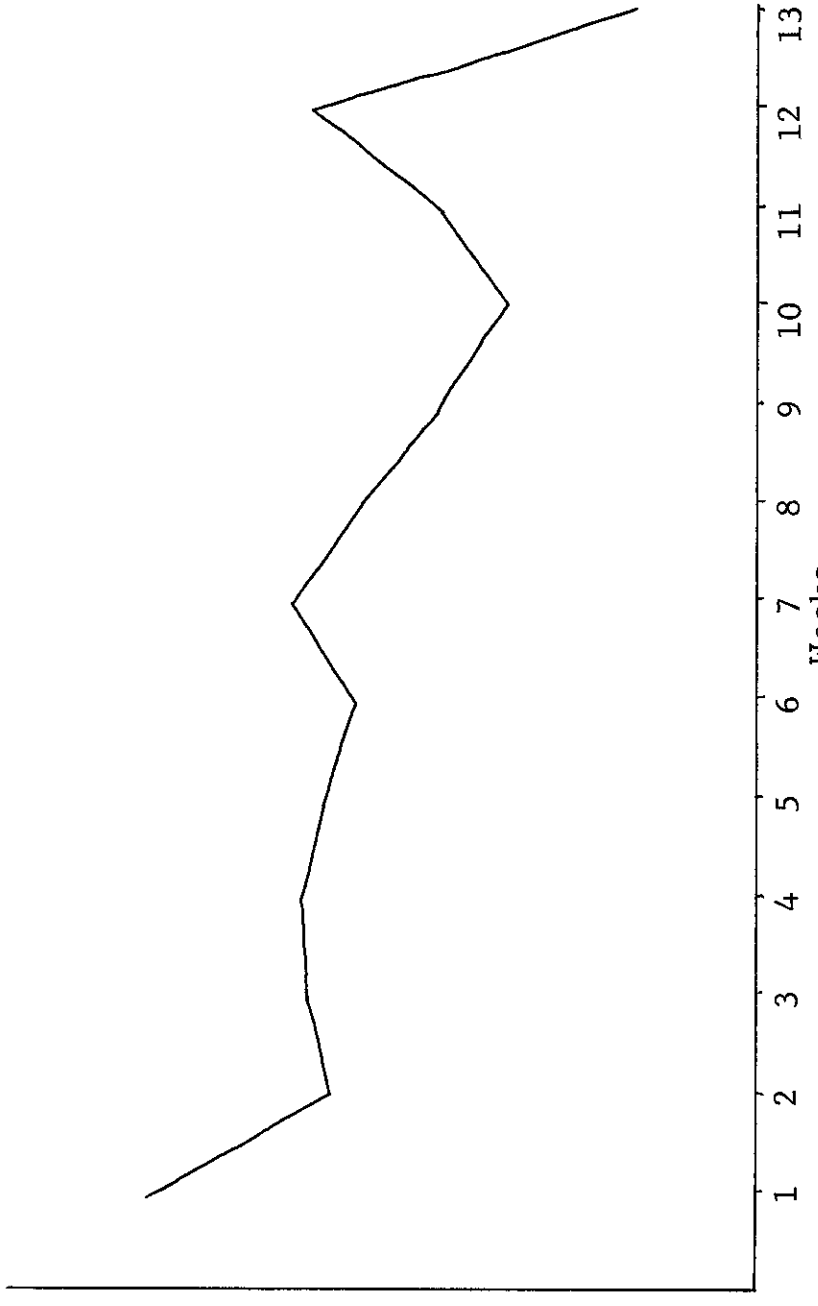

Figure 7--Week One Indicator Plot

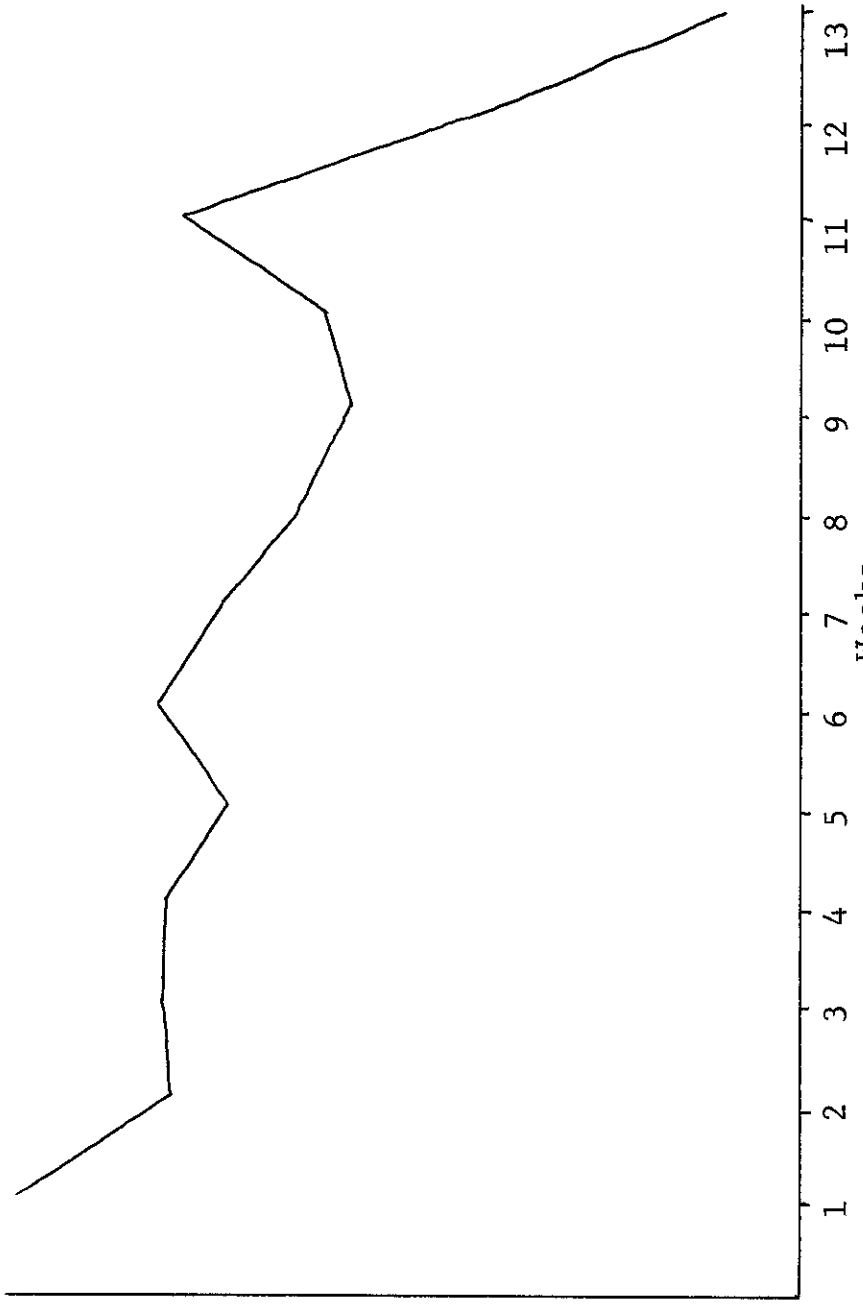

Figure 8--Week Two Indicator Plot

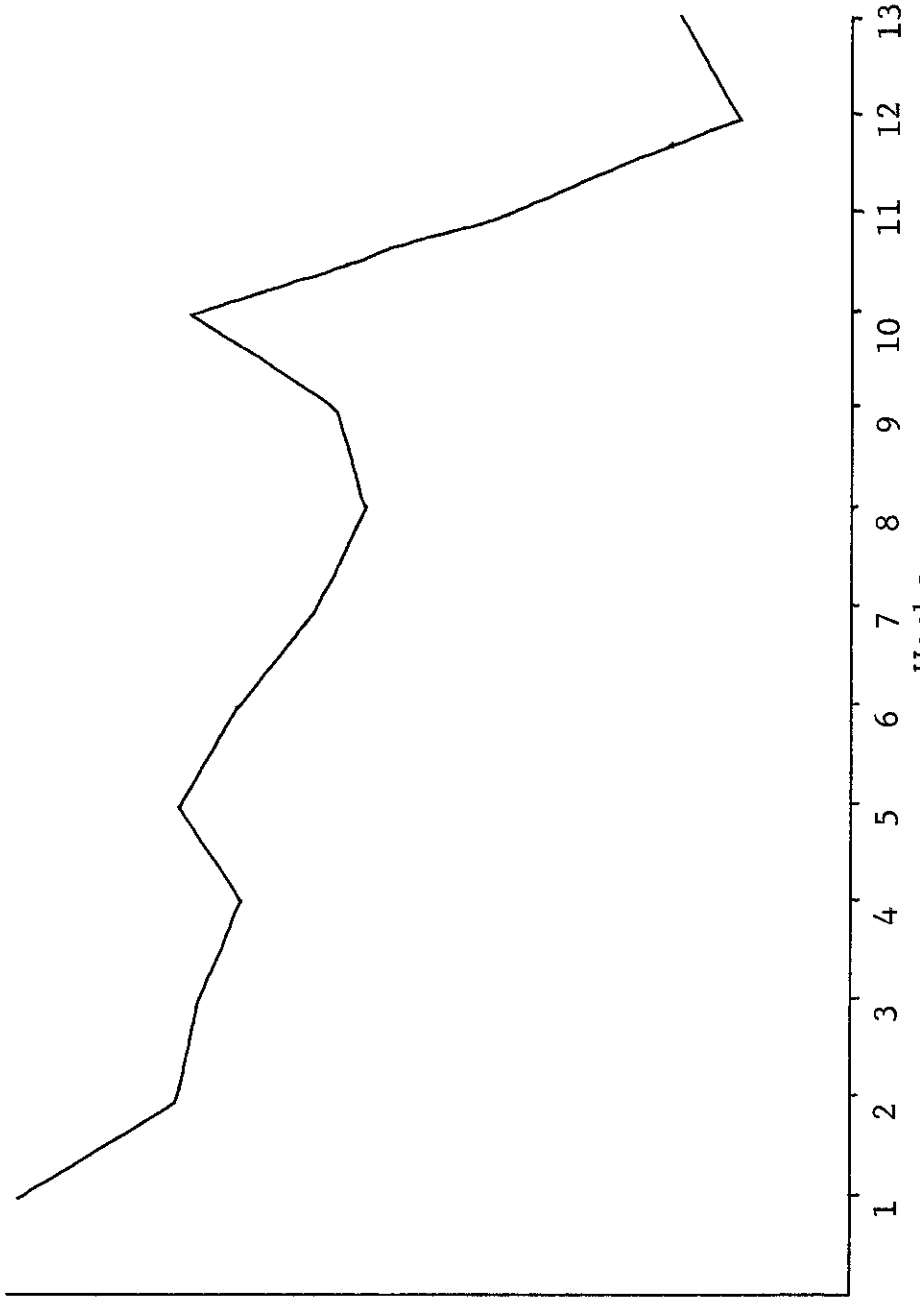

Figure 9-- Week Three Indicator Plot

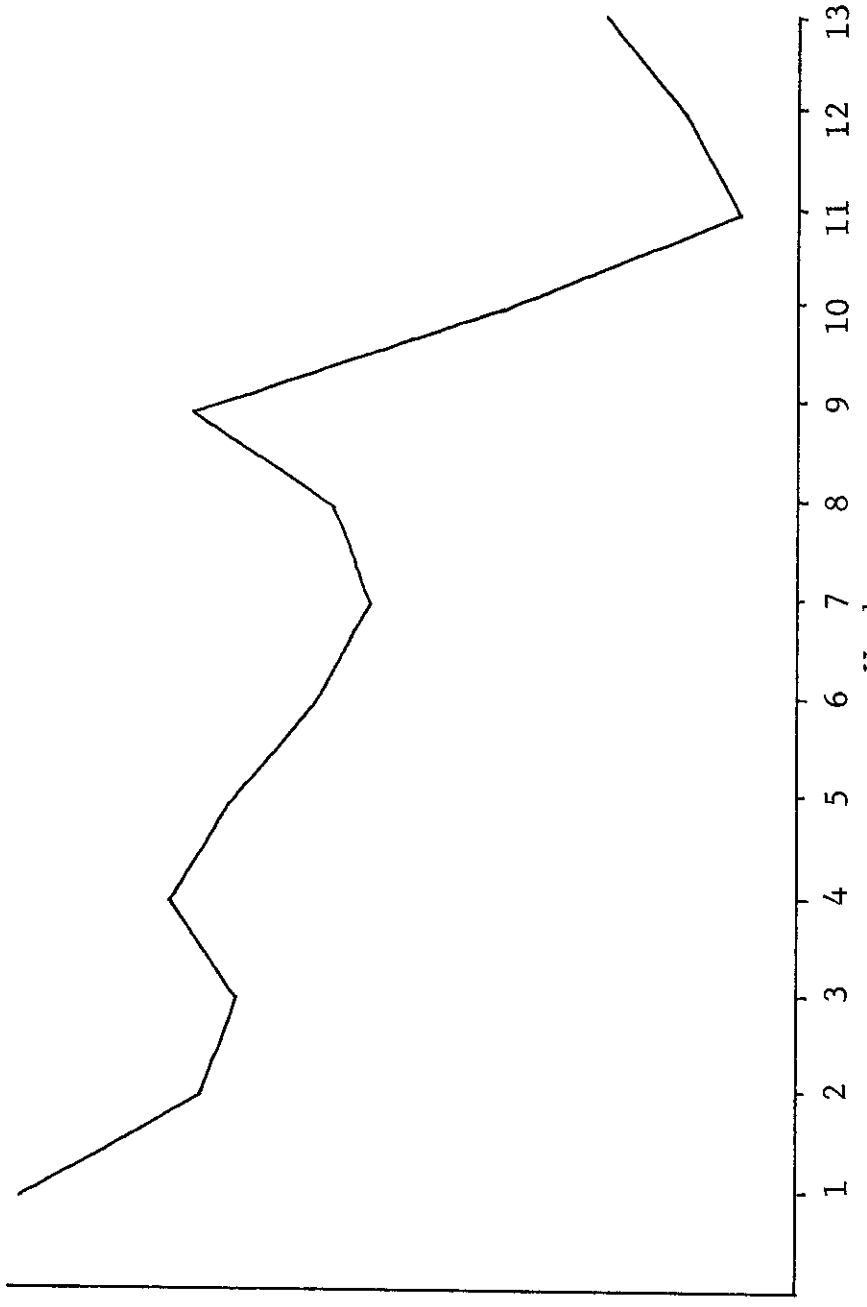

Figure 10--Week Four Indicator Plot

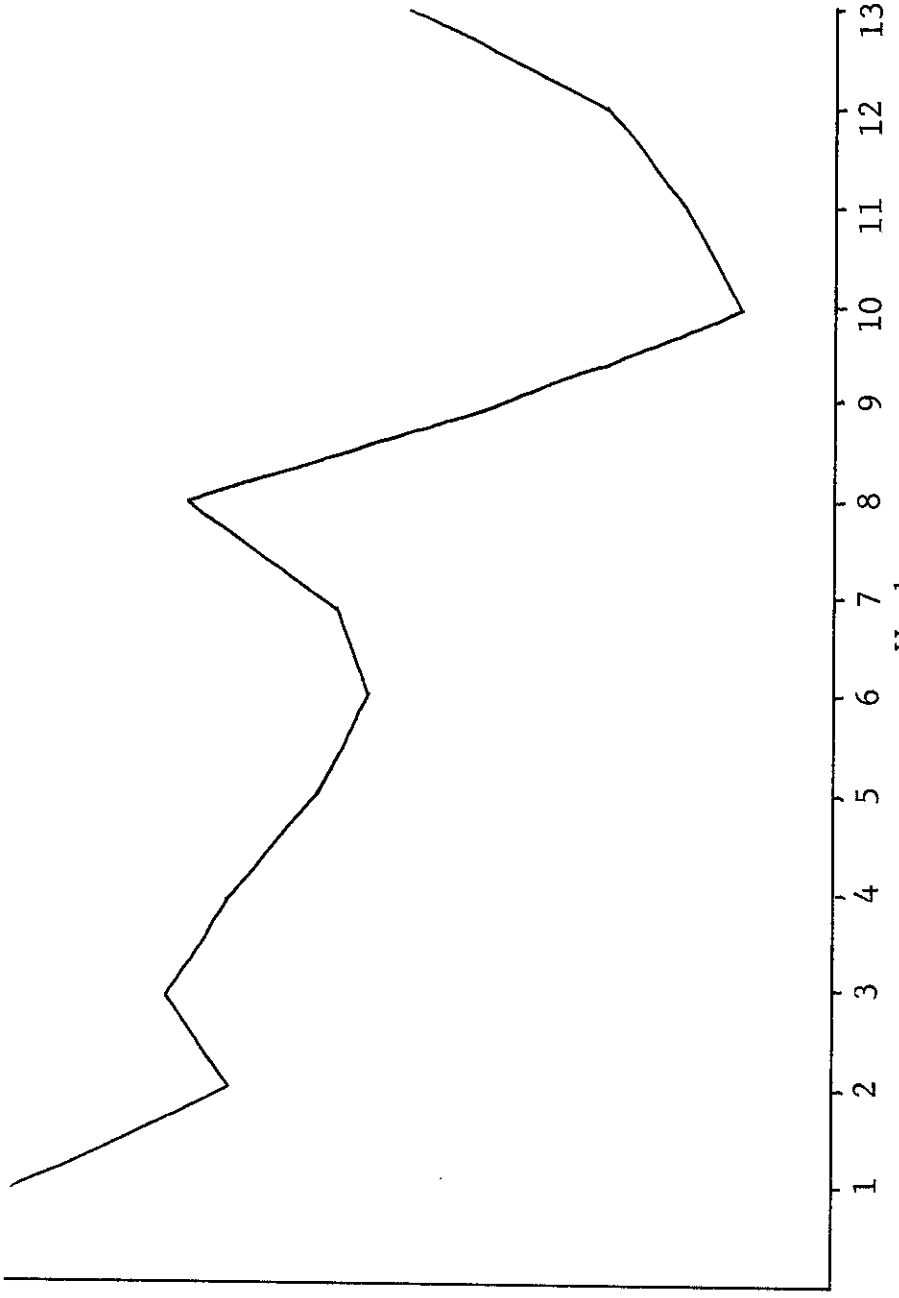

Figure 11--Week Five Indicator Plot

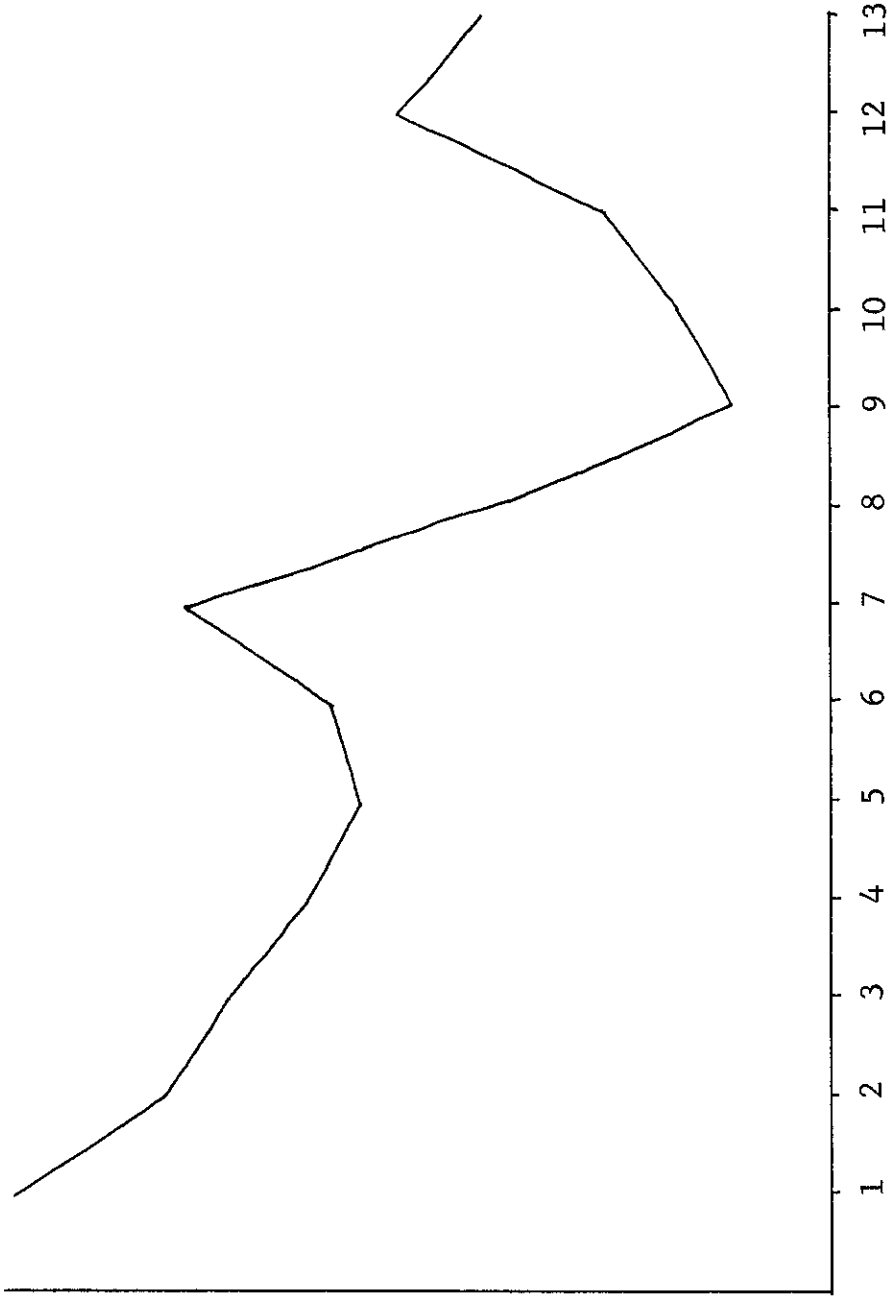

Figure 12--Week Six Indicator Plot

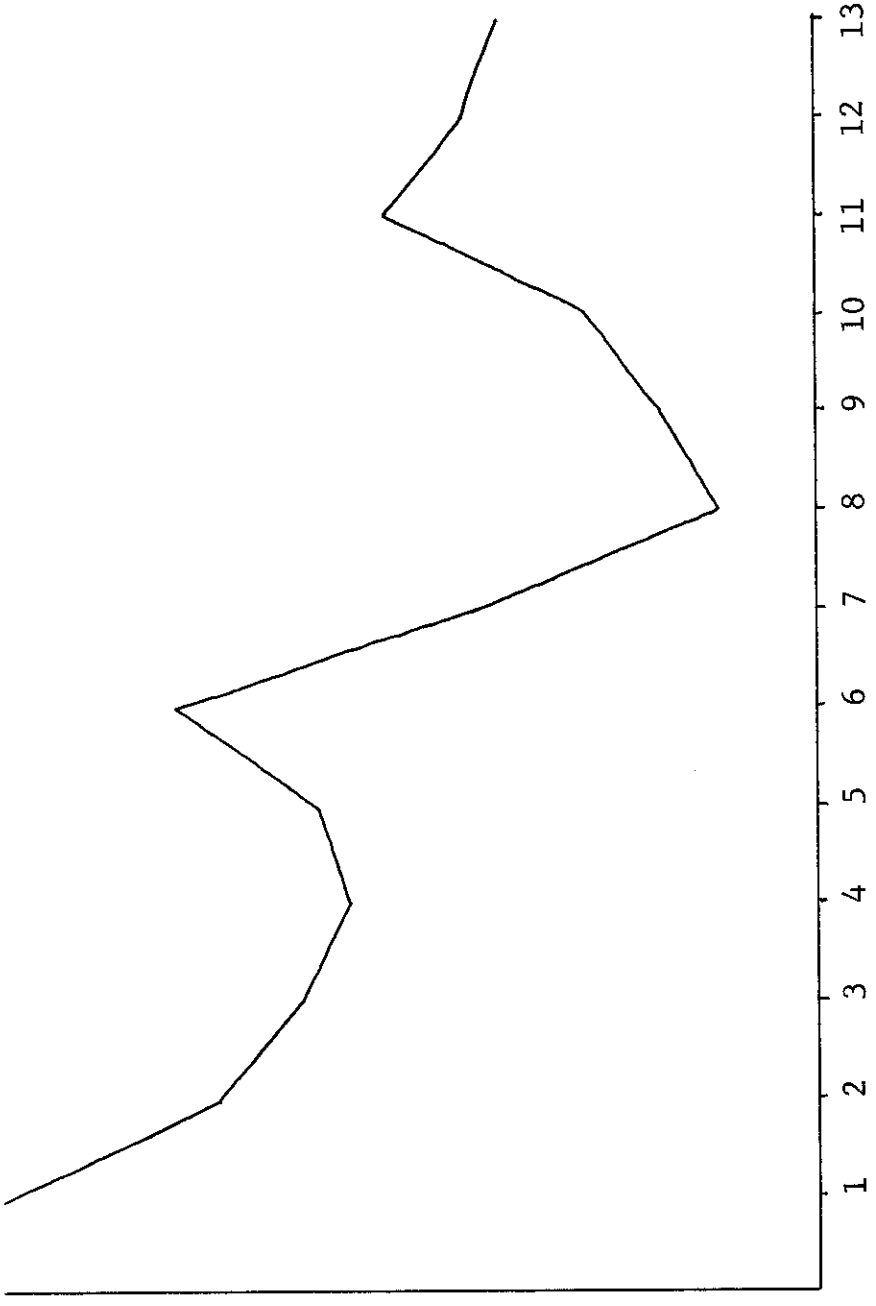

Figure 13--Week Seven Indicator Plot

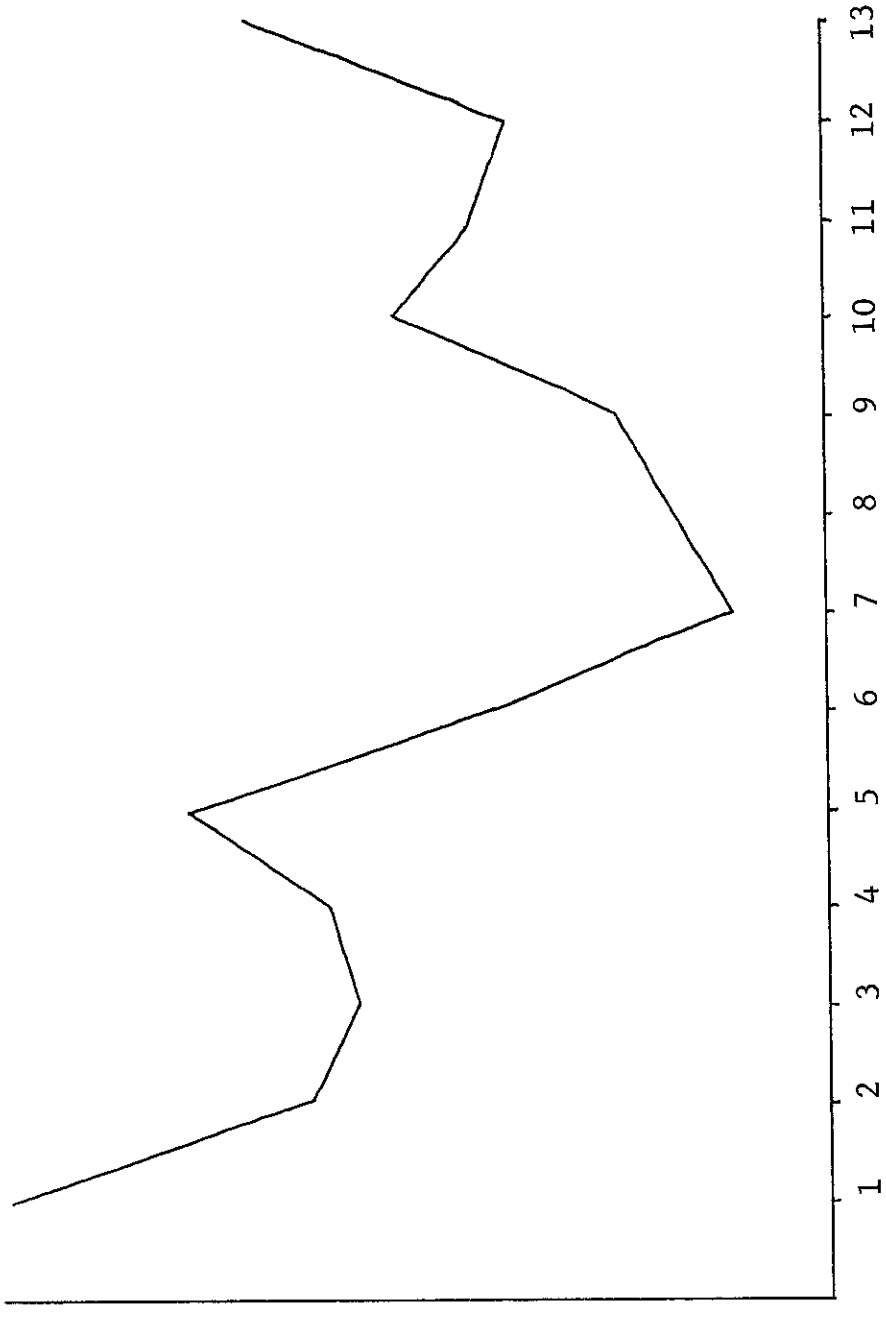

Figure 14--Week Eight Indicator Plot

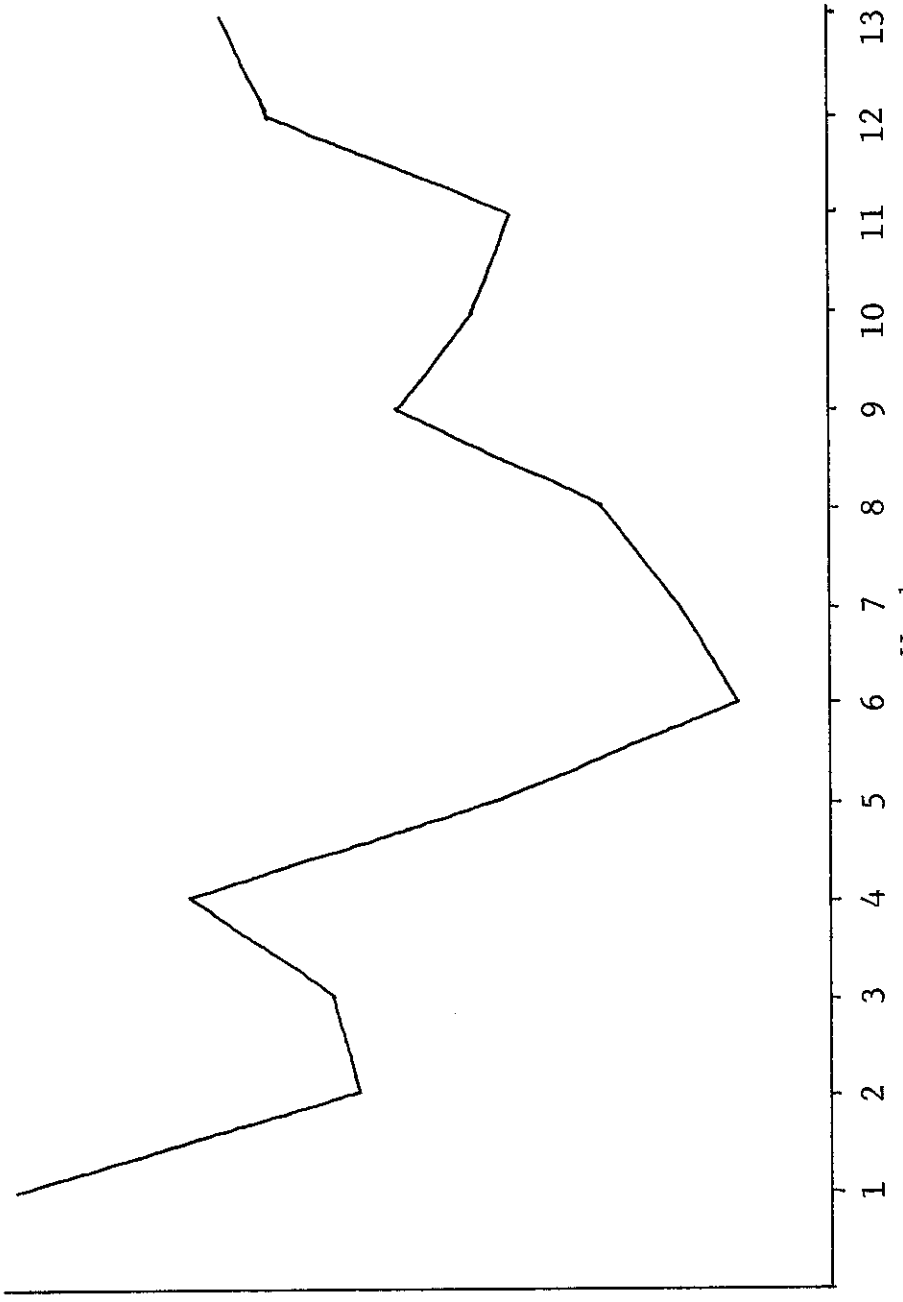

Figure 15--Week Nine Indicator Plot

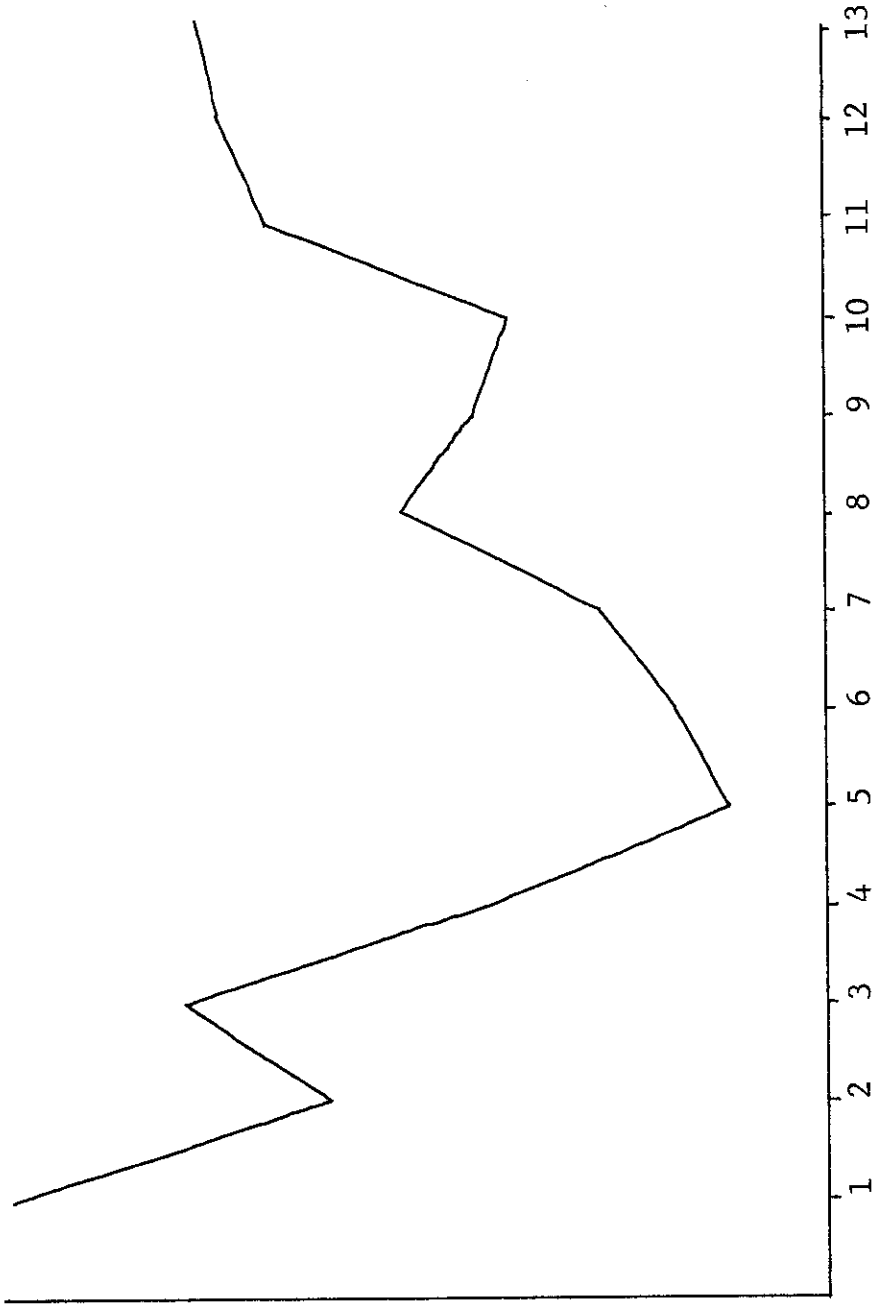

Figure 16--Week Ten Indicator Plot

TABLE VI

WEEK ONE INDICATOR VALUES

INDICATOR

Week	Value
1	2.26
2	1.77
3	1.83
4	1.86
5	1.79
6	1.69
7	1.87
8	1.71
9	1.48
10	1.36
11	1.43
12	1.81
13	1.00

Slope = 0.00

TABLE VII

MODEL OUTPUT WEEK ONE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	7.97	7.96	7.60
2	8.08	7.99	7.50
3	8.25	8.06	7.63
4	8.63	8.43	8.03
5	9.01	8.62	8.15
6	9.26	8.90	8.33
7	9.61	9.32	8.93
8	10.14	9.89	9.34
9	10.28	10.25	9.47
10	10.69	10.70	9.80
11	10.85	10.93	10.10
12	10.80	10.25	9.80
13	11.02	10.91	9.65

TABLE VIII

WEEK TWO INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.45
3	2.48
4	2.41
5	2.31
6	2.49
7	2.33
8	2.10
9	1.98
10	2.05
11	2.43
12	1.62
13	1.00

Slope = -0.09

TABLE IX

MODEL OUTPUT WEEK TWO

Recommended Maturity Selections
(1=3 Mo., or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	8.08	7.99	7.50
2	8.25	8.06	7.63
3	8.63	8.43	8.03
4	9.01	8.62	8.15
5	9.26	8.90	8.33
6	9.61	9.32	8.93
7	10.14	9.89	9.34
8	10.28	10.25	9.47
9	10.69	10.70	9.80
10	10.85	10.93	10.10
11	10.80	10.25	9.80
12	11.02	10.91	9.65
13	10.95	10.38	8.50

TABLE X

WEEK THREE INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.48
3	2.41
4	2.31
5	2.49
6	2.33
7	2.10
8	1.98
9	2.05
10	2.43
11	1.62
12	1.00
13	1.15

Slope = -0.11

TABLE XI

MODEL OUTPUT WEEK THREE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	8.25	8.60	7.63
2	8.63	8.43	8.03
3	9.01	8.62	8.15
4	9.26	8.90	8.33
5	9.61	9.32	8.93
6	10.14	9.89	9.34
7	10.28	10.25	9.47
8	10.69	10.70	9.80
9	10.85	10.93	10.10
10	10.80	10.25	9.80
11	11.02	10.91	9.65
12	10.95	10.38	8.50
13	10.92	10.23	8.50

TABLE XII

WEEK FOUR INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.41
3	2.31
4	2.49
5	2.33
6	2.10
7	1.98
8	2.05
9	2.43
10	1.62
11	1.00
12	1.15
13	1.35

Slope = -0.12

TABLE XIII

MODEL OUTPUT WEEK FOUR

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	8.63	8.43	8.03
2	9.02	8.62	8.15
3	9.26	8.90	8.33
4	9.61	9.32	8.93
5	10.14	9.89	9.34
6	10.28	10.25	9.47
7	10.69	10.70	9.80
8	10.85	10.93	10.10
9	10.80	10.25	9.80
10	11.02	10.91	9.65
11	10.95	10.38	8.50
12	10.92	10.23	8.50
13	10.89	10.13	8.60

TABLE XIV

WEEK FIVE INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.31
3	2.49
4	2.33
5	2.10
6	1.98
7	2.05
8	2.43
9	1.62
10	1.00
11	1.15
12	1.35
13	1.88

Slope = -0.11

TABLE XV

MODEL OUTPUT WEEK FIVE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.01	8.62	8.15
2	9.26	8.90	8.33
3	9.61	9.32	8.93
4	10.14	9.89	9.34
5	10.28	10.25	9.47
6	10.69	10.70	9.80
7	10.85	10.93	10.10
8	10.80	10.25	9.80
9	11.02	10.91	9.65
10	10.95	10.38	8.50
11	10.92	10.23	8.50
12	10.89	10.13	8.60
13	9.90	9.20	8.20

TABLE XVI

WEEK SIX INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.49
3	2.33
4	2.10
5	1.98
6	2.05
7	2.43
8	1.62
9	1.00
10	1.15
11	1.35
12	1.88
13	1.68

Slope = -0.10

TABLE XVII

MODEL OUTPUT WEEK SIX

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.26	8.90	8.33
2	9.61	9.32	8.93
3	10.14	9.89	9.34
4	10.28	10.25	9.47
5	10.69	10.70	9.80
6	10.85	10.93	10.10
7	10.80	10.25	9.80
8	11.02	10.91	9.65
9	10.95	10.38	8.50
10	10.92	10.23	8.50
11	10.89	10.13	8.60
12	9.90	9.20	8.20
13	9.61	8.80	7.60

TABLE XVIII

WEEK SEVEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.33
3	2.10
4	1.98
5	2.05
6	2.43
7	1.62
8	1.00
9	1.15
10	1.35
11	1.88
12	1.68
13	1.58

Slope = -0.09

TABLE XIX

MODEL OUTPUT WEEK SEVEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.61	9.32	8.93
2	10.14	9.89	9.34
3	10.28	10.25	9.47
4	10.69	10.70	9.80
5	10.85	10.93	10.10
6	10.80	10.25	9.80
7	11.02	10.91	9.65
8	10.95	10.38	8.50
9	10.92	10.23	8.50
10	10.89	10.13	8.60
11	9.90	9.20	8.20
12	9.61	8.80	7.60
13	9.52	8.70	7.40

TABLE XX

WEEK EIGHT INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.10
3	1.98
4	2.05
5	2.43
6	1.62
7	1.00
8	1.15
9	1.35
10	1.88
11	1.68
12	1.58
13	2.21

Slope = -0.06

TABLE XXI

MODEL OUTPUT WEEK EIGHT

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.14	9.89	9.34
2	10.28	10.25	9.47
3	10.69	10.70	9.80
4	10.85	10.93	10.10
5	10.80	10.25	9.80
6	11.02	10.91	9.65
7	10.95	10.38	8.50
8	10.92	10.23	8.50
9	10.89	10.13	8.60
10	9.90	9.20	8.20
11	9.61	8.80	7.60
12	9.52	8.70	7.40
13	9.23	8.50	7.83

TABLE XXII

WEEK NINE INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	1.98
3	2.05
4	2.43
5	1.62
6	1.00
7	1.15
8	1.35
9	1.88
10	1.68
11	1.58
12	2.21
13	2.33

Slope = -0.03

TABLE XXIII

MODEL OUTPUT WEEK NINE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.28	10.25	9.47
2	10.69	10.70	9.80
3	10.85	10.93	10.10
4	10.80	10.25	9.80
5	11.02	10.91	9.65
6	10.95	10.38	8.50
7	10.92	10.23	8.50
8	10.89	10.13	8.60
9	9.90	9.20	8.20
10	9.61	8.80	7.60
11	9.52	8.70	7.40
12	9.23	8.50	7.83
13	8.83	8.10	7.55

TABLE XXIV

WEEK TEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.05
3	2.43
4	1.62
5	1.00
6	1.15
7	1.35
8	1.88
9	1.68
10	1.58
11	2.21
12	2.33
13	2.38

Slope = -0.00

TABLE XXV

MODEL OUTPUT WEEK TEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.69	10.70	9.80
2	10.85	10.93	10.10
3	10.80	10.25	9.80
4	11.02	10.91	9.65
5	10.95	10.38	8.50
6	10.92	10.23	8.50
7	10.89	10.13	8.60
8	9.90	9.20	8.20
9	9.61	8.80	7.60
10	9.52	8.70	7.40
11	9.23	8.50	7.83
12	8.83	8.10	7.55
13	8.50	7.90	7.40

CHAPTER V

MODEL PERFORMANCE

Twenty-six iterations of the model program were run, using the cash forecast shown in Table IV. The first iteration was for the week of August 24, 1974. The leading indicator was calculated from the thirteen weeks yield data prior to that date.

Each successive iteration used the same forecast, with the next available week's yields added for the indicator calculation. Each week the indicator was calculated with the most recent thirteen week's data.

The investment strategy suggested by the model for the twenty-six week period is shown in Table XXVI. The cash availability schedule, shown in Table V, indicates that funds are available for investment for periods of three weeks, sixteen weeks, and twenty-six weeks. When the model strategy called for investment of funds for less than the full period of their availability, they were assumed to be re-invested under the strategy prevailing in the period in which they became once again available.

TABLE XXVI

STRATEGIES SUGGESTED BY THE MODEL

Week	3 Month or Less	6 Month	12 Month
1	X		
2			X
3			X
4			X
5			X
6			X
7			X
8			X
9	X		
10	X		
11	X		
12	X		
13	X		
14	X		
15	X		
16	X		
17	X		
18	X		
19			X
20			X
21			X
22	X		
23	X		
24	X		
25	X		
26	X		

For example, if the strategy in week one was to invest in one-month instruments, both sixteen-week, and twenty-six-week funds would once again be available for investment four weeks later. If the strategy for that week was for one-month investment, the funds were assumed to be so invested.

Based on the strategies suggested by the model, the profitability index was calculated for each week. In week one the strategy resulted in the investment of funds in one month instruments for one-month, and in twelve-month instruments for twelve weeks and twenty-two weeks. Using the relationship for the profit index outlined in Chapter IV, the total profit index for week one was calculated to be

$$(3)(.108)+(4)(.108)+(4)(.108)+(52)(.086)-(40)(.078)$$
$$+(52)(.086)-(30)(.0725) = 4.8370$$

Results of these calculations for the entire twenty-six-week period are shown in the first column of Table XXVII. The remaining columns are the results of profit index calculations for the three strategies against which the model strategy was tested.

The "short strategy" consisted of assuming purchases of one month maturities only. The "long strategy" was one of

TABLE XXVII

PROFITABILITY INDEXES FOR INVESTMENT STRATEGIES

3, 16, and 26 Weeks Equal Amounts

Week	Model Strategy	Short Strategy	Long Strategy	Max Y Strategy
1	4.8370	4.4634	4.6750	4.4634
2	6.4300	4.4612	4.8812	4.4612
3	6.2880	4.3182	4.7339	4.3182
4	4.6700	4.4078	4.6863	4.4078
5	4.8600	4.2638	4.6481	4.2638
6	5.2190	4.1310	4.2507	4.1310
7	3.9620	4.0814	4.0986	4.0814
8	3.0949	4.1057	4.0548	4.1057
9	3.2576	4.0642	3.9589	4.0642
10	4.0424	4.0424	3.7897	4.0424
11	1.6802	1.3326	1.6198	1.3326
12	1.7654	1.7108	1.6625	1.7108
13	1.5390	1.6976	1.7088	1.6976
14	1.7074	1.7074	1.7434	1.7074
15	1.4566	1.7055	1.7450	1.7055
16	1.1236	1.6996	1.7667	1.6996
17	.7437	1.6675	1.7443	1.6675
18	1.6630	1.6630	1.7281	1.6630
19	1.6798	1.6798	1.7544	1.6798
20	1.6892	1.6892	1.7485	1.6892
21	1.6754	1.6754	1.7393	1.6754
22	1.6990	1.6990	1.7614	1.6990
23	1.7160	1.7160	1.7648	1.7160
24	.2598	.2598	.2598	.2598
25	.2424	.2424	.2424	.2424
26	.2400	.2400	.2400	.2400
	67.5414	64.7246	67.0064	64.7246

purchasing the longest maturity for which funds were available. The "max Y" strategy assumed purchases of the highest yielding maturities available. This strategy was at all points coincident with the "short strategy." All strategies were based upon the same cash forecast.

The bottom line of Table XXVII is the totals of weekly profit indexes for all strategies. Although the model strategy shows an aggregate result which is slightly better than the other strategies, its performance on a weekly basis is rather undramatic. Curiously enough, the results show that there was very little difference between the performance of any of the strategies.

One major strength of the model that is not reflected in the performance comparisons of Table XXVI is the weekly plot of the leading indicator. The model makes investment selections based on the aggregate slope of the leading indicator, and, in so doing, ignores peaks and valleys. Observation of the actual slope of the indicator curve would allow the money manager to modify the strategy suggested by the model. Though the leading indicator has not been infallible over its short history, it has predicted several major peaks, as can be seen in Figure 6.

It is very possible that the model would have shown better performance given a longer trial. Lack of data, as previously mentioned, dictated the brevity of the test. The funds available for twenty-six weeks were dropped from consideration after week ten, and those available for sixteen weeks after week twenty-three, because rates were not available for evaluating investments far enough in the future.

CHAPTER VI

RECOMMENDATIONS FOR FURTHER RESEARCH AND POSSIBLE REFINEMENTS TO THE MODEL

It is unfortunate that a suitable leading indicator could not be constructed from T-Bill data that were analyzed in the foregoing study. The amount of data available for T-Bills would certainly have made the results of the study more conclusive. However, the leading indicator developed here is based on the yield differential between six-month and twelve-month instruments. For T-Bills this differential proved to be quite small and very consistent. It is believed that this consistency is the reason for the failure of the T-Bill data to yield a useful relationship.

It is also unfortunate that only a little over a year of useful data was available. Prior to February, 1973, negotiable CD's were under Regulation "Q" and, like T-Bills, exhibited a consistent differential between yields of different maturities. This scarcity of data

would lead one to question the continuing validity of the leading indicator developed in the study.

Another fact that throws some shadow of doubt over the validity of the study results is that over almost the entire period of CD analysis the term structure of interest rates has been inverted. Whether or not the leading indicator will work when the term structure is normal (long-term rates higher than short-term rates) remains to be seen. The credibility of the leading indicator can only be established with time and continued testing.

In Chapter IV, the model described in this study was said to be general in nature. Actually, it is more like an engineering prototype. As such, it has many rough edges. The modifications needed to make it a production model are many.

From the results of comparison of the model strategy with other strategies, it is apparent that the optimum seeking section of the model needs to be more sensitive to weekly changes in the leading indicator. Also, it is severely limited by its inability to consider more than three maturities. The assumptions imposed during the model test may have simplified calculations, but probably restricted performance.

A modification that would be required to render this model operational would be the addition of transaction cost analysis capability. Although transaction costs were assumed to be equal for all strategies tested, and therefore irrelevant, the number of transactions were not the same for all strategies.

In this study the author has attempted to demonstrate that a computer-aided model is a feasible, and potentially useful tool for short-term investment decision making. Naturally, the accuracy with which the model is able to forecast the future is the real key to its usefulness. No amount of sophistication and refinement of the model can overcome the lack of an accurate indicator.

The first modification of the basic model described in this study is presently being developed. In addition to the refinements mentioned above, the new model will have the capability of maintaining a running cash availability schedule. This will take into consideration profits made from previous investments and will aid in deciding which maturities to liquidate when unforeseen cash needs occur. The same indicator used in the present model will be

employed in the new, for, at this point, no better has been found by the author.

If better indicators have been found by other researchers, they have been very slow in making them known. It may be that the publication of an accurate forecasting model would be self-destructive.

APPENDIX A

COMPUTER TEST RUNS - WEEKS 11 THROUGH 26

APPENDIX A

COMPUTER TEST RUNS - WEEKS 11 THROUGH 26

WEEK ELEVEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.85	10.93	10.10
2	10.80	10.25	9.80
3	11.02	10.91	9.65
4	10.95	10.38	8.50
5	10.92	10.23	8.50
6	10.89	10.13	8.60
7	9.90	9.20	8.20
8	9.61	8.80	7.60
9	9.52	8.70	7.40
10	9.23	8.50	7.83
11	8.83	8.10	7.55
12	8.50	7.90	7.40
13	8.88	8.50	7.73

WEEK ELEVEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	2.43
3	1.62
4	1.00
5	1.15
6	1.35
7	1.88
8	1.68
9	1.58
10	2.21
11	2.33
12	2.38
13	2.11

Slope = 0.01

WEEK TWELVE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.80	10.25	9.80
2	11.02	10.91	9.65
3	10.95	10.38	8.50
4	10.92	10.23	8.50
5	10.89	10.13	8.60
6	9.90	9.20	8.20
7	9.61	8.80	7.60
8	9.52	8.70	7.40
9	9.23	8.50	7.83
10	8.83	8.10	7.55
11	8.50	7.90	7.40
12	8.88	8.50	7.73
13	9.18	8.50	7.88

WEEK TWELVE INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	1.62
3	1.00
4	1.15
5	1.35
6	1.88
7	1.68
8	1.58
9	2.21
10	2.33
11	2.38
12	2.11
13	2.26

Slope = 0.05

WEEK THIRTEEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	11.02	10.91	9.65
2	10.95	10.38	8.50
3	10.92	10.23	8.50
4	10.89	10.13	8.60
5	9.90	9.20	8.20
6	9.61	8.80	7.60
7	9.52	8.70	7.40
8	9.23	8.50	7.83
9	8.83	8.10	7.55
10	8.50	7.90	7.40
11	8.88	8.50	7.73
12	9.18	8.50	7.88
13	9.40	8.82	7.93

WEEK THIRTEEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.88
2	1.00
3	1.15
4	1.35
5	1.88
6	1.68
7	1.58
8	2.21
9	2.33
10	2.38
11	2.11
12	2.26
13	1.99

Slope = 0.05

WEEK FOURTEEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.95	10.38	8.50
2	10.92	10.23	8.50
3	10.89	10.13	8.60
4	9.90	9.20	8.20
5	9.61	8.80	7.60
6	9.52	8.70	7.40
7	9.23	8.50	7.83
8	8.83	8.10	7.55
9	8.50	7.90	7.40
10	8.88	8.50	7.73
11	9.18	8.50	7.88
12	9.40	8.82	7.93
13	9.38	8.65	7.70

WEEK FOURTEEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.73
2	1.00
3	1.20
4	1.73
5	1.53
6	1.43
7	2.06
8	2.18
9	2.23
10	1.96
11	2.11
12	1.84
13	1.78

Slope = 0.03

WEEK FIFTEEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.92	10.23	8.50
2	10.89	10.13	8.60
3	9.90	9.20	8.20
4	9.61	8.80	7.60
5	9.52	8.70	7.40
6	9.23	8.50	7.83
7	8.83	8.10	7.55
8	8.50	7.90	7.40
9	8.88	8.50	7.73
10	9.18	8.50	7.88
11	9.40	8.82	7.93
12	9.38	8.65	7.70
13	9.48	8.98	8.00

WEEK FIFTEEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.53
2	1.00
3	1.53
4	1.33
5	1.23
6	1.86
7	1.98
8	2.03
9	1.76
10	1.91
11	1.64
12	1.58
13	1.55

Slope = 0.00

WEEK SIXTEEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	10.89	10.13	8.60
2	9.90	9.20	8.20
3	9.61	8.80	7.60
4	9.52	8.70	7.40
5	9.23	8.50	7.83
6	8.83	8.10	7.55
7	8.50	7.90	7.40
8	8.88	8.50	7.73
9	9.18	8.50	7.88
10	9.40	8.82	7.93
11	9.38	8.65	7.70
12	9.48	8.98	8.00
13	9.31	8.78	7.80

WEEK SIXTEEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.30
2	1.30
3	1.10
4	1.00
5	1.63
6	1.75
7	1.80
8	1.53
9	1.68
10	1.41
11	1.35
12	1.32
13	1.32

Slope = -0.02

WEEK SEVENTEEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.90	9.20	8.20
2	9.61	8.80	7.60
3	9.52	8.70	7.40
4	9.23	8.50	7.83
5	8.83	8.10	7.55
6	8.50	7.90	7.40
7	8.88	8.50	7.73
8	9.18	8.50	7.88
9	9.40	8.82	7.93
10	9.38	8.65	7.70
11	9.48	8.98	8.00
12	9.31	8.78	7.80
13	9.14	8.50	7.50

WEEK SEVENTEEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.30
2	1.10
3	1.00
4	1.63
5	1.75
6	1.80
7	1.53
8	1.68
9	1.41
10	1.35
11	1.32
12	1.32
13	1.30

Slope = -0.03

WEEK EIGHTEEN

Recommended Maturity Selections
(1-3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.61	8.80	7.60
2	9.52	8.70	7.40
3	9.23	8.50	7.83
4	8.83	8.10	7.55
5	8.50	7.90	7.40
6	8.88	8.50	7.73
7	9.18	8.50	7.88
8	9.40	8.82	7.93
9	9.38	8.65	7.70
10	9.48	8.98	8.00
11	9.31	8.78	7.80
12	9.14	8.50	7.50
13	9.18	8.38	7.50

WEEK EIGHTEEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.30
2	1.00
3	1.63
4	1.75
5	1.80
6	1.53
7	1.68
8	1.41
9	1.35
10	1.32
11	1.32
12	1.30
13	1.42

Slope = -0.04

WEEK NINETEEN

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.52	8.70	7.40
2	9.23	8.50	7.83
3	8.83	8.10	7.55
4	8.50	7.90	7.40
5	8.88	8.50	7.73
6	9.18	8.50	7.88
7	9.40	8.82	7.93
8	9.38	8.65	7.70
9	9.48	8.98	8.00
10	9.31	8.78	7.80
11	9.14	8.50	7.50
12	9.18	8.38	7.50
13	9.10	8.38	7.50

WEEK NINETEEN INDICATOR VALUES

INDICATOR

Week	Value
1	2.00
2	1.33
3	1.45
4	1.50
5	1.23
6	1.38
7	1.11
8	1.05
9	1.02
10	1.02
11	1.00
12	1.12
13	1.12

Slope = -0.05

WEEK TWENTY

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.23	8.50	7.83
2	8.83	8.10	7.55
3	8.50	7.90	7.40
4	8.88	8.50	7.73
5	9.18	8.50	7.88
6	9.40	8.82	7.93
7	9.38	8.65	7.70
8	9.48	8.98	8.00
9	9.31	8.78	7.80
10	9.14	8.50	7.50
11	9.18	8.38	7.50
12	9.10	8.38	7.50
13	8.99	8.00	7.10

WEEK TWENTY INDICATOR VALUES

INDICATOR

Week	Value
1	2.00
2	1.45
3	1.50
4	1.23
5	1.38
6	1.11
7	1.05
8	1.02
9	1.02
10	1.00
11	1.12
12	1.12
13	1.10

Slope = -0.05

WEEK TWENTY-ONE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	3
1000.00	3
2000.00	3

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	8.83	8.10	7.55
2	8.50	7.90	7.40
3	8.88	8.50	7.73
4	9.18	8.50	7.88
5	9.40	8.82	7.93
6	9.38	8.65	7.70
7	9.48	8.98	8.00
8	9.31	8.78	7.80
9	9.14	8.50	7.50
10	9.18	8.38	7.50
11	9.10	8.38	7.50
12	8.99	8.00	7.10
13	9.10	8.33	7.67

WEEK TWENTY-ONE INDICATOR VALUES

INDICATOR

Week	Value
1	2.00
2	1.50
3	1.23
4	1.38
5	1.11
6	1.05
7	1.02
8	1.02
9	1.00
10	1.12
11	1.12
12	1.10
13	1.34

Slope = -0.04

WEEK TWENTY-TWO

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	8.50	7.90	7.40
2	8.88	8.50	7.73
3	9.18	8.50	7.88
4	9.40	8.82	7.93
5	9.38	8.65	7.70
6	9.48	8.98	8.00
7	9.31	8.78	7.80
8	9.14	8.50	7.50
9	9.18	8.38	7.50
10	9.10	8.38	7.50
11	8.99	8.00	7.10
12	9.10	8.33	7.67
13	9.06	8.56	7.56

WEEK TWENTY-TWO INDICATOR VALUES

INDICATOR

Week	Value
1	2.00
2	1.23
3	1.38
4	1.11
5	1.05
6	1.02
7	1.02
8	1.00
9	1.12
10	1.12
11	1.10
12	1.34
13	1.00

Slope = -0.03

WEEK TWENTY-THREE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	8.88	8.50	7.73
2	9.18	8.50	7.88
3	9.40	8.82	7.93
4	9.38	8.65	7.70
5	9.48	8.98	8.00
6	9.31	8.78	7.80
7	9.14	8.50	7.50
8	9.18	8.38	7.50
9	9.10	8.38	7.50
10	8.99	8.00	7.10
11	9.10	8.33	7.67
12	9.06	8.56	7.56
13	8.65	8.19	7.50

WEEK TWENTY-THREE INDICATOR VALUES

INDICATOR

Week	Values
1	2.00
2	1.38
3	1.11
4	1.05
5	1.02
6	1.02
7	1.00
8	1.12
9	1.12
10	1.10
11	1.34
12	1.00
13	1.31

Slope = -0.02

WEEK TWENTY-FOUR

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.18	8.50	7.88
2	9.40	8.82	7.93
3	9.38	8.65	7.70
4	9.48	8.98	8.00
5	9.31	8.78	7.80
6	9.14	8.50	7.50
7	9.18	8.38	7.50
8	9.10	8.38	7.50
9	8.99	8.00	7.10
10	9.10	8.33	7.67
11	9.06	8.56	7.56
12	8.65	8.19	7.50
13	8.08	7.68	7.40

WEEK TWENTY-FOUR INDICATOR VALUES

INDICATOR

Week	Value
1	2.00
2	1.11
3	1.05
4	1.02
5	1.02
6	1.00
7	1.12
8	1.12
9	1.10
10	1.34
11	1.00
12	1.31
13	1.72

Slope = 0.00

WEEK TWENTY-FIVE

Recommended Maturity Selections
(1=3 Mo. or Less, 2 = 6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.40	8.82	7.93
2	9.38	8.65	7.70
3	9.48	8.98	8.00
4	9.31	8.78	7.80
5	9.14	8.50	7.50
6	9.18	8.38	7.50
7	9.10	8.38	7.50
8	8.99	8.00	7.10
9	9.10	8.33	7.67
10	9.06	8.56	7.56
11	8.65	8.19	7.50
12	8.08	7.68	7.40
13	8.00	7.68	7.40

WEEK TWENTY-FIVE INDICATOR VALUES

INDICATOR

Week	Value
1	2.00
2	1.05
3	1.02
4	1.02
5	1.00
6	1.12
7	1.12
8	1.10
9	1.34
10	1.00
11	1.31
12	1.72
13	1.72

Slope = 0.02

WEEK TWENTY-SIX

Recommended Maturity Selections
(1=3 Mo. or Less, 2=6 Mo., 3 = 12 Mo.)

Amount	Maturity
1500.00	1
1000.00	1
2000.00	1

Actual Yields
(Past 13 Weeks)

Week	3 Mo.	6 Mo.	12 Mo.
1	9.38	8.65	7.70
2	9.48	8.98	8.00
3	9.31	8.78	7.80
4	9.14	8.50	7.50
5	9.18	8.38	7.50
6	9.10	8.38	7.50
7	8.99	8.00	7.10
8	9.10	8.33	7.67
9	9.06	8.56	7.56
10	8.65	8.19	7.50
11	8.08	7.68	7.40
12	8.00	7.68	7.40
13	7.98	7.53	7.25

WEEK TWENTY-SIX INDICATOR VALUES

INDICATOR

Week	Value
1	2.00
2	1.02
3	1.02
4	1.00
5	1.12
6	1.12
7	1.10
8	1.34
9	1.00
10	1.31
11	1.72
12	1.72
13	1.72

Slope = 0.03

APPENDIX B

THE MODEL COMPUTER PROGRAM

APPENDIX B

THE MODEL COMPUTER PROGRAM

MAIN

```
      DIMENSION IPER(50),DA(100,4)
      DIMENSION JPER(50),PROF(3,50)
      DIMENSION AA(500),FBI(100),RATA(50),RATB(50),RATC(50)
      DIMENSION FB(100),AVB(100,100),A(100),B(100),C(100)
      DIMENSION Y(50),X(50),VEST(60),FY(50),FX(50)

      READ(5,2000)IXT,LEADX,LEADY
 2000 FORMAT(313)
      DO 10 I = 1,IXT
   10 READ(5,2010)FB(I)
      DO 20 I = 1,LEADX
      READ(5,2020)A(I),B(I),C(I)
      DA(I,1)=I
      DA(I,2)=A(I)
      DA(I,3)=B(I)
   20 DA(I,4)=C(I)
 2010 FORMAT(F8.2)
 2020 FORMAT(6X,3F5.2)

   15 CONTINUE

      XINDM = 0.0
      X(1) = 0.0
      DO 30 I = 2, LEADX
      IF(C(I) - B(I))31,31,32
   32 X(I) = X(I-1) + (C(I) -B(I))
      XINDM = X(I)
      GO TO 30
   31 X(I) = XINDM + (C(I) -B(I))
   30 CONTINUE
      XINDM = 0.0
      DO 40 I = 1,LEADX
      IF(X(I).LT.XINDM) XINDM = X(I)
   40 CONTINUE
      IF (XINDM.GT.0.0) GO TO 50
```

```
      DO 45 I = 1,LEADX
      X(I) = X(I) -(XINDM-1.0)
   45 CONTINUE

   50 DO 60 I = 1,LEADY
      Y(I) = (2.*C(I+10))-B(I+10)
   60 CONTINUE

      DO 65 I = 1,IXT
   65 FBI(I) = FB(I)
      DO 70 I = 1,IXT
      DO 70 J = 1,IXT
   70 AVB(I,J) = 0.0
      CALL XLIM(FB,IXT,II,JJ)
   75 IF(II.GE.IXT) GO TO 90
      IF(II.EQ.JJ) GO TO 90
      XMIN = FB(II)
      IL = II + 1
      DO 80 I = IL,JJ
      IF (FB(I).GT.XMIN) GO TO 80
      XMIN = FB(I)
   80 CONTINUE
      AVB(II,JJ) = XMIN
      DO 85 I = II,JJ
      FB(I) = FB(I) - XMIN
   85 CONTINUE
      GO TO 100
   90 AVB(II,JJ) = FB(II)
      FB(II) = 0.0
      IF(II.GE.IXT) GO TO 105
  100 CALL XLIM(FB,IXT,II,JJ)
      GO TO 75
  105 CONTINUE

      DO 110 I = 1,LEADX
      FX(I) = X(I)
  110 CONTINUE
      DO 120 I = 1,LEADY
      FY(I) = Y(I)
  120 CONTINUE

      XI = 0.
      SUMXY = 0.
      SUMX = 0.
```

```
      SMX2 = 0.
      SUMY = 0.
      DO 130 I = 1,LEADX
      XI = I
      SUMXY = SUMXY +(XI*FX(I))
      SUMX = SUMX + XI
      SUMY = SUMY + FX(I)
      SUMX2 = SUMX2 + XI**2
  130 CONTINUE
      SLOPX = ((XI*SUMXY)-(SUMX*SUMY))/((FLOAT(LEADX)*SUMX2)
         -(SUMX**2))
      XI = 0.
      SUMXY = 0.
      SUMX = 0.
      SUMX2 = 0.
      SUMY = 0.
      DO 140 I = 1,LEADY
      XI = I
      SUMX = SUMX + XI
      SUMY = SUMY + FY(I)
      SUMX2 = SUMX2 + XI**2
  140 CONTINUE
      SLOPY =((XI*SUMXY)-(SUMX*SUMY))/((FLOAT(LEADY)*SUMX2)
         -(SUMX**2))

      DO 150 J = 1,IXT
      IF(AVB(1,J).EG.).) GO TO 150
      IF(J.LE.LEADY) GO TO 145
      RATA(J) = A(LEADX) + SLOPX *J
      RATB(J) = B(LEADX) + SLOPX *J
      RATC(J) = C(LEADX) + SLOPX * J
      GO TO 150
  145 RATA(J) = A(LEADX) + SLOPY * J
      RATB(J) = B(LEADX) + SLOPY * J
      RATC(J) = C(LEADX) + SLOPY * J
  150 CONTINUE
      DO 160 J = 1,IXT
      IF(AVB(1,J).EG.0.) GO TO 160
      PROF(1,J) = (A(LEADX)*13.)-(RATA(J)*(13-J))
      PROF(2,J) = (B(LEADX)*26.)-(RATB(J)*(26-J))
      PROF(3,J) = (C(LEADX)*52.)-(RATC(J)*(52-J))
      XMAX = PROF(1,J)
      IPER(J) = 1
      DO 170 I = 2,3
```

```
      IF(PROF(I,J).LE.XMAX) GO TO 170
      IPER(J) = I
  170 CONTINUE
  160 CONTINUE

 1000 FORMAT('1',T30,'FREE CASH BALANCE FORECAST')
 1010 FORMAT('0',T20,'WEEK',T54,'AMOUNT AVAILABLE (000)')
 1020 FORMAT('0')
 1030 FORMAT(' ',T21,I2,T60,F8.2)
 1040 FORMAT('1',T29,'CASH AVAILABLE FOR INVESTMENT')
 1050 FORMAT('0',T8,'WEEK AVAILABLE',T35,'WEEK BACK TO CASH',
        T66,'AMOUNT
     1 (000)')
 1060 FORMAT(' ',T14,I2,T42,I2,T67,F8.2)
 1080 FORMAT('0',T39,'INDICATOR I')
 1070 FORMAT('1',T36,'INDICATOR VALUES')
 1090 FORMAT('0',T20,'WEEK',T62,'VALUE')
 1095 FORMAT('0',T39,'SLOPE = ',F5.2)
 1100 FORMAT(' ',T21,I2,T61,F8.2)
 1110 FORMAT('0',T38,'INDICATOR II')
 1120 FORMAT('1',T28,'RECOMMENDED MATURITY SELECTIONS')
 1125 FORMAT(' ',T25,'(1=3 MO. OR LESS, 2 = 6 MO., 3 = 12
        MO.)')
 1130 FORMAT('0',T19,'AMOUNT',T60,'MATURITY')
 1140 FORMAT(' ',T18,F8.2,T63,I2)
 1150 FORMAT('0',T37,'ACTUAL YIELDS')
 1160 FORMAT(' ',T36,'(PAST 13 WEEKS)')
 1170 FORMAT('0',T13,'WEEK',T31,'3 MO.',T49,'6 MO.',T66,'12
        MO.')
 1180 FORMAT(' ',T13,F5.2,T31,F5.2,T49,F5.2,T65,F5.2)
 3000 FORMAT ('0',T33,'ADJUSTED FREE BALANCES')
 3010 FORMAT ('0',T20,'WEEK',T59,'AMOUNT(000)')
 3020 FORMAT (' ',T21,I2,T61,F8.2)
      WRITE(6,1000)
      WRITE(6,1010)
      WRITE(6,1020)
      DO 200 I = 1,IXT
  200 WRITE(6,1030)I,FBI(I)
      WRITE(6,1040)
      WRITE(6,1050)
      WRITE(6,1020)
      DO 210 I = 1,IXT
      DO 210 J = 1,IXT
      IF(AVB(I,J).EQ.0.) GO TO 210
```

```
      WRITE(6,1060)I,J,AVB(I,J)
  210 CONTINUE
      WRITE(6,1070)
      WRITE(6,1080)
      WRITE(6,1090)
      WRITE(6,1020)
      DO 220 I = 1,3
  220 WRITE(6,1100) I,Y(I)
      WRITE(6,1095) SLOPY
      WRITE(6,1110)
      WRITE(6,1090)
      WRITE(6,1020)
      DO 230 I = 1,LEADX
  230 WRITE(6,1100) I,X(I)
      WRITE(6,1095) SLOPX
      WRITE(6,1120)
      WRITE(6,1125)
      WRITE(6,1130)
      WRITE(6,1020)
      DO 240 J = 1,IXT
      IF(AVB(1,J).EQ.0.) GO TO 240
      WRITE(6,1140)AVB(1,J),IPER(J)
  240 CONTINUE
      WRITE(6,1150)
      WRITE(6,1160)
      WRITE(6,1170)
      WRITE(6,1020)
      DO 250 I = 1, LEADX
  250 WRITE(6,1180) I,A(I),B(I),C(I)
      CALL PLOT(DA,4,LEADX)
      DO 4 I = 1,13
    4 DA(I,2)=X(I)
      CALL PLOT(DA,2,LEADX)
      I = LEADX + 1
      READ(5,2020) A(I),B(I),C(I)
      IF(A(I).EQ.0.) GO TO 555
      DO 500 I = 1,LEADX
      A(I) = A(I+1)
      B(I) = B(I+1)
      C(I) = C(I+1)
      DA(I,1) = I
      DA(I,2) = A(I)
      DA(I,3) = B(I)
      DA(I,4) = C(I)
```

```
500 CONTINUE
    DO 510 I = 1,IXT
    FB(I) = FBI(I)
510 CONTINUE
    GO TO 15
555 STOP
    END
```

XLIM

```
    SUBROUTINE XLIM(A,K,J1,M1)
    DIMENSION A(52)
    DO 2000 I = 1,K
    IF(A(I).NE.0.0) GO TO 2010
2000 CONTINUE
2010 J1 = I
    IF(J1.EQ.K) GO TO 2040
    J = I + 1
    DO 2020 I = J,K
    IF(A(I).EQ.0.0) GO To 2030
2020 CONTINUE
    M1 = K
    GO TO 2050
2030 M1 = I-1
    GO TO 2050
2040 J1 = K
    M1 = K
2050 RETURN
    END
```

PLOT

```
      SUBROUTINE PLOT(DA,M,N)
      DIMENSION OUT(101),YPR(11),ANG(9),TITLE(20),DATA(10000),
         DA(100,4)

      NL=25
      DO 10 I=1,N
      I1=N+I
      I2=2*N+I
      I3=3*N+I
      DATA(I)=DA(I,1)
      DATA(I1)=DA(I,2)
      DATA(I2)=DA(I,3)
10    DATA(I3)=DA(I,4)
      READ(5,1) (TITLE(I),I=1,20)
      READ(5,2) BLANK,(ANG(I),*=1,9)
      WRITE(6,13)
13    FORMAT(1H1)
      WRITE(6,1) (TITLE(I),*=1,20)
      WRITE(6,4)
      XSCAL=(DATA(N)-DATA(1))/(FLOAT(NL-1))
      M1=N+1
      YMIN=DATA(M1)
      YMAX=YMIN
      M2=M*N
      DO 40 J=M1,M2
      IF(DATA(J)-YMIN) 28,26,26
26    IF(DATA(J)-YMAX) 40,40,30
28    YMIN=DATA(J)
      GO TO 40
30    YMAX=DATA(J)
40    CONTINUE
      YSCAL=(YMAX-YMIN)/100.
      XB=DATA(1)
      L=1
      MY=M-1
      I=1
45    F=I-1.
      XPR=XB+F*XSCAL
      IF(DATA(L)-XPR) 50,50,70
50    DO 55 IX=1,101
55    OUT(IX)=BLANK
      DO 60 J=1,MY
```

```
      LL=L+J*N
      JP=((DATA(LL)-YMIN)/YSCAL)+1.
      OUT(JP)=ANG(J)
60    CONTINUE
      WRITE(6,3) XPR,(OUT(IZ),IZ=1,101)
      L=1+1
      GO TO 80
70    WRITE(6,4)
80    I=I+1
      IF(I-NL) 45,84,86
84    XPR=DATA(N)
      GO TO 50
86    WRITE(6,7)
      YPR(1)=YMIN
      DO 90 KN=1,9
90    YPR(KN+1)=YPR(KN)+YSCAL*10.
      YPR(11)=YMAX
      WRITE(6,8) (YPR(I),*=1,11)
1     FORMAT(20A4)
2     FORMAT(10A1)
3     FORMAT(1H ,F11.4,2X,'1',2X,101A1)
4     FORMAT(1H )
7     FORMAT(1H ,16X,101H.

8     FORMAT(1H0,9X,11F10.4)
      RETURN
      END
```

APPENDIX C

CERTIFICATES OF DEPOSIT RATES

01/05/73 TO 04/26/74

APPENDIX C

CERTIFICATES OF DEPOSIT RATES

01/05/73 TO 04/26/74

Date	Weekly Average Yields Bank Negotiable Certificates of Deposit ($100,000 or more)				
	1 Month	2 Month	3 Month	6 Month	12 Month
01/05/73	5.25	5.375	5.50	5.625	5.625
01/12/73	5.35	5.475	5.60	5.725	5.725
01/19/73	5.375	5.50	5.625	5.75	5.75
01/26/73	5.515	5.66	5.765	5.87	5.95
02/02/73	5.65	5.80	5.90	6.10	6.20
02/09/73	5.65	5.80	5.90	6.10	6.25
02/16/73	5.65	5.80	5.90	6.10	6.25
02/23/73	5.84	5.98	6.09	6.285	6.375
03/02/73	6.175	6.30	6.45	6.60	6.625
03/09/73	6.35	6.50	6.60	6.80	6.85
03/16/73	6.75	6.93	7.08	7.00	7.15
03/23/73	6.98	7.105	7.23	7.00	7.125
03/30/73	7.01	7.135	7.27	7.00	7.25
04/06/73	7.105	7.24	7.445	7.0	7.25
04/13/73	6.95	7.095	7.21	7.00	7.25
04/20/73	6.96	7.125	7.26	7.00	7.25
04/27/73	7.01	7.19	7.345	7.00	7.25
05/04/73	7.09	7.26	7.40	7.00	7.25
05/11/73	7.09	7.29	7.44	7.00	7.25
05/18/73	7.12	7.335	7.48	7.13	7.25
05/25/73	7.29	7.49	7.63	7.565	7.46
06/01/73	7.43	7.605	7.73	7.75	7.605
06/08/73	7.765	7.89	7.97	7.96	7.60
06/15/73	7.955	8.03	8.08	7.99	7.5
06/22/73	8.08	8.16	8.245	8.06	7.625
06/29/73	8.375	8.495	8.625	8.425	8.025

Date	Weekly Average Yields Bank Negotiable Certificates of Deposit ($100,000 or more)				
	1 Month	2 Month	3 Month	6 Month	12 Month
07/06/73	8.81	8.90	9.01	8.62	8.15
07/13/73	9.09	9.16	9.26	8.90	8.325
07/20/73	9.365	9.49	9.605	9.315	8.93
07/27/73	9.955	10.045	10.14	9.885	9.335
08/03/73	10.055	10.175	10.275	10.25	9.47
08/10/73	10.41	10.545	10.69	10.695	9.80
08/17/73	10.39	10.72	10.845	10.925	10.10
08/24/73	10.20	10.65	10.80	10.25	9.80
08/31/73	10.605	10.845	11.02	10.91	9.65
09/07/73	10.615	10.83	10.95	10.375	8.50
09/14/73	10.645	10.80	10.92	10.23	8.50
09/21/73	10.60	10.78	10.885	10.125	8.60
09/28/73	9.95	9.965	9.895	9.20	8.20
10/05/73	9.775	9.625	9.61	8.80	7.60
10/12/73	9.70	9.575	9.52	8.70	7.40
10/19/73	9.55	9.35	9.225	8.50	7.825
10/26/73	9.20	9.00	8.825	8.10	7.55
11/02/73	8.80	8.625	8.50	7.90	7.40
11/09/73	9.075	8.95	8.875	8.50	7.725
11/16/73	9.26	9.225	9.18	8.50	7.875
11/23/73	9.53	9.55	9.40	8.82	7.925
11/30/73	9.57	9.55	9.38	8.65	7.70
12/07/73	9.775	9.69	9.48	8.975	8.00
12/14/73	9.85	9.645	9.31	8.775	7.80
12/21/73	9.79	9.4o	9.135	8.50	7.50
12/28/73	9.97	9.81	9.183	8.375	7.50
01/04/74	9.72	9.425	9.10	8.375	7.50
01/11/74	9.385	9.165	8.985	8.00	7.10
01/18/74	9.41	9.25	9.10	8.33	7.666
01/25/74	9.34	9.23	9.06	8.56	7.56
02/01/74	8.85	8.75	8.66	8.19	7.50
02/08/74	8.33	8.20	8.08	7.60	7.30
02/15/74	8.25	8.125	8.00	7.675	7.40
02/22/74	7.98	7.53	7.98	7.53	7.25
03/01/74	8.36	8.26	8.14	7.54	7.125
03/08/74	8.545	8.435	8.33	7.73	7.20
03/15/74	8.76	8.615	8.49	8.105	7.60

Date	Weekly Average Yields Bank Negotiable Certificates of Deposit ($100,000 or more)				
	1 Month	2 Month	3 Month	6 Month	12 Month
03/22/74	9.045	8.97	8.885	8.325	7.775
03/29/74	9.50	9.51	9.505	9.20	8.60
04/05/74	9.79	9.78	9.75	9.454	9.00
04/12/74	10.025	10.045	10.06	9.75	9.10
04/19/74	10.138	10.20	10.18	9.625	9.00
04/26/74	10.515	10.515	10.505	10.045	9.42

APPENDIX D

T-BILL RATES 01/02/60 TO 11/03/73

APPENDIX D

T-BILL RATES 01/02/60 TO 11/03/73

Date	Yields		
	90 Day	180 Day	360 Day
10260	4.40	4.91	5.02
10960	4.59	5.07	5.15
11660	4.53	4.81	4.96
12360	4.27	4.60	4.92
13090	4.01	4.49	4.76
20660	3.94	4.42	4.56
21360	3.67	4.08	4.41
22060	4.04	4.30	4.41
22760	4.14	4.34	4.39
30560	3.92	4.27	4.31
31260	3.60	3.87	3.97
31960	3.41	3.57	3.56
32660	2.84	3.17	3.27
40260	2.88	3.21	3.32
40960	2.96	3.18	3.30
41660	3.56	3.86	3.91
42360	3.34	3.73	4.17
43060	3.19	3.58	4.08
50760	3.08	3.41	4.01
51460	3.32	3.55	4.05
52160	3.50	3.77	4.09
52860	3.29	3.64	3.75
60460	2.94	3.18	3.56
61160	2.61	2.80	3.23
61860	2.31	2.52	2.90
62560	2.39	2.76	3.04
70260	2.18	2.64	2.95
70930	2.27	2.85	3.03
71660	2.41	2.87	3.07
72360	2.31	2.62	3.12
73060	2.24	2.56	2.92
80660	2.13	2.39	2.81

Date	Yields		
	90 Day	180 Day	360 Day
81360	2.18	2.48	2.79
82060	2.31	2.66	2.83
82760	2.43	2.70	2.81
90360	2.53	2.82	2.87
91060	2.56	2.83	2.87
91760	2.58	2.87	2.89
92460	2.43	2.80	2.82
100160	2.35	2.82	2.87
100860	2.40	2.88	2.92
101560	2.54	2.88	2.95
102260	2.23	2.71	2.99
102960	2.11	2.53	2.85
110560	2.20	2.50	2.82
111260	2.40	2.59	2.85
111960	2.46	2.75	2.91
112660	2.38	2.71	2.87
120360	2.35	2.70	2.86
121060	2.28	2.62	2.77
121760	2.25	2.50	2.63
122460	2.24	2.42	2.56
123160	2.18	2.38	2.50
10761	2.28	2.48	2.56
11461	2.28	2.51	2.57
12161	2.25	2.46	2.71
12861	2.17	2.42	2.66
20461	2.29	2.49	2.68
21161	2.35	2.55	2.71
21861	2.40	2.59	2.73
22561	2.51	2.68	2.83
30461	2.56	2.75	2.86
31161	2.44	2.56	2.76
31861	2.35	2.74	2.71
32861	2.35	2.47	2.71
40161	2.38	2.54	2.78
40861	2.36	2.58	2.75
41561	2.31	2.52	2.68
42261	2.25	2.41	2.77
42961	2.23	2.35	2.76
50661	2.22	2.38	2.69

Date	Yields		
	90 Day	180 Day	360 Day
51361	2.23	2.40	2.66
52061	2.29	2.43	2.70
52761	2.39	2.53	2.80
60361	2.38	2.60	2.82
61061	2.40	2.64	2.83
61761	2.32	2.50	2.78
62461	2.31	2.50	2.78
70161	2.27	2.45	2.77
70861	2.31	2.79	2.80
71561	2.25	2.46	2.72
72261	2.19	2.39	2.81
72961	2.22	2.76	2.83
80561	2.28	2.51	2.85
81261	2.38	2.64	2.93
81961	2.50	2.78	2.95
82661	2.43	2.71	2.89
90261	2.34	2.65	2.90
90961	2.32	2.67	2.89
91661	2.29	2.68	2.88
92361	2.26	2.69	2.87
93061	2.25	2.69	2.87
100761	2.28	2.64	2.83
101461	2.34	2.67	2.84
102161	2.29	2.67	2.97
102861	2.29	2.67	2.94
110461	2.28	2.58	2.88
111161	2.40	2.61	2.87
111861	2.53	2.74	2.93
112561	2.54	2.73	2.91
120261	2.56	2.78	2.91
120961	2.58	2.88	2.97
121661	2.59	2.89	2.97
122361	2.61	2.86	2.95
123061	2.66	2.90	3.02
10662	2.72	2.96	3.06
11362	2.78	3.02	3.12
12062	2.73	2.90	3.27
12762	2.67	2.87	3.25

Date	Yields		
	90 Day	180 Day	360 Day
20362	2.69	2.92	3.26
21062	2.70	2.92	3.24
21762	2.81	3.00	3.27
22462	2.74	2.93	3.18
30362	2.69	2.87	3.10
31062	2.74	2.88	3.05
31762	2.74	2.91	3.02
32462	2.70	2.84	3.93
33162	2.73	2.96	3.90
40762	2.72	2.82	3.86
41462	2.74	2.84	3.86
42162	2.72	2.82	2.95
42862	2.73	2.92	2.95
50562	2.74	2.83	2.94
51262	2.67	2.77	2.90
51962	2.67	2.77	2.91
52662	2.69	2.77	2.92
60262	2.68	2.76	2.88
60962	2.65	2.74	2.86
61662	2.69	2.76	2.86
62362	2.73	2.80	2.88
63062	2.84	2.90	2.97
70762	2.92	3.00	3.06
71462	2.97	3.09	3.12
72162	2.95	3.13	3.26
72862	2.88	3.09	3.22
80462	2.85	3.03	3.19
81162	2.93	3.03	3.19
81862	2.84	3.00	3.11
82562	2.82	2.96	3.04
90162	2.80	2.93	3.02
90862	2.82	2.95	3.04
91562	2.78	2.93	3.00
92262	2.77	2.93	2.98
92962	2.75	2.90	2.95
100662	2.75	2.89	2.90
101362	2.76	2.86	2.87
102062	2.74	2.84	2.92
102762	2.74	2.83	2.91

Date	Yields		
	90 Day	180 Day	360 Day
110362	2.74	2.82	2.90
111062	2.82	2.87	2.92
111762	2.82	2.86	2.94
112462	2.84	2.90	2.95
120162	2.86	2.94	2.97
120862	2.85	2.91	2.94
121562	2.84	2.88	2.93
122262	2.88	2.90	2.94
122962	2.89	2.93	2.95
10563	2.89	2.94	2.95
11263	2.90	2.95	2.96
11963	2.90	2.95	3.00
12663	2.93	2.99	3.03
20263	2.93	2.99	3.02
20963	2.95	3.00	3.02
21663	2.93	2.99	3.01
22363	2.90	2.96	2.99
30263	2.90	2.94	2.98
30963	2.89	2.93	2.97
31663	2.88	2.94	2.95
32363	2.90	2.96	2.97
33063	2.91	2.98	2.99
40663	2.91	2.98	2.99
41363	2.90	2.98	3.00
42063	2.90	3.00	3.07
42763	2.89	2.98	3.05
50463	2.90	2.99	3.05
51163	2.91	2.99	3.04
51863	2.90	2.99	3.04
52563	2.94	3.02	3.06
60163	2.98	3.06	3.09
60863	3.00	3.08	3.12
61563	2.98	3.07	3.11
62263	2.98	3.08	3.11
62963	2.99	3.07	3.11
70663	3.03	3.12	3.16
71363	3.22	3.34	3.39
72063	3.19	3.36	3.49
72763	3.19	3.36	3.47

Date	Yields		
	90 Day	180 Day	360 Day
80363	3.24	3.38	3.46
81063	3.26	3.39	3.48
81763	3.32	3.43	3.50
82463	3.36	3.47	3.52
83163	3.39	3.49	3.54
90763	3.36	3.47	3.56
91463	3.36	3.48	3.57
92163	3.41	3.51	3.58
92863	3.38	3.51	3.56
100563	3.41	3.53	3.59
101263	3.45	3.56	3.60
101963	3.47	3.59	3.61
102663	3.44	3.60	3.63
110263	3.47	3.59	3.60
110963	3.54	3.64	3.68
111663	3.55	3.68	3.69
112363	3.51	3.65	3.67
113063	3.48	3.63	3.66
120763	3.52	3.68	3.69
121463	3.50	3.66	3.68
122163	3.53	3.67	3.69
122863	3.52	3.64	3.69
10464	3.52	3.65	3.70
11164	3.53	3.66	3.72
11864	3.54	3.65	3.69
12564	3.52	3.63	3.66
20164	3.50	3.61	3.65
20864	3.51	3.63	3.65
21564	3.52	3.66	3.70
22264	3.53	3.69	3.71
22964	3.56	3.72	3.76
30764	3.56	3.74	3.78
31464	3.54	3.72	3.78
32164	3.54	3.72	3.77
32864	3.54	3.73	3.80
40464	3.52	3.70	3.77
41164	3.48	3.69	3.77
41864	3.47	3.67	3.78
42564	3.45	3.64	3.74

Date	Yields		
	90 Day	180 Day	360 Day
50264	3.45	3.64	3.74
50964	3.49	3.63	3.72
51664	3.47	3.59	3.71
52364	3.47	3.60	3.71
53064	3.47	3.58	3.70
60664	3.47	3.57	3.71
61364	3.47	3.57	3.71
62064	3.49	3.58	3.71
62764	3.47	3.53	3.68
70464	3.48	3.51	3.68
71164	3.48	3.53	3.67
71864	3.43	3.55	3.63
72564	3.46	3.61	3.65
80164	3.46	3.57	3.61
80864	3.48	3.58	3.65
81564	3.51	3.62	3.66
82264	3.50	3.63	3.67
82964	3.50	3.62	3.67
90564	3.50	3.64	3.70
91264	3.52	3.67	3.72
91964	3.54	3.69	3.74
92664	3.54	3.70	3.74
100364	3.55	3.71	3.77
101064	3.57	3.73	3.80
101764	3.58	3.72	3.80
102464	3.58	3.74	3.80
103164	3.56	3.71	3.77
110764	3.56	3.72	3.79
111464	3.58	3.74	3.79
112164	3.61	3.78	3.80
112864	3.78	3.96	4.00
120564	3.82	3.97	4.02
121264	3.81	3.94	3.96
121964	3.86	3.95	3.94
122664	3.86	3.94	3.94
10265	3.83	3.93	3.93
10965	3.80	3.92	3.92
11665	3.77	3.94	3.90
12365	3.81	3.94	3.90
10065	3.85	3.94	3.91

Date	Yields		
	90 Day	180 Day	360 Day
20665	3.89	3.97	3.97
21365	3.90	3.99	3.99
22065	3.94	4.02	4.02
22765	3.99	4.04	4.04
30665	3.96	4.02	4.05
31365	3.94	4.01	4.04
32065	3.92	3.99	4.00
32765	3.91	3.98	3.99
43650	3.92	3.99	4.01
41065	3.93	3.98	4.00
41765	3.93	4.00	4.00
42465	3.93	4.00	4.00
50165	3.91	3.98	3.98
50865	3.89	3.95	3.96
51565	3.89	3.96	3.96
52265	3.90	3.95	3.96
52965	3.88	3.94	3.95
60565	3.85	3.92	3.94
61265	3.80	3.88	3.93
61965	3.80	3.86	3.91
62665	3.78	3.82	3.82
70365	3.81	3.85	3.86
71065	3.86	3.90	3.91
71765	3.86	3.92	3.91
72465	3.82	3.89	3.87
73165	3.81	3.88	3.87
80765	3.84	3.94	3.94
81465	3.82	3.93	3.94
82165	3.82	3.93	3.95
82865	3.86	3.96	4.00
90465	3.87	4.00	4.03
91165	3.89	4.03	4.04
91865	3.88	4.04	4.03
92565	3.94	4.10	4.12
100265	4.01	4.17	4.19
100695	4.00	4.17	4.16
101665	4.00	4.18	4.14
102365	4.03	4.20	4.16
103065	4.05	4.19	4.16

Date	Yields		
	90 Day	180 Day	360 Day
110665	4.07	4.22	4.22
111365	4.06	4.23	4.24
112065	4.09	4.25	4.23
112065	4.09	4.25	4.23
112765	4.11	4.25	4.24
120465	4.21	4.26	4.29
121165	4.33	4.47	4.49
121865	4.40	4.58	4.59
122565	4.46	4.65	4.65
10166	4.47	4.66	4.70
10866	4.53	4.70	4.69
11566	4.59	4.73	4.68
12266	4.61	4.73	4.70
12966	4.57	4.68	4.67
20566	4.63	4.75	4.75
21266	4.63	4.78	4.77
21966	4.66	4.90	4.84
22666	4.66	4.87	4.86
30566	4.62	4.81	4.91
31266	4.63	4.83	4.87
31966	4.64	4.82	4.82
32666	4.50	4.70	4.72
40266	4.51	4.72	4.75
40966	4.53	4.68	4.75
41666	4.64	4.77	4.79
42366	4.65	4.74	4.75
43066	4.64	4.74	4.75
50766	4.66	4.80	4.83
51466	4.60	4.79	4.82
52166	4.63	4.83	4.86
52688	4.63	4.83	4.88
60466	4.59	4.75	4.88
61166	4.57	4.73	4.84
61866	4.52	4.64	4.75
62566	4.39	4.53	4.66
70266	4.47	4.68	4.86
70966	4.67	4.82	4.88
71666	4.85	5.00	4.98
72366	4.89	4.99	4.96
73066	4.73	4.89	4.93

Date	Yields		
	90 Day	180 Day	360 Day
80666	4.81	4.88	5.02
81366	4.87	5.13	5.13
82066	5.06	5.37	5.35
82766	5.01	5.40	4.58
90366	5.07	5.58	5.73
91066	5.18	5.70	5.72
91766	5.40	5.91	5.83
92466	5.52	5.92	5.90
100166	5.39	5.69	5.79
100866	5.36	5.65	5.63
101566	5.44	5.71	5.56
102266	5.36	5.60	5.48
102966	5.22	5.53	5.44
110566	5.29	5.57	5.53
111266	5.41	5.68	5.58
111966	5.38	5.63	5.53
112666	5.26	5.49	5.49
120366	5.17	5.26	5.27
121066	5.16	5.26	5.25
121766	4.97	5.06	5.01
122466	4.81	4.93	4.78
123166	4.80	4.92	4.83
10767	4.80	4.76	4.90
11267	4.81	4.67	4.76
11967	4.71	4.56	4.64
12667	4.66	4.54	4.63
20467	4.66	4.54	4.63
21167	4.66	4.54	4.63
21867	4.66	4.54	4.63
22567	4.66	4.54	4.63
30467	4.47	4.47	4.45
31167	4.37	4.37	4.32
31867	4.28	4.21	4.16
32567	4.14	4.16	4.05
40167	4.13	4.09	4.06
40867	3.95	4.00	3.98
41567	3.84	3.89	3.89
42267	3.82	3.88	3.88
42967	3.72	3.81	3.84

Date	Yields		
	90 Day	180 Day	360 Day
50667	3.72	3.86	3.91
51367	3.65	3.83	3.89
52067	3.59	3.78	3.87
52767	3.50	3.74	3.88
60367	3.50	3.74	3.88
61067	3.50	3.74	3.88
61767	3.50	3.74	3.88
62467	3.50	3.74	3.88
70167	3.74	4.17	4.63
70867	4.20	4.62	4.84
71567	4.17	4.67	4.84
72267	4.19	4.76	4.89
72967	4.24	4.82	5.00
80567	4.15	4.67	5.07
80967	4.17	4.76	5.07
81667	4.18	4.78	5.05
82367	4.29	4.89	5.00
83067	4.42	4.93	5.09
90667	4.33	4.79	5.04
91367	4.33	4.89	5.06
92067	4.46	4.98	5.11
92767	4.55	5.07	5.16
100467	4.42	5.04	5.16
101167	4.53	5.02	5.18
101867	4.63	5.12	5.23
102567	4.58	5.09	5.25
110167	4.54	5.05	5.29
110867	4.62	5.11	5.34
111567	4.62	5.12	5.28
112267	4.75	5.29	5.37
112967	4.88	5.45	5.54
120667	4.95	5.54	5.64
121367	4.91	5.46	5.60
122067	4.99	5.48	5.54
122767	4.94	5.46	5.53
10368	5.01	5.49	5.64
11068	5.01	5.34	5.36
11768	5.03	5.23	5.20
12468	5.03	5.26	5.28
13168	4.87	5.02	5.24

Date	Yields		
	90 Day	180 Day	360 Day
20768	4.93	5.12	5.25
21468	5.01	5.22	5.24
22168	4.95	5.15	5.16
22868	5.03	5.20	5.33
30668	5.01	5.19	5.32
31368	5.13	5.34	5.42
32068	5.33	5.45	5.47
32768	5.16	5.32	5.41
40368	5.17	5.29	5.39
41068	5.28	5.40	5.36
41768	5.39	5.49	5.39
42468	5.47	5.61	5.58
50168	5.50	5.63	5.66
50868	5.50	5.71	5.72
51568	5.58	5.77	5.75
52268	5.84	5.99	5.95
52968	5.73	5.91	5.99
60568	5.66	5.73	5.74
61268	5.69	5.76	5.76
61968	5.59	5.65	5.66
62668	5.30	5.52	5.59
70368	5.33	5.46	5.62
71068	5.36	5.42	5.44
71768	5.41	5.49	5.48
72468	5.28	5.39	5.35
73168	5.19	5.32	5.20
80768	4.94	5.15	5.07
81468	5.05	5.24	5.18
82168	5.14	5.28	5.17
82868	5.17	5.25	5.17
90468	5.19	5.23	5.16
91168	5.26	5.28	5.22
91868	5.22	5.28	5.20
92568	5.15	5.23	5.17
100268	5.15	5.28	5.17
100968	5.28	5.37	5.25
101668	5.33	5.41	5.33
102368	5.37	5.42	5.35
103068	5.46	5.47	5.42

Date	Yields		
	90 Day	180 Day	360 Day
110668	5.49	5.55	5.44
111368	5.44	5.59	5.47
112068	5.43	5.63	5.52
112768	5.44	5.58	5.56
120468	5.62	5.73	5.66
121168	5.75	5.87	5.78
121868	5.93	5.98	5.85
122568	6.21	6.32	6.27
10169	6.21	6.34	6.30
10869	6.18	6.35	6.14
11569	6.14	6.30	6.02
12269	6.07	6.22	5.96
12969	6.15	6.26	6.10
20569	6.19	6.31	6.20
21269	6.14	6.33	6.16
21969	6.10	6.28	6.16
22669	6.06	6.26	6.26
30569	6.16	6.31	6.33
31269	6.03	6.20	6.24
31969	6.02	6.16	6.17
32669	5.94	6.09	6.12
40269	5.99	6.08	6.16
40969	6.13	6.14	6.12
41669	6.19	6.20	6.05
42369	6.18	6.17	6.02
43069	5.99	6.04	5.95
50769	5.97	6.07	6.04
51469	6.02	6.14	6.10
52169	6.10	6.17	6.12
52869	6.07	6.02	6.14
60469	6.16	6.48	6.49
61169	6.50	6.82	6.84
61869	6.65	6.75	6.77
62569	6.48	6.84	7.00
70269	6.38	6.88	7.35
70969	6.93	7.16	7.14
71669	6.98	7.30	7.06
72369	7.08	7.35	7.11
73069	7.12	7.25	7.29

Date	Yields		
	90 Day	180 Day	360 Day
80669	6.99	7.10	7.27
81369	7.04	7.24	7.37
82069	6.86	7.15	7.18
82769	7.04	7.28	7.27
90369	7.01	7.20	7.31
91069	7.09	7.32	7.36
91769	7.11	7.33	7.30
92469	7.13	7.33	7.36
100169	7.07	7.32	7.41
100869	7.00	7.31	7.37
101569	7.02	7.33	7.30
102269	6.94	7.24	7.09
102969	7.00	7.26	7.10
110569	7.01	7.32	7.04
111269	7.14	7.42	7.11
111969	7.16	7.55	7.28
112669	7.44	7.93	7.73
120369	7.55	7.81	7.52
121069	7.75	7.92	7.62
121769	7.88	7.91	7.59
122469	7.83	7.83	7.64
123169	8.00	8.01	7.68
10770	7.92	7.95	7.57
11470	7.88	7.74	7.53
12170	7.82	7.67	7.43
12870	7.89	7.77	7.50
20470	7.70	7.71	7.49
21170	7.36	7.42	7.23
21870	6.83	7.03	6.93
22570	6.84	7.02	6.90
30470	6.89	6.84	6.66
31170	6.80	6.69	6.55
31870	6.78	6.68	6.62
32570	6.31	6.31	6.34
40170	6.33	6.28	6.33
40870	6.39	6.44	6.31
41570	6.36	6.33	6.23
42270	6.51	6.53	6.45
42970	6.74	7.05	7.03

Date	Yields		
	90 Day	180 Day	360 Day
50670	6.94	7.14	7.14
51370	6.74	6.88	7.07
52070	6.72	6.92	7.08
52770	6.94	7.16	7.20
60370	6.87	6.96	7.04
61070	6.78	6.89	7.06
61770	6.73	6.95	7.15
62470	6.64	6.89	7.13
70170	6.43	6.60	6.92
70870	6.61	6.62	6.77
71570	6.53	6.63	6.68
72270	6.38	6.43	6.60
72970	6.34	6.43	6.46
80570	6.43	6.53	6.57
81270	6.51	6.65	6.65
81970	6.50	6.58	6.57
82670	6.28	6.45	6.44
90270	6.33	6.55	6.51
90970	6.37	6.57	6.48
91670	6.33	6.54	6.45
92370	5.93	6.31	6.27
93070	5.81	6.38	6.32
100770	5.95	6.39	6.32
101470	6.02	6.25	6.24
102170	5.89	6.15	6.22
102870	5.81	6.12	6.19
110470	5.74	5.93	5.99
111170	5.49	5.74	5.78
111870	5.34	5.48	5.47
112570	5.00	5.08	4.98
120270	5.04	5.01	4.97
120970	4.94	4.95	4.90
121670	4.82	4.85	4.83
122370	4.79	4.84	4.84
123070	4.87	4.89	4.77
10271	4.87	4.88	4.86
10971	4.84	4.89	4.71
11671	4.51	4.55	4.48
12371	4.20	4.22	4.19
13071	4.19	4.24	4.18

Date	Yields		
	90 Day	180 Day	360 Day
20671	4.06	4.11	4.11
21371	3.71	3.75	3.80
22071	3.56	3.65	3.72
22771	3.43	3.57	3.68
30671	3.35	3.44	3.64
31371	3.28	3.39	3.52
32071	3.39	3.51	3.57
32771	3.37	3.54	3.63
40371	3.61	3.72	3.70
41071	3.78	3.85	3.79
41771	3.96	4.04	4.10
42471	3.81	4.02	4.14
50171	3.93	4.22	4.44
50871	3.84	4.20	4.46
51571	3.96	4.23	4.58
52271	4.36	4.49	4.79
52971	4.38	4.46	4.73
60571	4.28	4.52	4.78
61271	4.58	4.79	5.13
61971	4.94	5.16	5.43
62671	4.86	5.06	5.56
70371	5.17	5.37	5.77
71071	5.40	5.35	5.65
71771	5.38	5.52	5.61
72471	5.45	5.73	5.77
73171	5.39	5.77	5.87
80771	5.28	5.67	5.90
81471	5.24	5.66	5.92
82171	4.71	4.89	5.24
82871	4.69	4.87	5.19
90471	4.47	4.79	5.13
91171	4.62	4.92	5.17
91871	4.79	5.02	5.22
92571	4.79	5.04	5.26
100271	4.65	4.95	5.17
100971	4.51	4.72	5.00
101671	4.45	4.58	4.73
102371	4.47	4.56	4.67
103071	4.36	4.47	4.49

Date	Yields		
	90 Day	180 Day	360 Day
110671	4.18	4.34	4.41
111371	4.18	4.37	4.47
112071	4.15	4.31	4.42
112771	4.33	4.49	4.61
120471	4.25	4.42	4.60
121171	4.11	4.28	4.53
121871	4.04	4.27	4.50
122571	4.02	4.25	4.38
10172	3.73	4.03	4.09
10872	3.59	3.92	4.03
11572	3.16	3.43	3.65
12272	3.31	3.58	3.64
12972	3.46	3.71	3.79
20572	3.35	3.78	4.05
21272	3.09	3.56	4.00
21972	3.04	3.50	3.95
22672	3.22	3.64	4.11
30472	3.44	3.78	4.17
31172	3.56	3.86	3.21
31872	3.85	4.25	4.51
32572	3.81	4.27	4.50
40172	3.82	4.36	4.67
40872	3.80	4.38	4.82
41572	3.81	4.30	4.77
42272	3.64	4.19	4.60
42972	3.54	4.01	4.39
50672	3.56	4.03	4.37
51372	5.58	4.03	4.42
52072	3.74	4.23	4.53
52772	3.78	4.19	4.47
60372	3.82	4.20	4.51
61072	3.86	4.25	4.62
61772	3.87	4.29	4.62
62472	3.97	4.40	4.69
70172	3.96	4.50	4.92
70872	4.05	4.54	5.00
71572	4.03	4.54	4.94
72272	3.92	4.46	4.86
72972	3.93	4.46	4.86
80572	3.79	4.30	4.78

Date	Yields		
	90 Day	180 Day	360 Day
81272	3.86	4.38	4.75
81972	3.90	4.46	4.75
82672	4.13	4.70	5.02
90272	4.47	4.92	5.28
90972	4.71	5.06	5.36
91672	4.71	5.11	5.42
92372	4.66	5.14	5.46
93072	4.60	5.22	5.52
100772	4.66	5.16	5.46
101472	4.79	5.16	5.39
102172	4.78	5.12	5.38
102872	4.73	5.10	5.34
110472	4.74	5.08	5.27
111172	4.71	5.04	5.18
111872	4.76	5.07	5.17
112572	4.82	5.10	5.20
120272	4.88	5.18	5.25
120972	5.00	5.25	5.27
121672	5.05	5.27	5.22
122372	5.15	5.36	5.26
123072	5.13	5.34	5.39
10673	5.16	5.42	5.44
11373	5.19	5.47	5.45
12073	5.40	5.63	5.52
12773	5.67	5.81	5.66
20373	5.70	5.88	5.99
21073	5.56	5.76	5.86
21773	5.43	5.60	5.74
22473	5.58	5.84	5.95
30373	5.81	5.11	6.18
31073	5.85	5.29	6.35
31773	6.05	5.56	6.56
32473	6.31	5.70	6.69
33173	6.29	5.67	6.66
40773	6.45	5.68	6.63
41473	6.20	5.40	6.41
42173	6.16	6.43	6.42
42873	6.23	6.56	6.56
50573	6.24	6.56	6.60
51273	6.07	6.42	6.49

Date	Yields		
	90 Day	180 Day	360 Day
51973	6.22	6.48	6.49
52673	6.56	6.78	6.78
60273	6.91	6.99	6.93
60973	7.07	7.09	6.94
61673	7.15	7.16	6.94
62373	7.25	7.27	7.02
63073	7.32	7.43	7.31
70773	7.94	7.95	7.71
71473	7.78	7.86	7.65
72173	8.03	8.17	7.97
72873	8.17	8.35	8.34
80473	8.30	8.43	8.40
81173	8.70	8.79	8.44
81873	8.88	8.78	8.34
82573	8.71	8.57	8.25
90173	8.62	8.58	8.22
90873	8.80	8.75	8.19
91573	8.94	8.97	8.45
92273	8.38	8.52	8.10
92973	7.13	7.63	7.57
100673	7.42	7.59	7.52
101373	7.14	7.32	7.26
102073	7.16	7.24	7.15
102773	7.07	7.09	6.85
110373	7.38	7.43	6.99

BIBLIOGRAPHY

BIBLIOGRAPHY

Books

Butler, William F. and Robert A. Kavesh, editors, How Business Economists Forecast, Englewood Cliffs, N. J., Prentice-Hall, Inc., 1966.

Christy, George A. and P. F. Roden, Finance: Environment and Decisions, San Francisco, Canfield Press, 1973.

Clendenin, John C. and George A. Christy, Introduction to Investments, New York, McGraw-Hill, 1969.

Committe, T. C., Managerial Finance for the Seventies, New York, McGraw-Hill, 1972.

Instruments of the Money Market, Richmond, Virginia, Federal Reserve Bank of Richmond, Virginia, 1970.

Polakoff, Murray E., Financial Institutions and Markets, Boston, Houghton Mifflin, 1970.

Roll, Richard, The Behavior of Interest Rates, New York, Hogarth Press, 1970.

Articles

Board of Governors of the Federal Reserve System, Federal Reserve Bulletin (January, 1960 through February, 1974).

Bureau of Labor Statistics, "The Consumer Price Index," as reported in Business Week (May, 1974), 1.

Dawson, John C., "A Cylical Model for U. S. Financial Markets," American Economic Review, XLVII (May, 1957), 187-219.

Freund, William C., "An Appraisal of the Source and Uses of Funds Approach to the Analysis of Financial Markets," Journal of Finance (May, 1958), 275-294.

Lutz, Friedrich A., "The Structure of Interest Rates," Quarterly Journal of Economics, L (1940), 36-63.

Newspapers

New York, The Wall Street Journal, January 5, 1973 through April 26, 1974.